

the  
complete  
holistic  
guide to  
working  
out  
in the gym

Yigal Pinchas, Ph.D.

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# MANTESh

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To my students



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# FOREWORD

Exercising in the gym involves everyone from education to big business. In North America, schools are beginning to incorporate daily physical education and expand exercise and weight training as educators accept the fact that students who participate in physical activity often perform better in school. Corporations have learned that healthy employees are productive employees and many companies are sponsoring health club and sport activity memberships for their staff.

Dr. Pinchas has worked in the field for over twenty years and has been an advocate for the holistic approach to exercising in the gym so that everyone can enjoy the experience while being effective and efficient in performing the exercises. Too many people undertake exercise without proper preparation. This usually leads to frustration, pain, injury, disappointing results and hence, loss of motivation to continue. When you read Dr. Pinchas's introduction to the culture of the gym, you appreciate his unique perspective and are captivated by the remainder of the book.

From August 2004 to July 2005, Dr. Pinchas was a visiting professor at the Sport Technology Research Laboratory in the Faculty of Kinesiology at the University of Calgary. In addition to helping to edit the book, our team continues to work closely with Dr. Pinchas to develop companion resources to complement the book.

This book is designed for the student of kinesiology and for specialists who work in fitness centers and gyms where this amazing book can be used as a resource over and over again. It also serves as a valuable guide for the general consumer. We hope you enjoy reading this book and using the many recommendations therein. For Dr. Pinchas, this book was a labour of love, and he looks forward to receiving your feedback.

Yours in health and wellness,

Larry Katz, Ph.D.  
Director, Sport Technology Research Laboratory



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Finally, I give boundless thanks to my dear wife, Avivit, who supported my efforts throughout and who oversaw our three children, Elyrun, Yael, and Gad, during the years I was engrossed in writing. Without her, the book would never have seen the light of day.

Yigal Pinchas  
October 2006



# PREFACE

You are invited to embark on a journey to discover your body and yourself. At times, it will require some effort, but you will find it extremely valuable. The results you see and the feelings you experience from utilizing the information in this book will be spectacular and uplifting. Join me – you will find the tour comprehensive and enjoyable!

I offer you a journey through the intricacies of theory and practice in the physical training sciences. The “work-out” in the “gym” gives a boost to far more than our muscular and skeletal systems. It also affects our cardiovascular, respiratory, and nervous systems and improves metabolism. Additional emotional, social, and conscious values of the workout are inseparable elements of training. As we engage in a workout, awareness of the effects of physical activity on both our physical and psychological well being will make the experience more relevant and enjoyable. Gym activity can make our lives much happier!

This book is an attempt to systematically arrange the fruits of my many years of studies, research, training, and teaching in order to meet a real need among sport and health enthusiasts. Throughout many years of work in both academic and athletic circles, I have often been asked, “Where can we find a book with a holistic approach?”

This book is an integration of theory, practice, and the experience that I have accumulated in my many years as a teacher, personal trainer, and coordinator of courses for fitness teachers and Ministry of Education examiners for certification courses for fitness instructors. This integration helps to make gym training a part of a comprehensive program of body-building and guides you according to your own physical and emotional needs. The information presented in this book is far more than a “How to ...” guidebook. It also raises your self-awareness as you understand the processes and products of working out in the gym. I have called this book *The Complete Holistic Guide to Working Out in the Gym* because it presents gym exercises as part of a comprehensive holistic approach to the training process: physical activity in the gym as a “way of life.” To be sure, the material that appears here reflects my personal viewpoint, and subject matter that others might have included has been omitted, mainly to keep the book within reasonable proportions. As it is, the book is already significantly longer than originally planned.

My hope is that this book makes your journey to physical and self-awareness both interesting and challenging, and that you gain as much pleasure, benefit, satisfaction, and happiness from following the instructions in this book as I do.

Yigal Pinchas  
October 2006



# 1: GYM CULTURE

During the past half century gyms have been “reborn” a number of times. The names “weight rooms,” “fitness rooms” and “gyms” have changed and overlapped. The original version of the weight room was usually located in a basement with faulty lighting and ventilation, or in an undesirable neighbourhood, a neglected place redolent of dried sweat and inadequate sanitary conditions. This accounts, in part, for the bad reputation generally associated with gyms until the end of the 1960s, so that they were simply “not a place where decent women set foot.” Due to technological developments in recent years, the equipment holding centre stage in today’s gyms make the places unrecognizable to those still locked into the old stereotype.

First, the gym began to offer activities such as walking, bicycling, and running, which until then had been confined to outdoors. The modern gym now contains sophisticated equipment with digital readouts displaying duration and intensity of activity, number of calories burned, pulse and heart rate parameters, and a variety of pre-programmed or manually controlled training programs. Powerful air-conditioning units, wall-to-wall mirrors, closed-circuit television, and sophisticated sound systems that pipe in background music make working out more interesting and have turned the gym into a very pleasant and user-friendly place for leisure-time athletic activity.

Due to these alterations, the clientele has also changed beyond recognition. Once the province of muscle-bound hulks and bodybuilders, nowadays, the gym is a meeting place for men, women, adolescents, and older adults, and bodybuilders, working side-by-side with individuals undergoing rehabilitation after injury or illness, and also

a large contingent of the weight-conscious population. The training environment, in combination with instruction, makes it possible for individuals and groups to adopt and adapt training programs to specific personal needs.

According to data from the International Health, Racquet, and Sportsclub Association (IHRSA), gyms have become a \$12.2 billion a year industry. It is especially well developed in the United States, with chains boasting millions of members in hundreds of clubs. The Bally Total Fitness chain, for example, numbers more than four hundred clubs, four million members and a turnover of about \$1 billion a year. Most of the chains are subsidiaries of corporations listed on the stock exchange and are managed by professional managers. There are almost eighteen thousand clubs in the United States today, up from 12,600 ten years ago (an increase of 41%). Membership in these clubs totals 33.8 million, as opposed to 20.8 million in 1992 (up almost 60%)! A similar growth can be seen in Western Europe: in England and Germany alone, the industry does almost \$5 billion of business a year.

When fitness began to boom in the United States during the 1960s, membership was almost exclusively male. Today, 52 per cent of club members in the United States are women! The most common age group among exercisers is 35–54 (36.5%), followed by the 18–34 group (31%), the over-55’s (22.5%), adolescents aged 12–17 (6%) and children aged 6–11 (4%).

## 1.1. A BRIEF HISTORY

The exercise most often performed in the gym is activating force against resistance. It has donned and discarded many forms over the years. Since the Middle Ages (and perhaps before), circus “strong men” displayed their strength by lifting barrels, hefting huge rocks or uprooting tree trunks. In more recent history, strong men have not only been asked to lift trucks, but also to adorn their skills with a display of scintillating musculature and body aesthetics, including body sculpting and developing eye-popping muscle mass: in a word, *bodybuilding*. The pioneer bodybuilder was a Prussian, Fredrick Muller (1867–1925), also known by his stage name Eugene Sando, who appeared in circuses and other shows in which he combined power with a show of body beauty that could stand on its own today.

The roots of western culture’s appreciation for the beauty of the human body as a value reaches back to Ancient Greece. The fully developed muscular male body was, for many Greek philosophers, writers, and educators, the “symbol of perfection.” This is reflected in Platonic philosophy and Homeric literature, as well as in the lyric poetry of Pindar and Bacheledis. On the other hand, throughout human history, and in almost all cultures, people have admired physical strength and power. The legendary Greek mythological hero Hercules symbolized the ideal of spiritual power. Jewish culture, the other strong underpinning of western culture, tends to downplay the importance of external body forms and shapes, extolling instead, virtues of learning. However, this may be attributable in part to Jewish history, and yet, at the same time, there is also an appreciation for physical strength as in the case of “Samson” – the “symbol of physical strength.”

At the beginning of the 1970s, a spate of scientific articles and popular publications began to appear on the importance of physical activity and its contribution to health (IHRSA, 2002). They reached a wide public and aroused interest in sport activities for health purposes. A remodelled, more genteel gym began to flourish. Today, any sports club worth its salt takes pride in its sophisticated gym. Senior citizen homes, luxurious apartment houses, and many commercial companies include gyms within their physical plant as part of their organizational and marketing concept.

The heart of “bodybuilding-land” today is southern California. Among its many gyms, Gold’s Gym (established by Joe Gold in 1964 in Venice near Los Angeles) is the largest. In 1978, the gym changed hands, increased its membership, opened branches around the world, and earned regular coverage in the professional literature and the mass media as the training place of choice of celebrities such as Bill Pearl, Tom Platz, and Arnold Schwarzenegger. Schwarzenegger is perhaps the best-known bodybuilder today, having taken first place in almost every competition until he retired and went on to become a successful actor, and now governor of California. His body dimensions and balanced development of his body remain legendary in the world of bodybuilding. Other famous bodybuilders include Sylvester Stallone, Chuck Norris, and Lisa Lyon, who have helped to increase public awareness through their bodybuilding in the gym.

IHRSA studies from 1999–2000 noted three main reasons for exerciser loyalty to a fitness club (IHRSA, 2002): a.) a feeling of belonging to the club; b.) the notice that club staff members take of them; and c.) the interest and variety of activities the club offers. Of course, the three factors are interrelated since all of them are based on the quality of the relationships with the club. In the United States, the rate of membership renewal in fitness clubs stands at 65 per cent. Among the top 25 per cent of clubs, renewals stand at 74 per cent, and the better clubs at the vanguard of the gym industry reach 80 to 85 per cent maintenance of clients. In England and Germany, the rate of membership renewals averages 60 per cent, and leading clubs come close to the maintenance rates registered by the American clubs (Run, 2002).

By the very nature of gym activity, the benefits of physical training are not noticeable immediately, but rather, they are achieved only after a lot of sweat, effort, and sore muscles. Thus, an important spur to continued activity is the social aspect of membership in a fitness club. A club that can create strong feelings of belonging, a feeling of “being at home,” and can also provide entertainment will retain membership loyalty.

## 1.2. FUTURE TRENDS

It can be assumed that a combination of technological developments, economics, new management concepts, and a continuing desire to innovate, will change gyms of the future beyond recognition. Not only will they be transformed in appearance, but they will offer different equipment and require different types of instruction. The following is one scenario.

Instruction will be computerized – the gym of the future may contain special suits or uniforms with electrodes that activate various muscles in the body according to precisely timed, computerized programs. Personal data about exercisers, including physique, training goal, favourite landscapes, and aromas will be “fed” into the program and processed into an individualized training program. Exercisers will simply don a computerized suit and helmet, hold a joystick or bar, and find an empty seat. They can choose any type of warm-up, perhaps kayaking through white water. Through their helmet they will see virtual training grounds and use the bar to perform rowing or kayaking movements in imitation of the movements that appear on the screen. Helmet speakers will provide background sounds of flowing water, chirping birds, or other sounds indigenous to the area, and a built-in sprinkler will spray a fine mist of water to give a feeling of the river water being churned up. The sprinkler can also give “whiffs” of vegetation characteristic of the changing landscape on the monitor. The computerized suit will also cause relevant muscles in the body to vibrate and exercisers will be completely convinced that this is a real experience and not just virtual reality. After the predetermined time period, the warm-up will end, the helmet will bring in fresh air to dry the wetness from the face, and the training stage of the program will begin.

In this stage, exercisers will be able to view themselves performing bench presses, for example. They imitate the movements using the bar, and throughout the training program, they perform guided movements according to what appears on the monitor. The computerized suit will vibrate the appropriate muscles in coordination with the display. During the cool-down stage, exercisers will place the bar near the seat, lean their head back, listen to relaxing music of their choice, and relax their body. The computerized suit will massage the body gently and the

helmet will provide a fine mist of relaxing aromas. At the conclusion of the session, a moment before removing the helmet and suit, exercisers will be able to access news, personal messages, and updates (and perhaps even commercials!) on the monitor. Around the gym, exercisers will see others in various stages of training, wearing helmets and suits, gripping the joystick and, through them, performing exercises. During the training itself, exercisers will not have to converse with other exercisers; there will be no personal instruction and no social interaction of any sort.

Does this sound strange, or even plausible? Well, if it doesn't, just think what a bodybuilder would have said fifty years ago had he been informed that, in the near future, exercisers would run, ride bicycles, or even ski in a gym. It may be just as absurd, fifty years hence, to hear that, until recently, people actually ran in city streets and inhaled polluted air for their “enjoyment” and health.

On the other hand, one of the drawing cards of the gym is its function as a social meeting place and it is also reasonable to say that the gym of the future will not find a substitute for interpersonal interactions. We need, and evidently will continue to need, social contact and interaction. If only for this reason, gyms will evidently continue to maintain a number of interpersonal elements of their present configuration.

## 1.3. GYM POPULATIONS

Activity in the gym or fitness centre is intended for all age groups: children, adolescents, adults, and seniors. Those frequenting these establishments have many different needs and goals, from the desire to keep in shape and control weight to improving physical fitness components for competition at the highest levels. It is not unusual to find elite athletes from both team and individual sports working out in the gym as well as individuals who have come in for rehabilitation. In short, the gym is a microcosm of the entire population. The following survey describes the main characteristics of the various elements of the population that frequent the gym.

## *Children*

Children are defined here as individuals under age twelve. Until the end of the 1980s children were not permitted to work out in the fitness centres for fear that gym work, and especially weightlifting, would stunt their growth. Scientific studies have proven beyond a shadow of a doubt the contribution and the importance of working out in the gym, mainly for improving the strength component in children (Faigenbaum and Westcott, 2000). Training in the gym contributes to improved motor abilities, better intramuscular coordination, improved posture, and greater self-confidence (Avery, Faigenbaum, Wayne, Westcott, LaRosa, and Long, 1999). These data become even more relevant when we realize that the schoolbags children carry may add up to 32 per cent of their body weight. The gym helps children to acquire basic skills while strengthening weaker muscle groups so that they can function effectively in daily life. Recommended activity for improving children's strength component should be from 50 to 60 per cent of their resistance maximum (RM<sub>r</sub>). For more detail, see the recommendations of the American College of Sports Medicine (ACSM, 1995). (Caution: since most machines are designed for adults, supervision and modification of training sessions for children are essential.)

## *Adolescents*

Adolescents are defined as 12 to 17-year-olds. At this age, physical activity is essential for development and for fulfilling growth potential. It is important to note that this "window of opportunity" for maximizing developmental potential of the skeletal system is important because, thereafter, the bones harden and the effect of training stimulation is lower. At this age, activity in the gym strengthens self-image and sexual identity. This is a period for working on all the fitness components. It is important to emphasize that training should be carried out under the supervision of qualified instructors and there should be adherence to an orderly work program.

## *Adults*

Adults work out in the gym mainly because they have come to accept the importance of physical activity for their physical and mental health. They have reached full growth and their body is mature enough for more complex training. Loads, frequencies, and durations can be increased considerably. At the same time, it is important to remember that all training should be performed according to a training program and under the guidance of a qualified instructor.

## *Seniors*

At this age, physical activity has a crucial effect on daily functioning and on reducing the risks of cardiovascular diseases, osteoporosis, and many other ills. The main characteristic of the activity recommended for this age group is working against resistance, to create pressure on the skeletal system, and to increase muscle mass. At this stage of life, physical activity is not a luxury but an essential means for improving quality of life and vitality. A number of senior citizens' homes have installed gyms for controlled, supervised activity and as a means of reducing the consumption of medications because of the therapeutic effects of the activities. The training program should be a part of routine daily life.

## *Rehabilitation exercisers*

What is a physical therapy institute if not another form of a fitness centre? The training principles are identical; only the emphasis on the exertion factors is different. People receive physical therapy as part of their rehabilitation process. Those who go through such a program usually recognize the effect that the tremendous health potential inherent in the gym has on their physical achievements, and many continue to work out in other frameworks. It is important to emphasize that training in the gym not only supplements the work in the physical therapy centre but should also be internalized as a way of life – "an ounce of prevention is worth a pound of cure."

## *Competitive athletes*

The gym is the meeting place for athletes from all types of sports: team sports, individual events, martial arts, challenge activities, swimming, gymnastics, track and field, etc., because all athletes can develop their personal fitness components. For example, tennis players can improve muscular endurance component of the *latissimus dorsi* muscles while mini-soccer players can work on quadriceps endurance by means of repeated kicks.

## *Weight watchers*

It's no secret that the most common reason for exercisers to frequent the gym is the desire to lose weight. Western society, with its generally sedentary life style and plethora of food, suffers from overeating and obesity. The various types of apparatus in the gym offer a means of correcting this situation. Training programs tailored for this population should include a high proportion of aerobic activity. Weight watchers should be aware of the consequences of weight gain on health (e.g., high blood pressure, greater risks of heart disease). Physical activity should be a long-term project and a part of a healthy life style, even beyond aesthetic considerations.

### **1.4. LAWS AND REGULATIONS GOVERNING GYM OPERATIONS**

The soaring popularity of gyms and fitness centres has created a need for some sort of legal framework. Considering potential physical damage to a person in such places, it is important to ensure that charlatans do not take charge. Joint injuries, inflammations, and growth disruptions are some of the potential outcomes of incorrect training or over-training. The theoretical and practical knowledge accumulated over time indicates the need for a scientific-academic approach by authorities, especially considering that children and seniors are among those frequenting fitness centres.

The minimum age for working out in a gym varies from country to country and from state to state, as does the training required of gym instructors. At the same time, there is no question that instructors should

be responsible professionals and that exercisers receive appropriate medical clearance before beginning a program or training session. The ideal instructor in this modern age should have more than professional knowledge. He or she should also be able to make gym frequenters feel at home and provide them with helpful, healthful, and safe instruction.

There is general agreement among professionals that legally defined and mandatory licenses, as well as medical clearances to work out under supervision, need to be standardized. One issue still being debated by experts and legislators is the prohibition on children under the age of fourteen or sixteen (depending on the state or country), based on the local legal definition of what constitutes a minor. Experts and sports organizations contend that there is no logical or scientific justification for the age limitation, especially if a certified instructor is present. Many studies indicate the contribution of physical activity, including power training, to improve children's achievements and personal development (Faigenbaum, and Westcott, 2000; Avery et al., 1999). Professionals and interested parties have tried to apply pressure on legislators to change the current laws.

To understand the importance of gym activity for children engaging in athletic activity, consider the following fact: in a recent fifty-metre freestyle swimming meet for ten-year-olds, the difference between first and second place was about half a second. Translating this into distance, this is about an inch or two! To close this gap, it is essential to improving the power component of the second-place athlete, which can be achieved in the gym.

At the same time, it is important to remember that chronological age does not always overlap with developmental age. Therefore, each athlete should be dealt with according to personal data. Furthermore, under age fourteen (i.e., before puberty) most children's bodies have less testosterone and androgen, the main hormones responsible for developing strength; therefore, there is no need to emphasize power training or hypertrophy at this age, especially for the amateur. Children's training should concentrate on varied movement experiences and on improving physical skills (operating and becoming familiar with the apparatus) since these are more important at this age than is competitive achievement. The approach should focus

mainly on quality rather than on quantity – improving technique and improving style. Special attention should be given to ergonomic aspects of drills. That is, apparatus should be adapted to the physique and physical size of children, with due attention to safety rules during physical activity on apparatus.

Decision-makers are not in agreement about the type of medical clearance form that should be required and on what basis it should be issued to minors wishing to work out in gyms (Gilad, 2004). Some doctors suggest that it is enough to conduct an *ergometric* test (stress test for aerobic capacity). Others think it necessary to examine the child's medical history and conduct a comprehensive physical examination before giving permission. Some contend that a resting ECG should be taken by a specialist before the clearance form is issued.

This raises a number of questions and generalizations about the status of and necessity for medical clearance: Can exercisers be required to undergo tests at specified medical institutions? Do examining doctors have to be sports physicians? There are no clear answers and the matter is still debated. Enforcement of this regulation is also important. This is not the case at many gyms due to financial considerations. Most gyms operate for profit, and owners have little desire to limit the number of registrants.

Other questions raised by the medical clearance pertain to school children: Who will finance the fitness tests? What about children who cannot afford the test? What about children in areas without an available sports physician or clinic to conduct tests? One proposed solution is a physical fitness “clinic-on-wheels” with sports doctors who travel from school to school, spending a full day at each school to test interested students, and to charge the school a fee (full or subsidized) for each test. Legislators' attitudes are not all-encompassing, and it is reasonable to assume that any law will undergo many changes before these issues are solved.

## 1.5. THE GYM AND THE EDUCATION SYSTEM

With the revolutionary change towards gyms in the late 1980s, school principals and sports coordinators in many cities around the world realized the potential inherent

in building gyms in their school, for promoting physical education or improving its image. Many schools now boast sophisticated, advanced facilities financed by a number of sources within and outside the education system. These gyms have become a source of pride for schools, as well as students, who begin to “sprout” and show off their muscles during the school year.

Some exercises require relatively great power and cannot be performed properly without prior preparation. One example is the *chin-ups*, where exercisers have to overcome their entire body weight in one explosive movement. Those who fail expose their weakness to their peers. The shame and embarrassment are considerable. One of the ways to improve strength in the relevant muscle groups is through the use of gym apparatus such as the upper pulley or the *Graviton*. These allow exercisers to regulate resistance and train gradually with the option of regulating the intensity of the exertion factors to improve the required fitness component.

Throughout the world, national, city, and local authority government usually conduct an annual rite of threatening or actually implementing budget reductions. Often, one of the main targets of these cuts is the education system, which means a loss of teaching hours and/or deferring purchase of equipment, including sport and fitness apparatus. It is important to remember that building a gym is not a one-time expenditure. Most of the financial burden is for clearing space or installing the physical infrastructure for a room that can hold at least twenty students. Gyms need at least ten work stations (pieces of equipment), space for electrical installations of air conditioning, and the use of aerobic apparatus. Further budget is needed for continued maintenance and upkeep.

Schools that see themselves as educating tomorrow's citizens for a healthy lifestyle and appropriate behavioural patterns are aware of the importance and growing effect of the gym on the activity habits of the public at large. Therefore, it is important that exercisers perform many activities with an awareness and understanding of personal needs and goals. To this end, schools are prepared to devote a number of months to gym work, including theoretical explanations and practical exercise with a number of training methods. Even if class numbers reach thirty, teachers can use training methods that allow each student to participate

in the training session. First, teachers have to create fifteen work stations to allow at least half of the students to exercise while the others observe correct performance of the activity. It is preferable, of course, that instructors have as many stations as they have exercisers. During lessons, students can gain experience with programs such as circuit training, sets, pyramid method training, and the Deloram method.

“cavort” in public places, the gym offers a closed and supervised environment in which they can work out and socialize with friends. Thus, the gym offers the possibility of maintaining physical fitness (and “figure”) while also adhering to religious principles.

## 1.6. THE RELIGIOUS PUBLIC

The gym is becoming an important element in the lives of religious individuals including: Christians, Jews, Muslims, Seiks, Hindus, and Buddhists. According to the physician-philosopher Maimonides, “the body is the basis for all spiritual activities” (Maimonides, No. 25). Further on, he cites the preventive benefits of physical activity: “As long as a person exerts himself and becomes fatigued, much illness will not come his way” (Maimonides, No. 70:5). A renowned twentieth-century rabbi went so far as to say that “when the body is weakened, so is the spirit and cannot pray properly. Therefore, we must constantly maintain our body in good condition” (Harvcook, *Orot*. 70).

The general Christian attitude is that the body is a temple of the Holy Spirit received from God (1 Cor. 6:15–20). Therefore, it is implied that we should honour God with our bodies and that we should keep and maintain our body, first to serve God, and second to improve our quality of life.

The Muslims say that physical strength is a gift from Allah. Islam is concerned with well-being in both body and soul, and it encourages all kinds of sports that will strengthen the body and maintain good health as well as providing relaxation and leisure (Qadaaya al-Lahw wa'l-Tarfeeh, 295).

For those who devote long hours to intensive religious studies, the gym offers a perfect avenue for caring for the body as well as the mind and spirit. The gym is open all day until late in the evening without having to rely on teammates. Furthermore, some gyms accommodate religious clientele by offering separate hours, or separate rooms, for men and women, which is an accommodation for those with religious objection to opposite-sex exposure. For females, who may not be allowed to

## 2: CHARACTERISTICS OF PHYSICAL ACTIVITY

“Gym training” has become one of the most popular athletic activities in the Western world today. Due to scientific developments, the gym has become a highly effective venue for body management. The comprehensive and systematic presentation of the physical and emotional aspects of gym activity is intended for all people who work out on a regular basis, and especially for sport teachers and fitness instructors. It contains basic concepts, up-to-date research findings, and instructions for building personal training programs. Such a broad approach is essential for reaping the benefits of the gym properly and safely. In essence, the gym is a place where exercisers of all persuasions can achieve their training goals, from competitive athletes who are intent on improving their skills, and high-risk individuals working to prevent a heart attack or involved in rehabilitation, to individuals who want to lose weight and tone up their bodies. Training centres attract children, adolescents, adults, older adults, and the very elderly – each age group has its own appropriate type of training. Tailoring personal training programs for different population types, each with its specific needs, requires familiarity with gym apparatus and good instruction. Instruction is essential for attaining desired results.

I call my approach to the gym *holistic* because I see physical training as only one aspect of an individual’s life. Concentrating only on physical achievements in the gym – body building and fitness – misses the point of the holistic philosophy because it isolates the physical component from our psycho-physical entity. We can measure physical achievements in the gym with great precision: the kilograms or pounds we have lost or

gained, the percentage of body fat lost, the number of inches or centimetres we have added to our arm or chest circumference, and so on. Less tangible achievements of gym training are difficult to measure numerically, but ignoring them would be a mistake. We are talking about a whole group of aspects of human existence – self-control and willpower, control of feelings and moods, optimism, creativity, and social skills. Holistic implies something composed of many factors; the gym is a place for dealing with diverse problems using a systemic approach and an array of complementary means for coping with them. Before working on any given muscle group, we will first conduct a comprehensive overview of the contribution and importance of activating these muscles, and then of the overall implications of this specific training for each exerciser.

The holistic approach is in essence an educational approach. By education I mean a process of *molding personality and behaviour*. Modern educational approaches emphasize assisting and guiding individual learners to utilize and express the inherent potential, so that they can recognize and address their individual needs. This is in contrast to older educational approaches of indoctrination or “rote learning” that shaped personalities according to predetermined patterns. *Physical education is the educational domain concerned with shaping behavioural patterns pertaining to physical functioning, in order to ensure the effective and healthy performance of our body*. In this book, we will learn ways to adapt training programs to each exerciser’s special needs using a modern holistic approach.

Table 2.1. Physiological differences between trained and untrained individuals performing strength and endurance exercises

| SYSTEM                  | SYSTEM COMPONENT                              | UNTRAINED INDIVIDUAL                                   | TRAINED INDIVIDUAL                                     |
|-------------------------|-----------------------------------------------|--------------------------------------------------------|--------------------------------------------------------|
| Cardiovascular          | Internal heart volume (size)                  | Small                                                  | Large                                                  |
|                         | Heart muscle strength                         | Weak                                                   | Strong                                                 |
|                         | Heart stroke volume (SV)                      | Small                                                  | Large                                                  |
|                         | Pulse at rest                                 | High                                                   | Low                                                    |
|                         | Pulse during effort                           | Maximal                                                | Submaximal                                             |
|                         | Heart output (amount of blood)                | Small                                                  | Large                                                  |
|                         | Blood hemoglobin level                        | Low                                                    | High                                                   |
|                         | Blood cholesterol level                       | High                                                   | Low                                                    |
|                         | Proportion of HDL to LDL cholesterol in blood | Low                                                    | High                                                   |
|                         | Number of constrictions in blood vessels      | High                                                   | Low                                                    |
|                         | Blood vessel branching                        | Little                                                 | Highly branched system                                 |
|                         | Risk of heart diseases                        | High risk level                                        | Low risk level                                         |
| Respiratory System      | Maximal oxygen intake                         | Low                                                    | High                                                   |
|                         | Respiratory muscles                           | Average and below                                      | Strong and thick                                       |
| Muscles                 | Volume of the muscles                         | Small volume<br>Small internal<br>cross-sectional area | Large volume<br>Large internal<br>cross-sectional area |
|                         | Energy reserves                               | Limited                                                | Increased                                              |
|                         | Aerobic metabolism                            | Lowered efficiency                                     | Efficient                                              |
|                         | Lactic acid threshold                         | Low                                                    | High                                                   |
|                         |                                               |                                                        |                                                        |
| Nerves                  | Simultaneous recruiting of motor units        | Small                                                  | Large                                                  |
|                         | Coordination                                  | Low                                                    | High                                                   |
| Skeleton                | Bones                                         | Low bone density                                       | Strong and dense                                       |
| Body Tissue Composition | Percentage of fat                             | High                                                   | Low                                                    |

## 2.1. BENEFITS OF INDIVIDUALIZED PHYSICAL ACTIVITY

On the physical plane, physical activity in the gym contributes to all fitness components: increased muscle mass and bone density, cardiovascular endurance, and greater maximal oxygen consumption. These physical changes directly help to decrease risk factors associated with diabetes, high blood pressure, cardiovascular diseases, and osteoporosis, among others. Physical activity in a holistic approach, when combined with nutritional awareness, obviates the need for weight reduction diets, because it regulates appetite and reduces the tendency to overeat. The level of HDL (“good” cholesterol) rises while the level of LDL (“bad” cholesterol) declines. Metabolism rate improves and tissue composition changes, with a decrease in body fat tissue and hypertrophy (thickening) of muscle fibres (Bray, 1990; McArdle, Katch, and Katch, 2001).

### *Improving psychological health through physical activity*

Physical activity is an important factor in mental health. According to publications of the National Institutes for Health and the International Federation of Psychology of Sport (FIMS), physical activity contributes to feelings of well-being and emotional health in general. Physical activity moderates chronic pains, mental stress and feelings of depression, and heightens feelings of self-confidence, alertness, concentration, self-image and self-estimation. Training in the right amount reduces neuromuscular tension and alters the secretion of hormones associated with nervousness, fatigue, and anxiety. These benefits accrue equally in individuals of all ages and of both genders.

On the emotional plane, feelings of self-satisfaction grow stronger. Trained individuals acquire control over their bodies through physical activity, both in aesthetic terms (a direct effect of good external appearance) and in terms of functioning (feeling of control over physical abilities). This satisfaction has direct emotional implications – usually a reduction in stress and an improvement in mood. Subjective feelings of well-being and vitality also increase – signs of “emotional power”

rather than of “emotional fatigue.” Sigmund Freud spoke about the “life urge”: that feeling of excitement with life and the desire to live it to the maximum. Numerous scientific studies recommend physical activity as a suitable and effective cure for low vitality, a feeling of low emotional strength that often takes the form of depression or living life in the slow lane. Many people who have begun to work out report positive changes in their mood and improvement in their self-image (Blais, Berire, Fortier, Pelletier, Tuson, and Vallerand, 1995). Physical activity contributes to these emotional changes and, therefore, it can serve as a means of treatment for populations with special needs. A direct link has been found between physical activity and relief from daily pressures (Doyme, Ossip-Klein, Bowman, Osborn, McDougall-Wilson, Neimeyer, 1987).

On the personality level, physical activity helps improve self-esteem, which directly affects self-image. Engaging in physical activity over time, with its concomitant increase in physical competency, helps to boost self-confidence, which is associated with a stronger and more dominant personality. Activity in the gym is especially effective in this domain because it is mostly individual work; thus, teaching self-discipline and the need to undertake responsibility. A direct link has been found between physical activity and these personality changes. Alterations on the emotional plane help to heighten self-competence and all the implications (Berger, 1993), usually called “quality of life.”

In the cognitive domain, physical activity of any kind (even moderate) has been found to exert a positive effect on concentration and attention among children and adolescents at different times of the day (Kenneth, Dwyer, and Makin, 1999; Leither and Tylor, 1990; Wills and Campbell, 1992). Aerobic physical fitness has been found to improve concentration and data processing during effort (Pinchas and Moyal, 2004).

In the social domain, the gym – of all the many types of sport activity – is different because it is a place where individuals usually gather to work out without competition and at individual tempos. This common denominator promotes the socialization process and social interaction and thus contributes to the social lives of those who exercise.

To summarize, physical activity contributes to all areas of life and has the general effect of significantly raising quality of life and longevity.

## 2.2. SPECIAL QUALITIES OF THE GYM

Gym activity is a relatively new sport (only about fifty years old) that has recently gained popularity as increasing numbers of people sign up to exercise and annual total revenues for the sport soar. As a result of technological advances and research findings, an entire “gym culture” has developed, including activity habits and areas of interest, dress codes and life styles, and expanding health awareness. People come to the gym to enhance their looks and health or simply to enjoy the activity and improve their quality of life. The gym allows them to improve the whole gamut of fitness components or to improve specific fitness components (mainly strength). Athletes work out in the gym to improve their achievements; others come for rehabilitation after injuries, accidents or health problems, and some use the gym for losing weight. For most, the gym is also a social meeting ground.

One common question asked by people who consider engaging in regular physical activity is why is it so important to develop strength in the gym when today’s life style requires so little physical effort? While the answer is quite simple, many people who exercise are not able to explain, to themselves or to others, what they find so attractive about developing their strength, other than the aesthetic benefit of a good physique.

Although “mens sana in corpore sano” – a healthy mind in a healthy body – is too general an answer, I have my own modern-day interpretation of this somewhat clichéd adage. A strong body is one that obeys us, while a weak body is one that orders us around. The weak body (of a person who is not properly fit) tends to control us and dictate mood and activity habits. When the question is posed: “Why don’t you work out?”, and someone answers: “I don’t have strength or energy,” the body is crying out, “I’m not in shape!” When people attain a proper level of fitness through exercise, their feeling of freedom is virtually unbounded. It’s as though they’re saying: “If I could meet the demands of my training schedule, nothing could stop me from achieving my goals in life.”

Although developing physical strength is important in modern times, we need to also be aware of the potential danger of overdevelopment. The gym, with all its benefits, is like many other types of sport – a potential

source of muscular injuries and pains. Above and beyond the obvious need to follow basic rules of gym safety, it is also necessary to avoid physical activity that falls into the category of “body worship.” Although, as the Book of Proverbs states, that: “The of young men is their strength” (Prv 20:29), the danger is that exercisers may concentrate almost exclusively on strength and ignore other fitness components. If exercise does not follow accepted training principles or adhere to a systematic training schedule, initial results may be good, but the long-range effects may be hazardous to health. Therefore, patience is important, and exercisers must accept the principle that patience and perseverance “pay off” in the gym. The special nature of the gym is, in the final analysis, created by its blend of benefits and drawbacks.

## 2.3. BENEFITS OF ACTIVITIES IN THE GYM

### *Safety*

The sophisticated equipment available in gyms today allows exercisers to perform a variety of sport activities under conditions of maximal safety with almost no risks. For example, riding stationary bicycles precludes the danger of road accidents, and aerobic running apparatus such as treadmills outfitted with shock absorbers and smooth surfaces reduce the chances of injuries (mainly sprains) that could occur while running on uneven road conditions. Working out on machines allows individuals to control many exercise factors, including resistance (weight), ranges of motion and number of repetitions and sets for strength building, and duration, incline, speed, resistance, and training schedule on aerobic apparatus (such as bicycles and treadmills). Controlling and adjusting these parameters in order to change training aims and needs during the training process significantly reduces injury risk factors such as muscle tears and inflammations.

### *Accessibility*

The gym is a protected artificial environment that can be accessible to exercisers at all times and under all

conditions. Not every major city offers open areas or protected environments for running outdoors. The gym is accessible for exercise and offers a wide array of training options as well.

### *No weather limitations*

Many outdoor exercisers are affected by weather conditions to the point that they may be completely “locked out” of all sport activity during inclement weather. Gym frequenters, on the other hand, enjoy controlled temperature and ideal visibility conditions at all hours of activity. They can perform their regular workouts any and every day of the year, exerting themselves to the required levels, and extracting the most they can from themselves as they strive towards their goals.

### *Feedback*

Many gym machines offer real-time feedback and data about an exerciser’s activity: duration, type of resistance (e.g., weight, incline), speed, RPMs, number of stories climbed, calories burned – whatever the apparatus measures. Such feedback stimulates motivation by challenging and encouraging those on the machines to continue with their tiring physical activity as they approach their goals.

### *Positive social framework*

Social activity in the gym gives club members a feeling of belonging and enhances the quality *and* quantity of their athletic endeavours.

### *Opportunity for individual work*

The gym is also the ideal place for those “loners” who come to work out rather than to develop social ties. Everyone in the gym can choose his or her own type of activity and work on a “personally tailored” training program. Working out in the gym does not force people

to wait for a partner or for enough people to divide up into teams, as is the case for ball games.

### *Graduated exercise*

One of the main principles employed to prevent injuries during physical activity is gradation, which means working according to a personal scale of effort. Due to gym apparatus instrumentation, exercisers can now regulate various exertion factors and adapt them to their own level and goals.

### *Isolating muscle groups*

The weakest link principle implies that the strength of a chain is measured by its weakest link. The same is true of our bodies. If we want to perform chin-ups but our forearm muscles are weak, we will not be able to perform the exercise even if our back muscles are strong. The instruments in the gym enable us to isolate those weak muscle groups and strengthen specific muscles.

### *Muscle group balance in training*

A structured, supervised training schedule provides exercisers with a healthy balance between muscle groups. Here, the fitness trainer plays an important role. Sometimes there may be an imbalance in tone between strong anterior muscles (e.g., pectorals) and weaker posterior/dorsal muscles (e.g., scapular adductors), but in the gym, we can strengthen weak muscle groups without detracting from strong muscle groups. The resulting balance contributes to a healthier posture, which, apart from its aesthetic benefits, helps to prevent or reduce back pains.

### *Improvement of body symmetry*

Every human body has a dominant side (right or left), which is often reflected in posture. Activity in the gym allows us to work on individual muscle groups and this helps to reduce differentials between the two sides of the body. Structured, supervised training following a

tailored schedule in the gym has been proven to reduce asymmetry significantly, to correct posture defects by raising awareness of the problem, and to instill correct activity habits.

### *Balanced development of fitness components*

The gym offers optimal conditions for developing all fitness components: muscle strength and endurance, cardiopulmonary endurance, coordination, flexibility, and speed. Balanced development of these components is essential for harmonious physical health, which is necessary for effective body functioning in the life cycle.

### *Varied activities in the gym*

The large variety of sophisticated equipment available in the gym offers all exercisers a broad selection of activities. The variety also stimulates interest and encourages individuals to persevere in their physical activity.

### *Background music*

Music can either stimulate or moderate the body in action, depending on the intensity and substance. Today, many exercisers prefer to work out to the beat of their own MP4 music. In many gyms, music is simply part of the background, and therefore gym operators should take exercisers' wishes into consideration while also keeping an ear out for overall volume levels.

Noise is measured in decibels (dB) and sounds are usually classified in the following way: a regular talking voice is usually 60-70 dB, a loud voice 80 dB, a deafening noise 100 dB, the pain threshold (of noise) 120 dB. A 140 dB noise is a danger to the unprotected ear, and 160 dB is enough to cause immediate deafness (The Biosphere, 1995).

Noise affects the body and emotional system in many negative ways. It stresses the nervous system, it increases the body's energy consumption, it fatigues and it impinges on the ability to concentrate. Strong, sudden noise can cause muscles to contract and the

endocrine system to release streams of adrenaline into the blood, stimulating heart rate, raising blood pressure and perspiration levels. "Audiophonic pollution" is a term describing a situation in which loudspeaker noise reaches a level of 100 dB. It may cause some of the above phenomena.

It is important to remember that music during physical activity and in the gym is a means and not an aim. Therefore, volume should be kept within reason. Exercisers who demand high music volume during their workout should remember that "noise disturbs and quiet soothes." If they must have it, ask them to buy – or lend them – personal music equipment. In short, only the intelligent use of music intensity and content will attain the positive aims of raising motivation for working out or relaxing body and soul.

## **2.4. DISADVANTAGES OF ACTIVITIES IN THE GYM**

### *Extrinsic rather than intrinsic motivation*

People often work out in the gym because it's socially fashionable. When activity is motivated by the need for social approval, for a well-shaped physique reflected in the mirror, or for digital feedback from the machines, exercise is not being performed for the right reasons. The problem is a lack of *intrinsic* motivation for exercise that arises from recognition of the importance and contribution of physical activity to one's life. As a result, exercisers may find it difficult to appreciate and enjoy the many benefits of working out.

### *Narcissism – and its consequences*

Activity in the gym enhances body awareness. Exercisers spend a lot of time working out in front of mirrors, and over time it is possible to discern certain physical activities that could be characterized as body worship and intensified self-love. This is narcissism, a potentially self-destructive love of self. As in the Greek myth

where beautiful young Narcissus fell so in love with his reflection in the river that one day he jumped into the water and drowned, the desire for gigantic muscle mass may lead exercisers to adopt an “all’s fair in love and muscle building” approach, including the use of steroids and stimulants. Scientific studies on the subject clearly indicate irreversible immediate and long-term impairment from the use of such drugs, including acute joint and ligament pains, digestive tract disturbances, damage to the immune system, acne (mainly on the back), reduced sexual potency, possible loss of consciousness, depression, and suicidal tendencies (see p. 159, for details about drug use). Another fashionable “short cut” to muscle development – in addition to, or instead of, gym activity – is electrode stimulation. Side effects may include tendon tears and damage to reflexes and coordination that impair movement precision and cause involuntary muscle spasms.

### *Apparatus dependency*

The gym provides exercisers with a pleasant work environment and easy-to-use equipment. A potential problem is dependency on the machines, to the point that exercisers may avoid any physical activity outside of the gym. It would be unfortunate, for example, if exercisers did not run outdoors only because they were accustomed to a work environment with constant digital feedback and music in the background.

### *Ignoring safety for rapid results*

The gym can cause exercisers to feel at their best because of good physical achievements. Often, training can be the direct cause of a so-called “high.” Work in the gym generates results (mainly in external appearance) at the very first stages of training, which may tempt exercisers to abandon the training schedule constructed specifically for them and to ignore training principles, including safety rules. When this happens, despite visible physical results, long-term health may be compromised. Taking short cuts and ignoring safety rules in the gym may cause microscopic tissue tears or inflammations. These injuries, in the long term, have a direct effect on physical fitness and mood.

### *Excessive development of strength*

Most injuries in the gym result from overdeveloping strength at the expense of other fitness components such as flexibility and cardiopulmonary endurance. This excessive emphasis may also deform posture, cause muscular pains, reduce range of joint movement, and make breathing during vigorous aerobic activity difficult.

### *Danger of diseases*

Gyms are often filled with dozens of exercisers at the same time, all breathing in the same recycled air-conditioned air. A lack of fresh air combined with relatively high temperatures creates fertile ground for the incubation and dissemination of disease, even if only one exerciser is ill. Thus, there is a susceptibility to becoming infected.

### *High costs*

Membership dues for belonging to a health club vary, sometimes by hundreds of percent. Price is determined by location, hours of operation, quality and variety of equipment, level of service, and extra services (e.g., showers, parking, sound systems, televisions). In the final analysis, high membership dues can become too burdensome and thus, deter exercisers from beginning to work out in the gym or renewing their membership.

Despite these drawbacks, working out in the gym using a holistic approach, helps you to recognize the different psychological, ergonomic, and safety aspects and, thereby, achieve your aim with minimal risk of injury, and with maximum enjoyment and enthusiasm. The following chapters help guide you through this process.

Good luck with your expedition!

# 3: BASIC CONCEPTS AND TERMINOLOGY IN PHYSICAL FITNESS THEORY

This chapter introduces concepts of body posture, physical training, and movement systems as well as the professional terminology used in training for various sports, especially in the gym. It is very important to use a homogeneous application of the terminology in this subject area. This is the prime condition for creating effective communication among all people involved: exercisers, coaches, teachers, and researchers. Explanations and applications for terms are provided.

## 3.1. COMPONENTS – PHYSICAL ACTIVITY

**Physical functioning** – The operation of body systems. Physical functioning can range from a state of complete rest or minimal exertion to sustain life to exercise that touches the upper limits of one's ability. In the gym, physical functioning activity ranges from moderate to maximal exertion.

**Physical exercise** – Any activity entailing physical exertion intended to maintain physical fitness or correct a physical problem.

**Aerobic exercise** – Physical exercise powered by energy from the oxygen inhaled during heightened respiration, for example, in prolonged jogging.

**Anaerobic exercise** – Physical exercise whereby muscles produce energy without utilizing oxygen; for example, weightlifting in the gym.

When we speak of *fitness* we are referring to ability; that is, the capacity to perform something. Thus, *physical fitness* is, in its broadest sense, only *one* of an array of human abilities that include intellectual, emotional, and social skills. Physical fitness allows us to activate all of

our body systems properly in all ranges of functional activity in order to guarantee our continued existence and to satisfy our needs. It includes all the major body systems: nervous, respiratory, cardiovascular, kinesthetic, digestive, urinary, reproductive, and immune systems.

**General physical fitness in the physical education context** – The ability of the kinesthetic (movement) system to perform a broad range of vigorous physical activities.

**Motion or movement** – A change in the spatial position of a given limb or of the entire body. The *movement* or *kinesthetic system* has five components which serve as:

1. **Skeletal bones** – Levers for movement.
2. **Skeletal joints** – Movement axes.
3. **Skeletal muscles** – Moving forces.
4. **Motor nerve system** – Activator and supervisor of skeletal muscles.
5. **Cardiopulmonary system** – The source of energy for skeletal muscle activity.

Physical achievements are attained through *exertion*, that is, by activating a system beyond its resting state.

**Physical exertion** – We activate our physical system beyond its resting state, and the intensity of our activity can be classified as one of *five levels of physical exertion*:

1. **Negligible exertion** – The minimal functional level for the subsistence of basic physical needs: up to about 10 per cent of maximal exertion.
2. **Low-level exertion** – The level characteristic of daily activities and therefore does not affect

physical fitness: 10 to 30 per cent of maximal exertion.

3. **Moderate exertion** – The minimal exertion that might affect physical fitness: 30 to 70 per cent of maximal exertion. 30 to 50 per cent is considered *low moderate exertion*; 51 to 70 per cent is considered *high moderate exertion*.
4. **High exertion** – Begins to approach maximum: 70 per cent to about 90 per cent of maximal exertion.
5. **Maximal exertion** – The highest possible exertion in a physical system: over 90 per cent of maximal exertion.

**Significant exertion** – The minimal exertion that produces any effect on the movement system. In the long run, only significant exertion can help us to improve our physical fitness.

**Stimulation threshold** – The point at any level at which exertion becomes significant. In other words, stimulation threshold is individual.

**Exertion factor** – Dictates, determines, and affects the essence of physical exertion, including its quality and its ability for improvement.

There are *five basic exertion factors*:

1. **Resistance** – Concentrates on the skeletal muscles.
2. **Duration** – Centres on the respiratory system (the lungs), the circulatory system (heart and blood vessels), and the skeletal muscles.
3. **Pace** – Focuses for the most part on the nervous system and the skeletal muscles.
4. **Range** – Concentrates mainly on the skeletal joints.
5. **Complexity** – Focuses mostly on the nervous system and the skeletal muscles.

In addition to these five basic exertion factors, certain *external factors affect physical exertion*:

1. Age.
2. Gender.
3. Physique (height, weight, surface area)

4. Weather during exertion (temperature, humidity, barometric pressure precipitation).
5. Environmental conditions in which exercise is performed (e.g., type of surface, conditions, incline, altitude, water).
6. Time of exercise (hour, day, month).
7. Nutrition during the exercise period.
8. Physical state and health (including previous physical exertions).
9. Mental state, including: understanding of the activity, motivation, emotional state, attitude towards the activity.
10. Human and social factors in the person's environment.

The physical fitness component is part of overall physical fitness that represents the ability of parts of the movement system to reach a specific exertion level. Physical fitness components are usually divided into basic physical fitness components and integrated physical fitness components.

### 3.2. BASIC PHYSICAL FITNESS COMPONENTS

The basic physical fitness component is one that enables us to surmount only one exertion factor at a significant exertion level. For example, in walking on a balance beam, movement complexity is the main exertion factor; therefore, the basic fitness component required for this exercise is balance, which is a coordination component. The other exertion factors (resistance, duration, speed, and range) represent insignificant exertion levels in the exercise and therefore do not affect the nature of the effort. Each of the five exertion factors is characterized by one basic physical fitness component.

**Muscular power** – Enables us to surmount the resistance factor.

**Endurance** – Allows us to cope with the duration factor.

**Coordination** – (Neuromuscular synchronization) allows exercisers to deal successfully with the complexity factor.

**Joint flexibility** – Facilitates our success in the range of activity factor.

**Speed** – Allows us to surmount the action pace factor.

## *Muscular power*

**Muscle** – Tissue with cells that are capable of contracting and creating movement or force. Muscles have a mechanism for producing mechanical energy that is released in the process of metabolism (chemical exchanges) in the cell. The main functions of muscles are: to initiate body movements, maintain posture against the force of gravity, move organs in the body (such as peristalsis in the digestive tract), and alter stresses or tensions in body structures (such as the pyloric muscles).

**Motor unit** – A muscle unit (muscle cell) linked to a neuron (a nerve extension) that activates the muscle.

**Joint** – A point at which two or more bones connect. In movement analysis, muscles are usually divided according to their four functions during performance of an action.

1. **Agonists** – Prime movers or muscles that perform a given action.
2. **Antagonists** – Muscles that provide counteraction (opposition) to the agonists; antagonists relax when agonists contract.
3. **Synergists** – Muscles that help agonists to perform a given action.
4. **Fixators** – Muscles that stabilize or *fix* the joint during performance of an action.

Muscles can change roles depending on the movements being performed. For example, the same muscle can serve as an agonist in flexion and as an antagonist in extension.

**Muscle power** – The capacity of skeletal muscles to overcome significant resistance (such as in weightlifting).

**Maximal power** – The maximum resistance that a specific muscle is capable of overcoming.

During anaerobic activity, lactic acid accumulates in the muscle as a by-product of energy-producing metabolism. The accretion of lactic acid in the muscles limits activity duration because it causes fatigue and pain. During aerobic activity and recovery, lactic acid decomposes.

## *Types of muscle contractions*

All physical activity is expressed as variations of muscle contractions. In muscle training, we speak mainly about types of contraction that improve physical fitness and build up the muscle:

**Isometric contraction** – Muscle contraction *without movement* that creates intramuscular tension during which the muscle *does not change in length*. Isometric contraction can be performed in both pulling and pushing movements (against equal resistance since there is no visible movement). The resistance can be external (wall, floor, or heavy weight) or internal (limb weight or opposing muscle).

**Concentric contraction** – Muscle contraction during movement that creates intramuscular tension during which the muscle *shortens*.

**Eccentric contraction** – Muscle contraction during movement that creates intramuscular tension during which the muscle *becomes longer*. The most significant effect of eccentric contraction is to improve the strength component.

## *Endurance*

Endurance is the ability to continue performing a given physical activity for a significant period of time. There are two types of basic endurance.

**Muscular endurance** – is the muscle's ability to persist in an action over a significant period of time; for example, drumming for a long time.

**Cardiopulmonary (aerobic) endurance** – The ability of the heart and lung systems to provide oxygen for the working muscles over a significant period of time; for example, running for ten minutes. Each type of endurance utilizes its own characteristic sources of energy (see p. 345, under "Nutrition").

## *Coordination (neuromuscular synchronization)*

Coordination is the ability of the nervous system to recruit exactly those muscles or parts of muscle required to perform a given movement at a significant level of complexity. There are *six types of coordination*.

**Rhythmic movement** – The ability of the nervous system to perform a movement or series of movements according to a given rhythm or beat, as in aerobic dance.

**Balance** – The ability of the nervous system to activate opposing muscle groups in order to maintain body balance over a narrow base of support, for example, walking on a beam.

**Movement timing** – The ability of the nervous system to respond with the appropriate movement exactly at the right time; for example, spiking in volleyball.

**Movement expression** – The ability of the nervous system to express a given idea through a physical act; for example, pantomiming a rope tow.

**Misdirection movement** – The ability of the nervous system to feint (give the opponent the illusion of doing one thing, but ending with an opposite action) through a physical act; for example, faking by an opponent in basketball or soccer.

**Muscular relaxation** – The ability of the nervous system to reduce muscular tension in various situations (e.g., standing, sitting, walking) by neutralizing the activity of muscles or muscle parts unnecessary for a given physical activity. For example, there is no need to tense up hand and finger muscles while driving, especially when there is power steering.

## *Joint flexibility*

Flexibility is the ability of a given joint (or joints) to perform an action at a significant level, for example, abducting the lower extremities as wide as necessary at the hip joint in order to perform a *split*. Flexibility training is based on improving range of joint movement. Muscles are only one of the factors limiting range of joint movement, but through proper stretching, range of joint movement can be substantially improved.

**Stretching** – An attempt to increase range of joint movement by increasing the length of the relevant muscles.

**Maximal range** – The range of movement that exercisers aspire to reach.

**Optimal range** – The range of movement that exercises actually attain without causing damage to the joint.

**Maximal-optimal range** – Attainment of the exerciser's potential range of movement at a given stage of training.

Actions meant to expand the range of joint movement have a tendency to stimulate the stretch reflex. The *stretch reflex* is a protective mechanism that entails an abrupt shortening of the muscle in reaction to sudden stretching. We experience the stretch reflex when we fall asleep in a sitting position and our head falls forward (because the centre of gravity in the head is above the eyes). Subsequently, the neck muscles respond to the excessive stretching by immediately and involuntarily shortening them (a reflex), bringing the head up with a jerk. This situation is familiar to students in especially boring lectures or drivers who fall asleep at the wheel. In the gym, stretching the chest muscles often stimulates the stretch reflex with its concomitant muscle contraction. This response causes microscopic tears and inflammations in the muscle, damage that may accumulate in the long run to the point of terminating physical activity in those muscles. To prevent the stretch reflex it is necessary to work *at a slow and controlled rate* during stretching activities, especially those intended to improve flexibility.

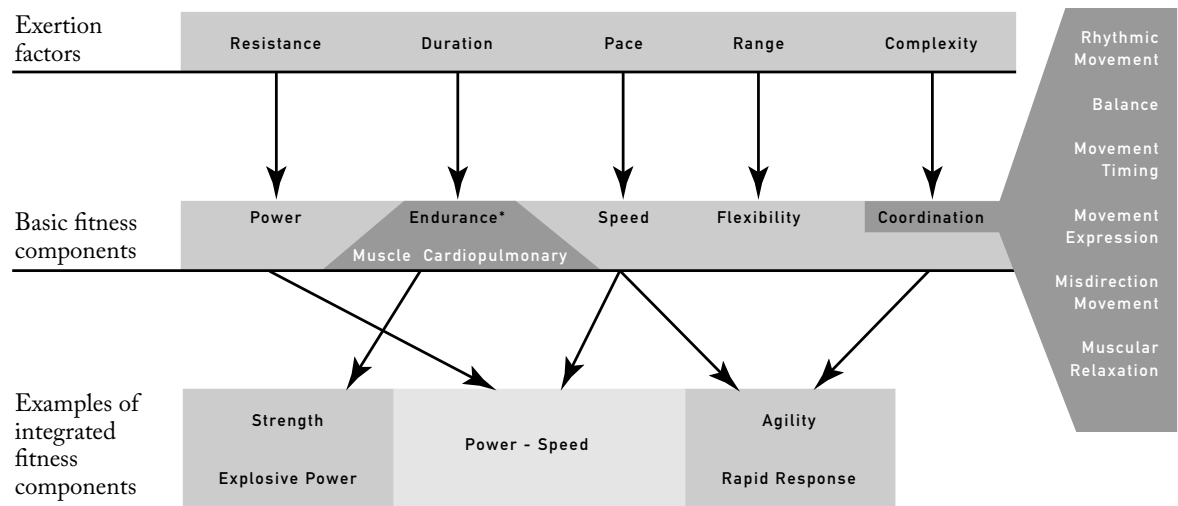
## *Speed*

Speed is the ability to perform a movement in minimum time. There are two types of movement speed.

**Explosive speed** – The ability to perform a one-time movement in minimum time; for example, drawing a pistol from its holster.

**Cyclical speed** – The ability to sequentially repeat a series of similar movements in minimum time, for example, running between hurdles.

Illustration 3.1. Exertion factors with basic and integrated fitness components



\* ENDURANCE - is involved in the physical activity components when the exercise or activity happens over an extended period of time.

### 3.3. COMPONENTS OF INTEGRATED PHYSICAL FITNESS

Basic physical fitness components are easy to recognize because of their distinctive exertion factors. In actual practice, physical training rarely makes use of any one basic fitness component. Most types of exercise incorporate several basic fitness components in varying degrees. Since the five basic exertion factors can be combined in many different ways in a given type of effort, the number of *integrated fitness components* is quite large.

An integrated physical fitness component is one that allows us to surmount two or more exertion factors at significant exertion levels. The following are examples in many sports.

**Strength** – A combination of two fitness components: power and endurance. Optimal strength is usually reflected at about 60 per cent of RM<sub>1</sub> (the maximal resistance against which one

can perform one single repetition of a movement) and in the mean of thirteen repetitions.

**Power-speed** – The ability of the skeletal muscular system and the nervous system to respond rapidly to a given stimulus at the proper intensity. This fitness allows us to surmount resistance and speed factors. An example in weightlifting is in the first stage of jerking and placing oneself under the bar.

**Explosive power** – The ability of the nervous system to activate a muscle once despite significantly high resistance and in the *shortest time possible*. An example is the standing long jump.

**Agility** – The ability of the nervous system to activate the muscular system at a significantly high level of speed to perform a movement of a significantly high level of complexity. This fitness allows us to surmount speed and complexity factors, for example, in a zigzag shuttle run.

**Rapid response** – The ability of the nervous system to respond to a given stimulus in the shortest time possible through appropriate physical action. For example, a rapid response to the starter's pistol in races or immediate response to visual cues such as weaving and ducking punches in boxing.

**Power endurance** – The ability of the skeletal muscles to persevere in an action despite significant resistance over a significant period of time. This fitness allows us to surmount duration and resistance factors. An example is a “stretcher run” carrying a patient with or without full military gear.

**Explosive power endurance** – The ability of a muscle to continue to perform explosive actions for a relatively long time. An example would be a long rally in tennis.

**Agility endurance** – The ability to continue performing agility actions for a relatively long period of time. This fitness allows us to surmount the factors of duration, speed, and complexity, for example, repeated changes of direction among table tennis or squash players.

**Rapid response endurance** – The ability to continue performing rapid physical responses over significant time periods, for example, the highest levels of professional table tennis or squash.

**Speed endurance** – The ability of the skeletal muscles and cardiovascular system to continue performing movements at a significantly rapid tempo for a significantly long period of time. Marathon running is an example.

Recognizing integrated physical fitness components is less relevant for novice exercisers’ training programs, but it is important to create training programs for advanced exercisers and athletes. Thus, identifying the type of integrated physical fitness components required for an athlete’s activity allows us to decide the basic exertion factors that need to be activated at higher levels for their development. Illustration 3.1 shows the basic fitness components and some of the integrated fitness components.

### 3.4. PULSE MEASURE

The *pulse* is the number of heartbeats per minute, and, as such, it reflects cardiopulmonary endurance. The lower the pulse rate is, the greater the aerobic fitness. Measuring the pulse at any given moment provides data about the individual’s level of exertion and resources for creating energy. Lower pulse rates indicate that the body is exerting itself less and its sources of energy are mainly fats that are being “broken down.” Higher pulse rates indicate that the body is exerting itself more strenuously and its source of energy is the oxidation of sugars (see p.

344 under “Nutrition and Physical Activity”). Thus, the pulse rate accurately reflects the level of exertion at any given moment. For example, an average pulse rate of 185 beats per minute indicates that the exerciser is working at a high level of exertion (close to 90% of maximal exertion). An average pulse of 130 beats per minute usually indicates intermediate level work (about 40% of maximal exertion).

**Maximal pulse rate** – The pulse measure during “all-out” exertion. The best way to determine maximal pulse usually entails competition against an opponent in order to raise motivation. Maximal pulse rate for a given individual may vary from one type of physical exertion to another and should be determined carefully from a variety of skills.

**Pulse range** – A measure of endurance level and type of exertion. It is measured in percentages of maximal pulse. There are six main pulse ranges:

**Recovery range** – Defined as 25–50 per cent of maximal pulse rate.

**Moderate physical activity range** – Extends from 50–60 per cent of maximal pulse rate.

**Aerobic fitness threshold range** – 60–70 per cent of maximal pulse rate.

**Aerobic fitness range** – 70–80 per cent of maximal pulse rate.

**Anaerobic fitness threshold range** – 80–90 per cent of maximal pulse rate.

**Anaerobic threshold range** – Extends from 90–100 per cent of maximal pulse rate (Kanitz, 1998).

The transition from one pulse range to another varies from one person to another. Therefore, it is more prudent to speak in terms of percentage of maximal rate rather than in exact pulse rates. Percentages for each of the six ranges can deviate up to 5 per cent among individuals.

In certain situations, our pulse behaviour can help us to determine – and predict – our own physical state, in terms of both physical fitness endurance and general health. The following measurements utilize pulse rate to predict and understand our physical state:

**Resting pulse rate** – The pulse as measured when we first wake up in the morning, before getting out of bed. A sphygmomanometer can help us to measure this lowest pulse rate close to sleep. It can also be used to measure the

lowest rate during sleep. A resting pulse rate of less than seventy beats per minutes indicates good physical fitness in terms of cardiopulmonary endurance. Continued exercise and improved endurance should be reflected in a further reduction of resting pulse rate, for example, from seventy to sixty. A rise in resting rate tells us that our aerobic fitness level has declined. At times, resting pulse rate also serves as a predictor of overtraining caused by excessive work loads. In this case, resting rates go higher than usual because the body must recover at a higher rate and compensation is attained by a rise in the resting pulse rate. High resting rate can also indicate illness. However, caution is needed because pulse is also a hereditary factor; some people may manifest a low resting pulse rate but actually have *poor* aerobic physical fitness, and vice versa.

**Regular pulse** – The pulse rate measured during the day as we perform routine daily activities.

**Recovery** – The process during which the body replenishes its energy stores, overcomes fatigue, and refreshes itself.

**Recovery segment** – The period required for recovery during training.

**Recovery period** – The amount of time it takes for the pulse to return to a regular rate at the end of a training session entailing a significant exertion level or during recovery segments. The recovery period provides a good indicator of our physical endurance. Fast recovery indicates good endurance level. Slow recovery points to a low endurance level. Recovery also depends on the duration and quality of the maximal exertion performed beforehand, the exerciser's age, gender, and the exertion percentage as calculated by the Karvonen formula presented below.

**Exertion pulse** – The pulse rate measured during physical activity and reflects the level of exertion during exertion. The higher the exertion pulse rate remains for a longer period of time without dropping, the higher the ability for aerobic output.

**Target pulse** – The pulse rate calculated from data such as resting pulse, age, gender, and desired level of exertion, as well as additional data required for specific methods of calculation. Target pulse rate helps to ascertain attainment of the training aim. If the pulse measured during training corresponds to the target pulse, it indicates that we have attained the training aim.

**Training aim** – Derived from all the factors involved in the decision to include physical activity in the life cycle.

## *Maximal Oxygen Uptake/Intake (VO<sub>2</sub>max)*

Maximal oxygen uptake is the body's potential for aerobic endurance. The higher the pulse range, the closer we come to VO<sub>2</sub>max. The amount of energy the body's aerobic mechanism can produce depends on the amount of oxygen it can utilize from the air. VO<sub>2</sub>max is the point at which oxygen consumption can rise no further even if intensity of exertion is increased. VO<sub>2</sub>max can be expressed in two ways:

1. **Absolute VO<sub>2</sub>max** – The actual maximal oxygen uptake without consideration of body weight; it is measured in litres of oxygen per minute. A long distance runner weighing 60 kilograms with an absolute VO<sub>2</sub>max of 5 litres per minute of oxygen has a better aerobic capability than a runner with the same absolute VO<sub>2</sub>max of 5 litres per minute who weighs 70 kilograms. This is due to the fact that the same amount of oxygen in the lighter-weight runner is intended for a smaller body and it can be moved with more force.
2. **Specific VO<sub>2</sub>max** – The maximal aerobic output per kilogram of body weight and is measured in relation to body weight (ml O<sub>2</sub>/kg weight/minute). This number is a measure of maximal aerobic output (aerobic capacity) (Nice and Inbar, 2003).

A number of formulas are used to calculate target pulse for a training session. Since these formulas are general, they are not accurate for determining training aim. Nevertheless, they can be used to gain an idea of the approximate desired pulse for training in order to improve a specific fitness component.

Table 3.1. Predicted VO2max for men aged 17–52 according to the Cooper test

| SPECIFIC VO2MAX FOR MALES AGED 17–52<br>IN ML/KG/MIN | DISTANCE IN METRES COVERED DURING<br>12 MIN. RUN |
|------------------------------------------------------|--------------------------------------------------|
| Less than 25                                         | Less than 1,600                                  |
| 25–33.7                                              | 1,600–2,000                                      |
| 33.8–42.5                                            | 2,000–2,400                                      |
| 42.6–51.5                                            | 2,400–2,800                                      |
| More than 51.6                                       | More than 2,800                                  |

Table 3.2. Physical fitness level values for males aged 17–52 according to the Cooper test

| 50–52           | 40–49           | 30–39           | UNDER 30        | AGE           |
|-----------------|-----------------|-----------------|-----------------|---------------|
|                 |                 |                 |                 | FITNESS LEVEL |
| Less than 1250  | Less than 1350  | Less than 1500  | Less than 1600  | 1. Very low   |
| 1,250–1,550     | 1,350–1,650     | 1,500–1,800     | 1,600–2,000     | 2. Low        |
| 1,550–1,900     | 1,650–2,000     | 1,800–2,200     | 2,000–2,400     | 3. Average    |
| 1,900–2,350     | 1,600–2,450     | 2,200–2,600     | 2,400–2,800     | 4. Good       |
| More than 2,350 | More than 2,450 | More than 2,600 | More than 2,800 | 5. Excellent  |

Table 3.3. Physical fitness level values for women\* aged 17–52 according to the Cooper test

| 50–52           | 40–49           | 30–39           | UNDER 30        | AGE           |
|-----------------|-----------------|-----------------|-----------------|---------------|
|                 |                 |                 |                 | FITNESS LEVEL |
| Less than 1000  | Less than 1200  | Less than 1350  | Less than 1500  | 1. Very low   |
| 1,000–1,300     | 1,200–1,500     | 1,350–1,650     | 1,500–1,800     | 2. Low        |
| 1,300–1,650     | 1,500–1,800     | 1,650–1,900     | 1,800–2,100     | 3. Average    |
| 1,650–2,150     | 1,800–2,300     | 1,900–2,450     | 2,100–2,600     | 4. Good       |
| More than 2,150 | More than 2,300 | More than 2,450 | More than 2,600 | 5. Excellent  |

\*Pilot table based on limited data.

### *The Karvonen Formula*

This is the most commonly used formula for calculating target pulse. The data entered into this calculation are: exerciser's age, resting pulse rate, and desired pulse range. This formula is suitable mainly for populations that are not active at the competitive level because it does not include maximal pulse rate.

**Men:**  $(220 - \text{age} - \text{resting pulse}) \times \text{exertion percentage} + \text{resting pulse} = \text{target pulse}$

**Women:**  $(226 - \text{age} - \text{resting pulse}) \times \text{exercise percentage} + \text{resting pulse} = \text{target pulse}$

For example: A thirty-year-old man with a resting pulse of sixty beats per minute is interested in training at the anaerobic threshold pulse range. To calculate his target pulse, the data are as follows:

$220 - \text{age} = 220 - 30 = 190$  beats per minute (bpm)  
 $190 - \text{resting pulse} = 190 - 60 = 130$  bpm  
 $130 \times 80\%$  (lower threshold of exercise percentage of  $\text{VO}_{2\text{max}}$ ) = 104 bpm  
 $130 \times 90\%$  (upper threshold of exercise percentage of  $\text{VO}_{2\text{max}}$ ) = 117 bpm  
 $104$  (Lower threshold) +  $60$ (resting pulse) = 164 bpm  
 $117$  (Upper threshold) +  $60$ (resting pulse) = 177 bpm

Thus, the target pulse is between 164 and 177 beats per minute.

Some exercisers have a relatively high resting pulse rate even though they are fit. In this case, the Karvonen formula is not sufficiently accurate.

### *The Brick Formula or Pulse Reserve Formula*

Matthew Brick's (Brick, 1994) formula is the most accurate for calculating target pulse for athletes and exercisers aspiring to extract the maximum from themselves. The data for calculation are maximal pulse rate and resting pulse rate. Since this formula has greater accuracy, it is the preferred calculation method among competitive athletes. It is not suitable for use by exercisers with physical limitations or with no athletic experience because they may be injured during attempts to define their maximum pulse.

### *The Brick Formula or Pulse Reserve Formula:*

$(\text{Maximal pulse} - \text{resting pulse}) \times \text{exertion percentage} + \text{resting pulse} = \text{target pulse}$

For example, an exerciser with a resting pulse of sixty and a maximal pulse rate of two hundred would like to train at his anaerobic threshold pulse rate. To calculate the target pulse, we use the data as follows:

Design change  
 $200 - 60 = 140$  beats per minute (bpm)  
 $140 \times 80\% = 112 + 60 = 172$  bpm (lower threshold of exercise percentage for  $\text{VO}_{2\text{max}}$ )  
 $200 - 60 = 140$  beats per minute (bpm)  
 $140 \times 90\% = 126 + 60 = 186$  bpm (upper threshold of  $\text{VO}_{2\text{max}}$  exercise percentage for  $\text{VO}_{2\text{max}}$ )

Thus, the target pulse is between 172 and 186 bpm.

A number of tests are used to determine specific  $\text{VO}_{2\text{max}}$ , either in the laboratory (which is considered more accurate) or in field tests that have a correlation of 90–95 per cent and are considered effective, such as the Cooper test.

The Cooper test measures the maximum distance a person is able to run during twelve minutes. The results of distance and age on the chart indicate distance values in relation to specific  $\text{VO}_{2\text{max}}$  (Cooper and Cooper 1988).

## 3.5. POSTURE

Posture is a complex physical composite, encompassing organization of our body limbs whether we are static or moving, and their adaptation to the changing nature of physical activity. While the word *posture* refers to the specific state in which the body is held; a multi-limbed, dynamic organism such as the human body cannot be defined as having one posture. People vary in body structures, making it difficult to define a universal norm for the "average person" (Steindler, 1964). The main difficulty in defining correct posture stems from the inability to designate any one specific posture as the best one. The body finds itself in many situations and only rarely does it remain in one for any considerable amount

of time. Since it is difficult to identify posture accurately, a number of definitions are offered:

**Galley** – Defines posture as “a relative alignment of the body parts that alters with the body’s movements and positions during the day and throughout life” (Galley and Foster, 1982).

**Roaf** – Sees posture as an intermediate state between the movement that was and the one that is to come: “Posture is the state the body takes upon itself when it is preparing for the next movement. Static erectness is not real posture” (Roaf, 1978).

**Bouzan** – Emphasizes the aesthetic aspects of posture: “Posture is defined as a graceful elegant phenomenon that combines composure and dignity, a state of balance and equilibrium” (Bouzan, 2003).

**Johnson and Nelson** – See posture as reflecting the body-soul connection: “Posture is an expression of the appearance of an aesthetic body that reflects personal existence, self-image, physical state and self-concept in relation to the environment” (Johnson and Nelson, 1986).

**Alduby** – Considers six main criteria for “good posture,” namely:

1. Whether the load on supporting limbs is minimal.
2. Whether muscular energy expenditure is minimal.
3. Whether optimal activity is assured for internal organs.
4. Whether the posture can be maintained as long as necessary without signs of overfatigue or discomfort.
5. Whether it is easy to “get into” and “out of” the state, for example, being able to begin to and to stop walking easily (if we lock our knees, to begin walking we have to unlock them first and only then begin to walk. This makes it difficult to “get out of” the posture, wasting time and energy).
6. Good posture should be aesthetic because it is part of our self-image (Alduby, 1982).

In light of the difficulty in defining posture, it is understandable that instilling awareness, knowledge, and understanding of the subject is so complex. In planning and organizing changing dynamic activity, it is worth devoting attention to changes in posture during physical training. *The latter is extremely important in the gym*

because apparatus has to be adjusted to each exerciser’s specific body structure and dimensions (what is called *ergonomic adjustment*).

We often see muscular “hulks” with posture disorders. Exercisers whose muscles have become shortened as a result of overdevelopment of the strength component often manifest a lack of balance between anterior and posterior muscle groups. Even if they develop the other fitness components (speed, flexibility, coordination, and cardiovascular endurance) but do not nurture suitable posture, cumulative damage to the spinal column might result. Only development of each of the physical fitness components, with maximal attention to dynamic and changing posture according to changing body positions, assures the best results in terms of both health and appearance. The gym is the ideal venue because most of the work is individual and relevant muscle groups can be worked on and developed to improve posture. Working in front of mirrors (for feedback) helps to raise exercisers’ awareness to develop correct posture that balances various muscle groups. The external result of this work is reflected in a dynamic balance between the muscular and skeletal systems and posture that is properly aligned. (See Chapters 6 to 15 for a broad variety of exercises for the different muscle groups.)

The exercises described in this book are accompanied by detailed explanations of their start and finish positions, their range of action, and a movement analysis of each exercise. Illustrations help to reduce injury risk factors while developing awareness about the nature of posture and changing physical alignment from exercise to exercise. (For visual information about the ideal posture in various body positions and parts, see pp. 57–78 under the “New York Posture Test”; Ben-Sira., G. Tennboym, and Lidor 1998)

### 3.6. PRINCIPLES OF PHYSICAL TRAINING

**Physical training** – Physical activity with an aim to improve physical ability in one or more of the physical fitness components.

**Training method** – A specific way of performing physical training (see Chapter 3 for the various training methods). Most training methods are composed of series of “sets.” These are series of a fixed or changing number of repetitions

(depending on the training method) of a given exercise; for example, a set of ten repetitions.

**Training unit** – A single training session, usually about one or one-and-a-quarter hours long. It is composed of three stages: *warm-up*, which is the preparatory stage for training; the *training* itself, which is the main part; and the *cool-down*, which is the concluding segment of the training unit.

**Training dosage** – The sum total of all the work carried out in the training unit.

**Muscular stimulation** – Activation of a muscle at a given level of exertion, whether for physical activity or for physical training. Training dosage components are muscular stimulation *intensity*, stimulation duration, stimulation *frequency* (number of stimuli in a training unit) and stimulus *density* (rest time between sets and rest between reps).

**Training period** – The amount of time required to complete the training aims. In the gym, this is usually a training period of about two or three months or twenty-five training units, at a frequency of three or four times per week, with a full-day break between training units.

**Physical adaptation** – The change in structural and/or functional physical characteristics in response to repeated muscular stimulation over time. The literature also refers to this as the *training effect*.

**Positive physical adaptation** – An adaptation response that is reflected in enhancement of the stimulated physical tissues or their capacity and in an improvement in their functioning. There are two types of positive adaptation: *hypertrophy* and *hyperplasia*.

**Hypertrophy** – A thickening or growth of tissue or organ because of an increase in the dimensions of its cells and not because of their multiplication. Muscles grow in this way in response to enhanced exertion.

**Hyperplasia** – The creation and increased multiplication of normal cells in a tissue or organ, for example, an increase in blood capillaries because of increased aerobic activity.

**Negative physical adaptation** – An adaptation response that is reflected in a thinning of the components of the stimulated tissues or their capacity and in a decrease in their functioning, as in *atrophy* or *osteoporosis*.

**Atrophy** – A thinning of an organ or tissue because of cell deterioration. Muscular atrophy is associated with certain diseases, injuries, or the result of the cessation of physical activity.

**Osteoporosis** – A disease usually characteristic of old age that is marked by a decrease in bone density. As bones

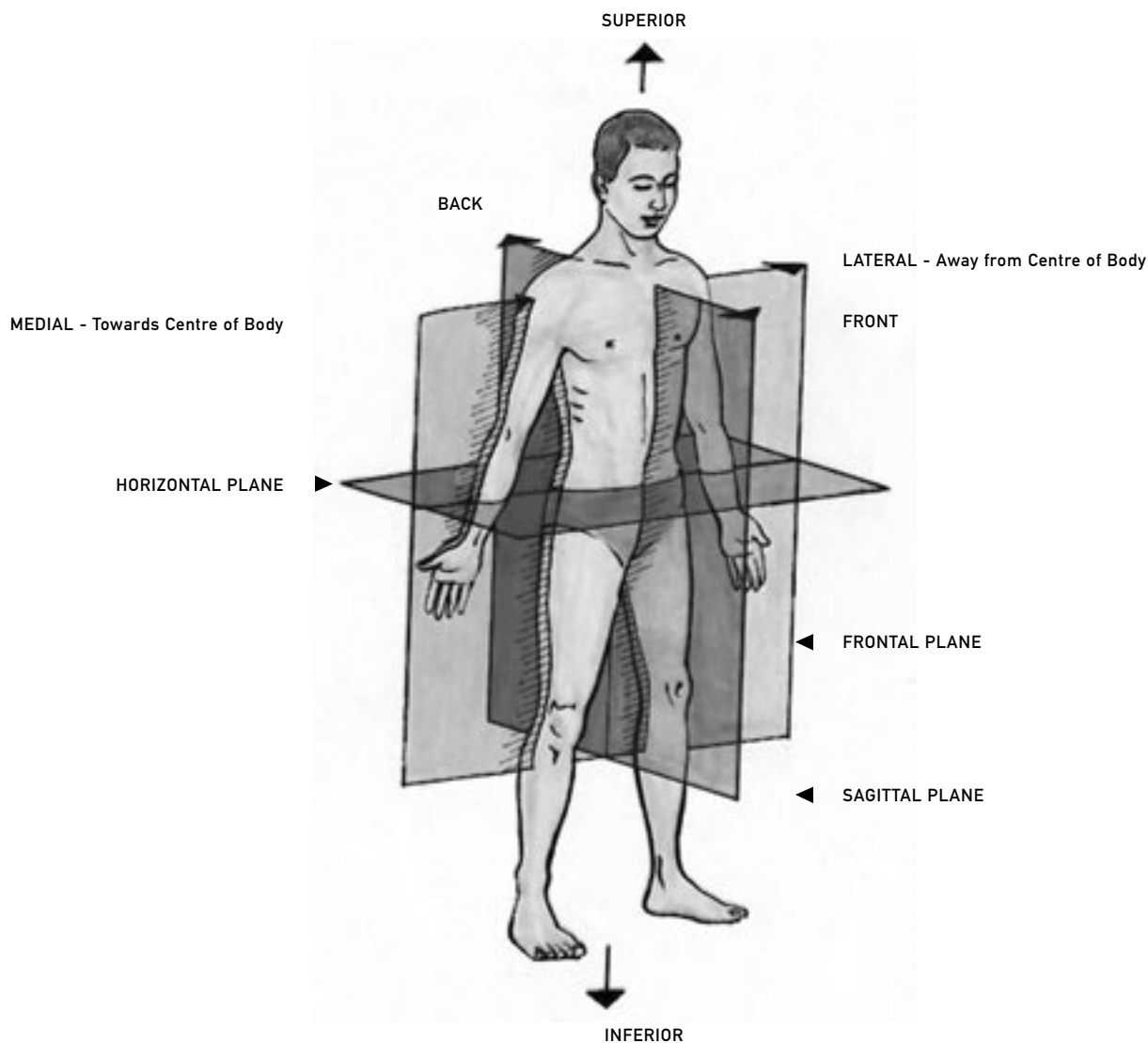
become thinner and more brittle they have a greater danger of fracturing easily. Local bone thinning can be the result of infection, injury, or *synovitis* (joint inflammation), which may also result from extended treatment with steroids.

## Training principles

The following six training principles serve as basic guidelines for physical training to ensure the desired physical adaptation:

1. According to the *overload principle*, improving physical fitness requires the simultaneous stimulation of the appropriate body parts for all the training dosage components: the proper *intensity* (above a given stimulation level), for a specific *duration* and at a specific *frequency* (with suitable pauses between the various exercises or between one training session and another).
2. According to the *principle of relative progress*, to ensure continuous improvement of fitness, the training dosage should be revised periodically in proportion to individual progress. Using the preliminary training dosage as the baseline, training intensity, duration and/or frequency can be revised according to training aims and special training conditions.
3. According to the *principle of gradation*, the body should attain the desired training dosage by gradually moving through the various training stages. The gradation principle should be implemented in terms of training unit and training period stages, and in the transition between training seasons in annual programs for professional athletes.
4. According to the *perseverance or continuity principle*, maintaining or improving physical fitness over time requires the appropriate training dosage throughout the entire desired period.

Illustration 3.2. The Movement Planes



5. According to the *specificity principle*, the closer training is to the activity to be improved, the more effective it will be. For example, training for maximal aerobic ability in swimming raises only slightly one's maximal aerobic ability for running, and vice versa.
6. According to the *expansion principle*, training the body for maximalization of personal fitness potential requires that training contain three components:

- a. *Specific activity* for each of the exertion factors.
- b. *Greater emphasis* on certain exertion factors.
- c. *Lesser emphasis* on certain exertion factors.

In general, greater emphasis is usually recommended for the preparatory period, while lesser emphasis applies to the transition period and specific training for the competitive season.

### 3.7. MOVEMENTS OF THE SKELETAL SYSTEM

To describe various body movements while explaining and analyzing exercises, we use *kinesiological* terminology (kinesiology = the study of movement). A fundamental familiarity with a number of basic kinesiological concepts and terms adds to an understanding of the movement analyses presented later.

#### *Anatomical position*

The reference stance for analyzing movement in physical activity is called the *anatomical position*. The body stands erect, limbs are straight, legs parallel with feet tending somewhat outward, arms hanging away from the sides of the body at an angle of about thirty degrees and palms of hands facing forward, with the thumbs on the outside (see Illustration 3.2).

#### *The three movement planes*

**Sagittal plane** – The vertical plane that divides the body from front to back, dividing it into right and left parts.

**Frontal plane** – The vertical plane that traverses the body from right shoulder to left shoulder and divides the body into front and back parts.

**Transverse or horizontal plane** – The plane parallel to the ground that traverses the body and divides it into upper (superior) and lower (inferior) parts.

#### *Movements in the sagittal plane*

**Flexion** – A movement that decreases the joint angle between two or more bones. For example, flexing the elbow joint reduces the angle between the forearm and the arm. In moving from the anatomical position to the fetal position, all the joints perform flexion.

**Hyperflexion** – Flexing the joint beyond the anatomical position, for example, as in swinging the arm upward in a volleyball serve.

**Dorsiflexion** – Upward flexion of the ankle joint, bringing the top of the foot towards the lower leg.

**Plantar-flexion** – Downward flexion of the sole of the foot, bringing the sole of the foot towards the lower leg.

**Extension** – A movement that increases the joint angle between two or more bones. It is the opposite of flexion.

**Hyperextension** – Extending the joint beyond the anatomical position, for example, lowering the arm from a position of flexion and continuing to lead it back beyond the vertical line of the body, such as in walking and running.

**Posterior pelvic tilt** – A movement of the pelvis that causes flexion of the lumbar spine and at the same time extension of the hip joints. Viewed from the side, the upper part of the pelvis rotates to the rear and the lower part of the pelvis rotates to the front.

**Anterior pelvic tilt** – The reverse of the posterior pelvic tilt. Here the movement causes extension of the lumbar vertebrae and at the same time flexion of the hip joints. Viewed from the side, the upper part of the pelvis rotates forward and the lower part of the pelvis rotates to the rear.

#### *Movements in the frontal plane*

**Abduction** – A movement to the side, away from the body, from the anatomical position. For example: raising the arm to the side.

**Hyperabduction** – Abduction in which the movement goes beyond the optimal angle that the joint allows. For example: scratching one's right ear by bringing the left hand over the head.

**Adduction** – The reverse of abduction, leading back to the anatomical position.

**Hyperadduction** – Bringing a limb beyond the midline of the body, for example, when scratching the left shoulder with the right hand.

**Elevation** – A movement of the shoulders towards the ears, as in shrugging as if to say, "I don't know."

**Depression** – The reverse of elevation, back to the anatomical position.

**Side-flexion** – Bending the head or the body to the side, for example, in bringing the ear to the shoulder.

#### *Movements in the horizontal plane*

**Transverse or horizontal abduction** – A movement unique to the extremities; it is performed on the transverse plane;

for example, stand with arms straight out and forward at shoulder height, moving them at shoulder level to the sides.

**Transverse or horizontal adduction** – The opposite of transverse abduction; for example, stand with both arms straight out to the sides, shoulder-width apart, bring arms forward along the shoulder line.

**Rotation** – A turning movement performed in the spinal joint.

Part of the body turns in rotation to left or right; for example, in shaking one's head to say "no."

**Lateral rotation** – A turning *outward* of the upper or lower extremities; for example, the "snuffing a cigarette" movement when standing, pressing with the forward part of the foot as the toes turn to the outside in a rotational movement.

**Medial rotation** – The reverse of lateral rotation, bringing the part of the body back to the anatomical position.

**Pronation** – A rotational turning *inward*, unique to the wrist. In the movement, the thumb is turned from the anatomical position and is rotated towards the body.

**Supination** – The reverse of *pronation*, returning to the anatomical position.

## 4: METHODS FOR DEVELOPING PHYSICAL FITNESS

Methods used for building personal training programs are discussed in this chapter. Some of these are applicable in the gym and others are necessary for understanding the subject as a whole. Familiarity with a large array of training methods is essential for the intelligent choice and design of a training program that serves each exerciser's needs and goals.

### *Training methods for developing strength and muscular endurance*

The following methods are the ones most commonly used by gym exercisers at various levels. Most of the methods are based on calculating percentages of maximal strength. Maximal strength is usually expressed in terms of RM, which stands for maximum resistance or repetition. RM<sub>1</sub> is the maximal resistance (weight) that an exerciser can overcome (e.g., raise, snatch) for one repetition within the bounds of safety. RM<sub>1</sub> can be defined as “pure power” in the sense that it is performed without assistance of any kind – it is maximal weight for one repetition. RM<sub>10</sub> is the maximal weight that can be lifted ten consecutive times while adhering to safety rules. Similarly, RM<sub>6</sub> is the maximal weight that can be lifted six consecutive times, and so on.

### 4.1. TRAINING METHODS FOR DEVELOPING POWER AND MUSCULAR ENDURANCE

**Round method** – A method intended for beginners. A number of muscle groups are selected and work is done on each

group in sequence. Consecutive work on all of the groups (that is, working at each station) is called a *round*. The aim is to avoid overloading a muscle group (instead, work is done in sequence) and to minimize rest periods between sets. Each muscle group has time to recover while the other groups are working. Each set has a predetermined number of repetitions, usually between ten and twenty. Resistance is determined by the desired number of repetitions.

**The Deloram method** – Originally intended for use in rehabilitation (physiotherapy). The intent is to work mostly on building muscle strength. Due to its success, it has been adopted by exercisers in many sports. Ten repetitions at 50 per cent of their RM<sub>10</sub> are performed, followed by ten repetitions (reps) at 75 per cent of their RM<sub>10</sub>, and finally ten reps at 100 per cent of their RM<sub>10</sub>. The emphasis in this method is on working from easy to hard. Of course exercisers have difficulties performing all ten reps of the third set, but if they do succeed, this indicates that their RM<sub>10</sub> has already risen. This method is relatively moderate and is suitable for beginners.

**The set method** – One of the most commonly used methods and is suitable for all levels of exercisers. Exercisers perform three to five sets with a short rest between sets. The emphasis in this training is on the final set while the first sets serve as preparation. In the latter, the number of reps is fixed, usually between ten and twenty, but in the final set, exercisers try for as many reps as possible. Resistance is adjusted according to the number of reps in the final set. For example, if the first three sets contain fifteen reps each, in the final set exercisers attempt to do more than fifteen reps. However, if they reach eighteen reps in the last set, resistance should be adjusted accordingly. When the aim is to develop power, the resistance is higher and the reps are fewer. When the aim is

to develop muscular endurance, the resistance is lower and the number of reps is greater.

**The Berger method** – Based on executing three sets of six reps each at a resistance calibrated for RM6. The first set is at 100 per cent of RM6, the second at 85 per cent of RM6, and the third at 70 per cent RM6. The method is suitable mainly for developing power and is intended for advanced-level exercisers. Exercisers tend to use this method after having completed a training period using the Deloram method.

**The pyramid method** – The name represents the direction of the load, which can be aimed towards developing power or developing endurance, depending on the goal of the training. Exercisers usually perform three to five sets at a decreasing number of reps and an increasing level of resistance. Here too, the emphasis is on the last set, which should be performed in a state of muscular fatigue. The method is intended mainly for developing “pure power” (that is, power with a minimal element of endurance) and, therefore, is used mainly by advanced exercisers.

**The rising pyramid method** – Based on a gradual addition of resistance. With each set the number of reps diminishes and the resistance level rises to near 100 per cent of RM1. The main aim is to develop muscular power.

**The inverted pyramid method** – The aim is to develop muscular endurance. The method is based on three to five sets whereby the first set consists of one rep at maximal weight; each additional set has an increasing number of reps and a decline in resistance. The load in this method tends to develop endurance.

**The rising and falling pyramid method** – Begins with fifteen reps, continues with ten reps, then six reps, then ten reps again, and concludes with fifteen reps. Resistance is adjusted for each set accordingly.

**The superset method** – Used for bodybuilding and is recommended only for advanced exercisers who are in very good physical condition. It is based on a ten-rep set for the main muscle followed immediately afterwards by another set of ten reps for the antagonist muscle. This usually means working on the agonist muscle and immediately afterwards on the antagonist muscle. The combined work on both muscles constitutes one set. This training method calls for five sets (of 20 reps each), which is considered one set of a hundred reps without rest. Five 100-rep sets are performed, with rest between each, so that in all there are 500 reps – 250 for the agonist and 250 for the antagonist muscle. The main benefit of this method is the time efficiency, making

it possible to perform a large number of exercises in a relatively short time.

**The split routine system** – A weekly training program whose main aim is to develop muscle mass. Exercisers divide their body into a number of groups and train each group on alternate days. The number of training sessions per week is between three and five, the number of sets for each muscle group is nine on average, and the number of reps in each set ranges from six to twenty. The emphasis is to avoid working on the same muscle group on consecutive days. For example, the first group may consist of the legs, arms, and back on Mondays and Fridays; the second group of chest, shoulders, and abdomen on Sundays and Wednesdays. Another variation of this method is to divide the body into individual muscle groups, each of which is trained on a different day.

**The Oxford (multi-set) method** – An advanced variation of the set method for developing maximal muscular endurance. It is intended for advanced exercisers only because of its large training volume. Ten sets of ten reps each are executed with resistance equal to RM10, with a two- to four-minute rest between sets. The total is a hundred reps, with care taken to perform the exercise correctly and thus reduce the risk of muscle or joint injury. Some contend that it is not necessary to maintain the same high resistance throughout the training and the emphasis should rather be on performing ten reps in each set.

**The isometric method** – Based on static (isometric) contraction of the skeletal muscles against external resistance (wall, floor, or an especially heavy weight) or internal resistance (another muscle). There is no visible movement in the exercise. The exercise is performed at a number of angles (usually three to five) from the full range of action movement that we want to strengthen. Each of the contractions should be repeated five to ten times, each contraction held for eight to ten seconds. It is very important to maintain steady breathing when beginning and concluding the maximal exertion part of the exercise. Power is added specifically at the joint angles at which the exercise is performed; this is both an advantage and a disadvantage. The advantage is the improvement in power at the “sticking point” (the point in the movement at which the muscular action is stopped) but, at the same time, it does not improve movement performance. It is important to note that, in this method, blood pressure rises significantly more than in other methods; therefore, it is not recommended for older populations or for exercisers with high blood pressure.

Table 4.1. Training methods for developing power and muscular endurance

| TRAINING AIM                                                                                | EXERTION LEVEL                                                                          | NUMBER OF REPS PER SET | NUMBER OF SETS PER TRAINING      | TRAINING METHOD                                                                                                                                       | REST TIME BETWEEN SETS (in mins) |
|---------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|------------------------|----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|
| Developing maximal strength for sports requiring one-time explosive effort                  | Concentric work – medium to maximal exertion<br><br>Eccentric work – Maximal exertion + | 1–5                    | Advanced 5–8<br>Intermediate 2–4 | Sets, Supersets, Pyramid 5*85% 1*100%<br>Mixed set (eccentric, concentric, isometric), Isokinetic, the California set, Forced repetitions, Plyometric | 4–5                              |
| Developing maximal power and muscular endurance for sports requiring repeated maximal power | High intermediate to high exertion                                                      | 5–10                   | 2–6                              | Sets, Oxford, Superset, Pyramid: 8*75% 6*80% 5*85%<br>Super circuit<br>Split routine                                                                  | 3–5                              |
| Developing power and muscular endurance                                                     | Intermediate exertion                                                                   | 6–10<br>5–8            | 4–6                              | Regular sets<br>Berger<br>Deloram<br>Pyramid: 10*30%<br>10*40%<br>10*50%<br>10*55%<br>10*60%                                                          | 3–5                              |
| Developing muscular endurance                                                               | Intermediate-low exertion                                                               | 15–30                  | 4–10                             | Regular sets, Oxford, Circuit training, Stations                                                                                                      | 0.5–4                            |
| Developing power or muscular endurance for all sports                                       | Intermediate exertion                                                                   | 15–20                  | 3–5                              | Rounds,<br>Circuit training<br>Oxford<br>Training stations                                                                                            | 0.5–4                            |

\*Rest time between sets for developing power: up to three minutes; for developing endurance, up to one and a half minutes.

**The California set method** – Good for developing maximal power and explosive power. Exercisers perform one rep at RM<sub>1</sub>, rest, another RM<sub>1</sub>, and so forth until they cannot continue.

**The “cheating” method** – Focuses on developing muscle strength. We load on resistance greater than RM<sub>1</sub>; we snatch the weight beyond the “sticking point” of the muscle, and we conclude the exercise with great caution. In this way, it is possible to apply a high load on the strong part of the muscle, which is not possible in regular performance of the exercise.

**The forced repetitions method** – A variation of the set method. It is intended mainly for highly skilled and fit athletes seeking muscle hypertrophy. When exercisers reach the last rep

in the set that they are able to perform, an assistant helps them to move the weight past the maximal effort point, or alternatively, removes some of the weight. This is essential so that exercisers do not interrupt the effort flow.

**The negative resistance method** – Focuses on muscle strength. The resistance load is slightly higher than RM<sub>1</sub> in the eccentric stage of the movement (when the muscle lengthens). The latter is usually the return to the starting position. Some contend that optimal resistance for eccentric training of this type is 120 per cent of RM<sub>1</sub> since in this condition the muscle is still in control. This training is intended for highly fit athletes and exercisers. It is recommended that a “buddy” provide assistance to prevent injury. It should be

remembered that exercisers should be careful because one characteristic of this method is late muscle pain syndrome, especially before competitions.

**Station training** – Based on different work stations whereby work is performed for predetermined durations at each station with set transition times from station to station.

**The circuit training method** – Each apparatus usually serves as a station in the circuit. There are a number of variables: work duration, transition time from station to station, resistance intensity, and number of reps. Several components can be developed in this type of training: endurance, power, explosive power, and muscle strength. The method can be performed without apparatus (using body weight resistance) or with simple auxiliary aids such as a chair, stick, jump rope, or elastic fitness band. The method can easily be adapted to all exercisers according to their specific needs, physical fitness level, age, and gender. The number of possibilities is virtually unlimited.

**The super circuit method** – Develops muscle strength and cardiopulmonary endurance. We work on a given power exercise and immediately afterwards continue for the same amount of time with aerobic exercise. The same sequence is repeated. This can be used as a variation of the circuit training method.

**The isokinetic (variable resistance) method** – Work tempo remains constant but resistance is varied. Special isokinetic equipment is required to perform exercises using this method. These machines control resistance according to the changing joint angle throughout the movement. This ensures the same load on the muscle throughout the movement.

**The plyometric method** – Develops explosive power based on the muscle stretch reflex mechanism. Plyometric contraction is a type of eccentric contraction except that the contraction itself is preceded by a rapid lengthening (for example, when absorbing the shock of landing). This stimulates the stretch reflex in the muscle and heightens the intensity of the contraction. Stretching the muscle stimulates a stronger contraction. For example, after landing from a height with both legs together, we immediately leap forward to an even greater height. The landing lengthens the quadriceps which makes a stronger immediate contraction possible.

## 4.2. TRAINING METHODS FOR DEVELOPING JOINT FLEXIBILITY

Power training is characterized by a shortening of the muscles. If stretches are not included as a regular part of training, the result may be a long-term negative effect on range of joint movement, mainly a loss of range of joint movement and a decline in quality of movement and performance. Short muscles also cause pressure on internal body parts creating muscular imbalance; and, as a result, these points become highly vulnerable to pain. Shortened muscles reduce antagonist muscle tone which *delays* the development of muscle strength. Therefore, muscle training and flexibility training are mutually complementary. Good flexibility improves physical sport achievements and significantly reduces dangers of injury to the soft tissues: muscles, tendons, ligaments, spindles, and capsules.

Flexibility has many important advantages:

1. Reduces muscular resistance to movement.
2. Improves blood flow to and from muscles.
3. Improves and enriches movement variety and range.
4. Assists in the efficient utilization of power, speed, endurance, and energy conservation.
5. Helps to improve athletic performance.
6. Reduces risk factors for injuries thanks to range of movement and to large mobility “reserves” for muscles.
7. Creates muscle group balance.
8. Promotes muscular relaxation and reduces physical and emotional tension.

Before describing the most commonly used methods for developing flexibility, it is important to mention the factors that limit range of joint movement. Intrajoint factors are bone structure and joint type (e.g., ball-in-socket, hinge). Factors outside the joints include joint ligaments and bursas (which envelop the joints) and muscle length or volume. Other limitations arise from factors such as age, gender, temperature (internal and external), fatigue, emotional state, genetics, personality, and occupation. In addition, pathological factors, degenerative changes, traumatic damage and others have to be considered. During the life cycle, the human body secretes a diminishing amount of *hyaluronic* acid that serves as a lubricant for collagen, a protein important for

the connective tissues of the bones, cartilage, ligaments, and skin. As a result, more crossed connections are created that impair muscle lengthening and joint flexibility. In the absence of physical activity, the range and flexibility of joint movement decline significantly.

Since flexibility training has a positive effect on joint structure, it is important that all exercisers, and especially beginners (educate them properly from the start!), include flexibility training in each training unit. Flexibility training should entail a gradual work schedule that acts on each joint individually. It is recommended to work in a specific order so as to stretch most of the joints: for example, limb order (from top to bottom or vice versa) or starting position (standing, sitting, lying).

The main part of flexibility training occurs through *stretching exercises*. Exercise can be considered flexibility training when the stretches are in the maximal-optimal range (movement range without causing damage). At a lesser range, the work is defined as stretch training. Stretching exercises should be performed only after proper preparation (raising body temperature). Also, they should be performed gently to avoid invoking the stretch reflex that could cause damage. The most effective type is passive stretching performed with the assistance of a partner, whereby exercisers relax their muscles and the partner manipulates the body for the stretch. It is important to note that a muscle lengthens only in response to some factor outside the body. It can shorten by itself.

### *Three main methods employed to improve flexibility*

**The moderate static method** – Develops flexibility without mobility and is based on activating the joint in the maximal-optimal range slowly and continuously. Exercises make use of the weight of the limb and/or body part being worked on and/or the assistance of adjacent muscle strength to facilitate direct activation of the joint (without outside assistance). The training effect is relatively moderate, risk of tissue damage is small, and the method is considered very safe. The slow and continuous movement helps to overcome the stretch reflex. Critics of the method say that the lack of dynamic exercise delays the development of dynamic flexibility (requiring movement) needed in many athletic activities.

**The vigorous dynamic method** – Also called the “ballistic method,” is characterized by rapid, large, rhythmic movements when the antagonist muscles are stretched as a result of the actions of the agonists. It is based on activating the joint to maximal-optimal range by means of external force, for example by a partner, to increase joint tissue stretching. It is suitable for specific activities requiring activation of the joints in large movement ranges and at high speeds such as the strong leg swing in high jumping. The training effect is relatively high but care has to be taken not to activate the stretch reflex. Some trainers add music during dynamic stretches to encourage exercisers to continue to stretch their muscles and ignore the pain threshold. Warm-up before dynamic stretches is an absolutely essential. To minimize chances of damaging muscles and connective tissues attached to the joint being stretched exercisers employ physical self-control and do not deviate from optimal movement ranges.

**Proprioceptive neuromuscular facilitation (PNF)** – A method that helps to receive neuromuscular information, is also known in the professional literature as the “contract-relax method”: contract the agonist muscles and relax the antagonist muscles. It is based on a combination of passive stretching (by someone else), isometric or dynamic contraction, relaxation and repeated contraction. It is considered the most effective method for developing flexibility. Isometric contraction in maximal stretching facilitates high relaxation of the muscle because of the stretch reflex; therefore, it is possible to further expand the range of joint movement. PNF is usually performed in pairs: the exerciser performs isometric contraction with the partner’s assistance for a few seconds and then the exerciser releases the contraction. Immediately after muscle relaxation, the muscle is stretched to an even greater range. For example, pectoral muscles are stretched this way: starting position – exerciser “A” stands and extends his hands behind his back, as close as possible to shoulder height. He or she tries to perform horizontal adduction (hugging movement) of the arms in front of his or her body while exerciser “B” prevents him or her from doing so (the effort is isometric). After exerciser “A” relaxes, exerciser “B” holds exerciser “A”’s hands together behind his or her back while trying to raise them carefully to shoulder level. It is important to bring the agonist muscle (in this case the pectoralis) to a lengthened state. Isometric contraction is held six to eight seconds, followed by four to six seconds

of relaxation, and then muscle stretching for twelve to fifteen seconds. Each exercise should be performed four or five times with an eight-second pause between reps. As a result of the repetitions, it will be possible to see the pectoral muscles stretch so that exerciser “A” will finally succeed in interlocking his or her hands behind his or her back very close to shoulder height. Care should be taken during isometric contraction not to close off the air passages and not to damage tissues during stretching (see *Valsalva* phenomenon, see pp. 99–100 under “My Body and the Self in the Gym”).

### 4.3. TRAINING METHODS FOR DEVELOPING CARDIOPULMONARY ENDURANCE

Cardiopulmonary endurance training assists in many physical changes:

1. Thickening and growth of the heart muscle. Beat volume increases along with the amount of oxygen-rich blood that is transferred to the body from the left ventricle with each contraction of the heart muscle. This is evidenced by a lower resting pulse.
2. The creation and opening of new capillaries (hyperplasia).
3. Increase in blood volume. A normal person has about four and a half to five litres of blood. High-level endurance athletes can increase their blood volume to eight litres.
4. Lengthening and thickening of blood vessels. Endurance athletes recover faster from injuries because their network of blood vessels is more developed and their blood reaches many more parts of the body.
5. Improved oxygen intake.
6. Larger glycogen stores in the muscles and liver (see p. 344 under “Nutrition and Physical Activity”).
7. Psychological changes, a feeling of self-fulfillment and greater self-efficacy.

#### *Main characteristics of pulse ranges*

The training aim is determined according to the pulse ranges. Training methods for developing cardiopulmonary endurance encompass six pulse ranges:

**Recovery** – Pulse ranges from 25 to 50 per cent of maximum.

Training conducted at this pulse range does not constitute a significant stimulation threshold for body systems because the effort level is low and the training effect is, therefore, negligible. At the same time, work in this pulse range after power training at a high exertion level is recommended for the cool-down stage of the training unit.

**Moderate physical activity** – Pulse ranges from 50 to 60 per cent of maximum. Training in this pulse range entails an intermediate exertion level, which exceeds the daily stimulation threshold and can improve endurance. This type of training emphasizes duration more than the other fitness components. An example of its use is long, slow distance running. This type of training is important for gym activity: exercisers working on high resistances for developing maximal power have to be able to lift the weights many times. In order to perform the extra lifts, their recovery capability between lifts has to be good. This can be acquired through training at the moderate physical activity pulse range. The endurance level acquired through this training is especially beneficial for initial warm-up before exertion, as well as in the cool-down process after a training session.

**Aerobic fitness threshold** – Pulse ranges from 60 to 70 per cent of maximum. Training at this pulse range is characterized by an intermediate level of exertion for a long duration. Its advantages become evident in improved heart beat volume and in the body systems’ greater ability to persevere over time in aerobic exertion. In the gym, activity at this level is the way to improve the fitness components of muscular strength and endurance. This type of training is also effective for losing weight since its main source of energy is fat.

**Aerobic activity** – Pulse ranges from 70 to 80 per cent of maximum. Training at this pulse range is characterized by an intermediate to high level of exertion and in significant activation of the respiratory system. Session duration is long and at steady state. The pulse rate stabilizes in the aerobic range and remains steady. The energy required for this activity comes from the aerobic metabolism pathway whose main source of energy is fats. At the same time, towards the 80 per cent threshold of maximal pulse, the anaerobic metabolic pathway also “kicks in.” The energy source for this is carbohydrates (see p. 321 under “Nutrition and Physical Activity”). As long as the activity is mainly aerobic, it can be continued for a long time since the body is able to remove the lactic acid concentrations more efficiently than in the anaerobic pathway. Aerobic activity is a step up from the

preceding two pulse levels and it turns the amateur exerciser into an advanced exerciser, with the potential for greatly improving aerobic capacities and not just maintaining fitness on the back burner.

**Anaerobic threshold** – Marks the pulse range of 80 to 90 per cent of maximum. Training at this range is at a high level of exertion for medium duration and is characterized by a transition from aerobic to anaerobic exertion. The anaerobic threshold marks the exertion point in which lactic acid concentrations begin to increase seriously in the muscle. The acid accumulates here and then moves into the blood. The accretion of lactic acid in the blood limits muscle contraction (a feeling of cramped muscle) and slows down activity. As activity intensity rises, the part that oxygen plays in supplying energy decreases and the anaerobic system for creating energy goes into action, secreting lactic acid to the muscle. The anaerobic threshold is reached mainly in very long races such as the half or full marathon. Recovery after activity at the anaerobic threshold is longer than at exertions at the preceding ranges.

**Anaerobic range** – Reflects 90 to 100 per cent of maximal pulse. Training at this pulse rate is as hard as possible and entails a high to maximal level of exertion. At this level, exercisers reach VO<sub>2</sub>max and improve their anaerobic threshold range. This means that they are able to train at higher pulse rates without lactic acid levels rising to the point that they have to slow down or stop their activity. The tremendous energy required for anaerobic range activity is produced from both the anaerobic pathway (burning carbohydrates) and from the aerobic pathway (burning fats). Towards the peak of the anaerobic range, the aerobic pathway for producing energy often cannot keep up with the body's demands and exercisers incur an oxygen debt. The fitness components employed in this pulse range are explosive power, high speed and endurance-speed. It is important to emphasize that activity in the anaerobic range is not recommended for everyone; it is mainly for athletes from sports such as weightlifting, or sprinters wishing to improve their competitive achievements.

In sport and physical activity, it is important to define the pulse range in which we want to train, that is, the endurance and exertion levels that we want to emphasize, according to our abilities, needs, and aims.

#### 4.4. SELECT METHODS OF DEVELOPING CARDIOPULMONARY ENDURANCE

**The sequence (marathon) method** – A classical training method at an intermediate exertion level in the moderate or aerobic activity pulse ranges. Training duration is very long and maintains a steady pulse rate; at the highest levels of the session it is at steady state. The emphasis in this type of training is the basic exertion factor *duration*. This method is good for building basic fitness or for specific training in long-duration activities such as long slow distance running, races, marches, swimming laps, or bicycle races.

**The Fartlek method** – Extended aerobic training that integrates natural obstacles such as inclines, muddy terrain, with changes in the basic exertion factor *speed*. What is special about this method is the “jump” between pulse ranges: it varies from occasional declines to the aerobic threshold range and occasional increases to the anaerobic threshold range. The training is usually performed outdoors and may entail running in forests or on hills, swimming in the ocean, riding mountain bicycles, etc. Some aerobic apparatus in the gym also offer training programs that simulate the method (usually called *Random*). The emphasis in Fartlek is on duration as well as on varying exertion levels. The basic pulse rate should remain steady, except for pulse rises when changing speeds or when negotiating specific obstacles. Changes in speed and clearing hurdles can be unplanned, that is, dictated by field conditions or mood. The method is suitable as the basis for building the physical fitness that athletes need when they begin the actual training season. Fartlek is used in many sports such as swimming, kayaking, running, bicycling, and skiing.

**The expanded interval method** – Extended training at the aerobic or aerobic threshold pulse range at an intermediate exertion level. Training consists of structured transitions between two predetermined pulse rates separated by a small differential, for example, a lower pulse threshold of 130 beats per minute (bpm) and a higher one of 170 bpm. The rates and the small differential between them assure short intervals. Exercisers perform activity for a predetermined time period at the higher pulse rate and then take a break (interval). When the pulse reaches the lower threshold, they return to the more strenuous activity. This pattern is repeated any number of times. The rates can be from the aerobic or the anaerobic threshold, or from both, as long as the differential between them is small. This method accurately controls all

Table 4.2. Adapting training stimuli to exercisers

| TRAINING AIM / PULSE RANGE                        | TRAINING DURATION   | AVERAGE PULSE RANGE IN BEATS PER MINUTE | EXERTION LEVEL     | TRAINING METHODS                                                                              | RECOVERY TIME BETWEEN TRAINING SESSIONS |
|---------------------------------------------------|---------------------|-----------------------------------------|--------------------|-----------------------------------------------------------------------------------------------|-----------------------------------------|
| Recovery                                          | Up to 35 min        | Less than 120                           | Intermediate – low | -Sequence<br>-Aerobic training in gym                                                         | 0                                       |
| Moderate physical activity                        | 45 minutes and more | 120–140                                 | Intermediate       | -Sequence<br>-Circuit training<br>-Aerobic training in gym                                    | About 6 hours                           |
| Aerobic fitness threshold                         | 30–60 minutes       | 140–160                                 | Intermediate       | -Sequence<br>-Circuit training<br>-Expanded intervals<br>-Aerobic training in gym<br>-Fartlek | About 12 hours                          |
| Aerobic activity                                  | 20–40 minutes       | 160–170                                 | Intermediate-high  | -Sequence<br>-Expanded intervals<br>-Fartlek<br>-Circuit training<br>-Aerobic training gym    | 12–24 hours                             |
| Anaerobic threshold                               | 12–16 minutes       | 180+                                    | High               | -Intensive intervals<br>-Fartlek<br>-Aerobic training in gym                                  | 24–36 hours                             |
| Anaerobic (VO <sub>2</sub> max + endurance/speed) | 4–8 minutes         | Maximal                                 | Maximal            | -Repetitions<br>-Aerobic training in gym                                                      | 48–72 hours                             |

training factor elements: rate, intensity, duration, and type (e.g., jogging, stretches, and power exercises) and number of repetitions. Pulse rates rise and fall “rectangularly” and there is full control over the desired pulse level. To carry out this method properly, exercisers should be equipped with a strap-on pulse meter (see the illustration on p. 292 under “Aerobic Apparatus”).

**The intensive interval method** – More difficult than the expanded interval method and is performed only in the anaerobic

threshold pulse range. It is based on the same principle of two predetermined pulse rates but here the differential is greater. Since higher pulse rates are used with a higher differential, duration is longer to partial recovery, that is, until the higher pulse drops to the lower threshold. If in the extensive interval method load intensity is low and the interval is short, in the intensive method load intensity is at high to maximal exertion level and the intervals are longer. The use of a lower pulse rate of 120 bpm and the higher

rate of 190 bpm is an example. This method is suitable for building specific fitness in sports that requires aerobic activity at high speeds. It is employed as preparation for many different sports.

**The repetition method** – Similar to the intensive interval method but the intervals in this method are longer and become recesses (full recovery). The load segments are very short but at maximal exertion level, and there is time for a long, full recovery. Under certain conditions, the method can also serve as intermediate short-range endurance training. The aim is to combine the fitness components of speed and power, and not only work on endurance training. The method is suitable for those engaging in various ball sports.

**The circuit training method** – Training usually in the range of aerobic pulse rate. This method uses activity stations with diverse physical tasks such as skipping rope, push-ups, jogging, sit-ups, running, and dribbling. Activity at the stations is carried out at a relatively moderate rate with sequential transitions from one station to the next. This method assures a relatively high mean pulse, and pulse rate increases during activity at a station and decreases during the transitions. It is possible in circuit training to drill a number of fitness components; this combination helps to improve cardiopulmonary endurance. Organizationally, circuit training allows a large number of exercisers to keep busy at the same time on a broad variety of physical fitness components.

**Aerobic training in the gym** – This is similar in nature to circuit training and is performed on the aerobic apparatus in the gym. There is also the possibility of integrating and alternating power and aerobic exercises – for example, skipping rope, chest presses, cycling, sit-ups, light running on a treadmill, and push-ups using the upper pulley. The great advantage of this training is the adaptation to all pulse ranges according to the training programs on the aerobic equipment. The emphasis in this training is on a sequential transition from one activity station to the next, or at least avoiding long rests between them, so that pulse rates do not decline to resting levels.

## 4.5. WARM-UP METHODS

Warm-up prepares all of the body's systems for strenuous activity, both physically and mentally. Physically, it is the "preparatory" or "arousal" stage of the training unit,

reducing risks of microscopic tears and inflammations in the various components of the kinesthetic system. Warm-up has two main parts: aerobic activity and stretches. *Aerobic activity* raises both body temperature and pulse rate. *Stretching exercises* improve range of joint movement and prepare the skeletal and muscular systems for the exertion expected in the training session. The emphasis in stretching exercises is on increasing range of joint movement by stretching the muscles enveloping the joint. During and after stretches, the diameter of the vessels leading blood into and out of the stretched muscle increases, enhancing blood supply and accelerating waste removal.

Warm-up is generally divided into two types according to the aim of the training program:

### *General warm-up*

General warm-up usually lasts about half an hour, of which about twenty minutes are devoted to moderate physical activity and another ten minutes to specific stretches. The aerobic activity has no special emphasis in terms of exertion factors (e.g., rate, incline, resistance).

### *Specific warm-up*

Activity time for specific warm-up varies from ten to forty minutes, according to the nature and overall aim of the training session. Specific warm-up does what its name implies – it focuses on the aim of the specific training program. For example, if exercisers want to develop their body and increase muscle mass, the aerobic segment is limited to ten minutes of low intensity activity and the emphasis is on stretching relevant muscle groups and is relevant to the expected training drills (see below). Some exercisers also integrate weightlifting at low exertion levels as part of the gradual build-up of the training session and as preparation for the training stage.

Many exercisers are aware of the importance of stretching exercises but do not know the timing and methods of performing them. Stretches can be performed before aerobic activity but their effectiveness is lower. Stretching exercises should usually be performed after exercisers have raised the body temperature, pulse,

and metabolism rate. In this state, they are readier to improve their range of joint movement and to stretch soft and muscle tissues. When muscle temperature rises, muscles become more elastic, their mechanical efficiency increases, and nervous impulses are conducted more effectively. It is recommended that about twenty different stretching exercises are performed for the various muscle groups (Alter, 1990; Anderson, 2005). The order of stretching exercises, top down, or vice versa, is not important as long as care is taken to stretch each muscle group, but one should be efficient in procedure (i.e., not up-down-up-down). A series of stretches should be performed for each muscle group, with an emphasis on those muscle groups that we intend to use most extensively in the training stage.

Stretching exercises should be performed gently and slowly. Each position should be held for an average of ten seconds.

#### 4.6. COOL-DOWN METHODS

Cooling down is an essential stage of each training unit. In terms of reducing risk factors of injury, this stage is no less important than warm-up. Cooling down is often called the “muscle release” stage since it marks the end of the training stage and a stage of relative “freedom” for the muscles. A more apt term would be *recovery and relaxation*. Muscular relaxation is one of the components of coordination, one of the five basic physical fitness components. Even so, it is almost completely forgotten during physical activity in the gym, which usually does not have apparatus for improving muscular relaxation (such as biofeedback equipment). At the same time, most gyms have a quiet corner suitable for relaxation. The relaxation or cooling down stage is generally composed of *active relaxation* that usually includes movement, flexibility, or breathing exercises, and *passive relaxation* that is performed while lying down and that raises awareness of the body’s progressive relaxation.

Relaxation or cooling down has three main aims:

1. To reduce muscle tone.
2. To decrease the activity level of various body systems.
3. To lessen emotional tension.

#### *Reducing muscle tone*

Training in the gym has the general effect of raising muscle tone, pulse, and blood pressure levels as other body systems become more active. When these activities cease, levels have to return to their normal state, called “homeostasis” (the body systems’ aspiration for balance). During cool-down, we gently stretch the agonist and antagonist muscles contracted during training in order to lengthen them. Shaking active limbs helps to increase the flow of oxygen-rich blood to fatigued muscles, assists in neutralizing lactic acid build-up, and lightly warms muscles after their activity.

#### *Decreasing activity level of various body systems*

If the aim of warm-up preceding training is to raise temperature and pulse levels, cooling down is intended to lower them and to remove the lactic acid that has accumulated in the muscles. The difference between the aerobic activity performed during warm-up and during active relaxation is in duration and intensity. During cool-down and active relaxation, blood supply to various muscle groups improves. To this end, cool-down should begin with five to fifteen minutes of light aerobic activity. After this activity, we should again perform a series of stretches; this time the purpose is to improve ranges of joint movement that decreased because muscles shortened during the training stage. Such activity can also be performed outside of the gym as long as it is immediately after the training.

#### *Lowering emotional stress*

In addition to the contribution of cooling down to physical recovery and improved range of movement after training, it also contributes significantly to mental wellbeing. Relaxation is essential for gaining feelings of self-control, calm and tranquillity, clear thinking, focus of attention and *joie d’vivre*. Working against resistance and various loads, characteristic of the training process, creates feelings of physical heaviness and emotional stress – and it is important to remove ourselves from this “pressurizing” feeling before returning to “normal”

life. Relaxation helps greatly in neutralizing nervousness and allows more “positive energies” to flow through the body. The combined pressures, tensions and angers we are exposed to in our lives have been shown to raise risk factors of heart disease, headaches, backaches and insomnia, and in some extreme cases of emotional crises, depressions and suicidal tendencies. Relaxation in its many forms allows us to cope more successfully with stress and its side effects. Exercisers who practice relaxation regularly develop a generally positive approach – they learn to cope with, and control, the stress factors in their lives. Extensive literature on the subject is readily available.

### *Selected methods of cooling down and muscle relaxation*

The cool-down and relaxation stage of the training unit has three parts: the first two – moderate aerobic activity and stretches – are more active. The third entails implementation of one of the relaxation methods, which are usually passive. The following methods refer only to the third and final part of the relaxation and cooling down stage. It is important to note that most of these methods can be practised as independent relaxation units, especially for exercisers who appreciate the mental contribution of relaxation. All of these relaxation methods share a number of basic principles:

1. Quiet surroundings – Absolute quiet or calming background music.
2. Comfortable position – Usually supine.
3. Concentration and attention – Internal attention to a specific process such as breathing.
4. A subject to deal with – An idea for concentration.
5. A subject to resolve – Finding solutions through mental activity.
6. Passive approach – “Letting go,” not undertaking any physical activity, letting the body rest and “fall” with gravity.
7. Closed eyes – The light hitting the optic nerve while our eyes are open stimulates it, interfering with relaxation and acting as an arousing force. Closing eyes also frees the eyelid muscles from their daily effort, intensifies the sensations of introspection and enhances the effectiveness of relaxation.

Relaxation methods are divided into two main groups: methods used before a test or competition, and general methods.

### *Methods used before a test or competition*

**Positive thinking** – Widely used by athletes, mainly in the final moments before competition. Athletes concentrate their thoughts on positive images, that is, they stimulate and centre themselves on optimistic thoughts about their chances of success.

**Mental training** – Athletes imagine the performances they are supposed to perform in various situations (such as a ground exercise in gymnastics or a high dive). At first, athletes picture themselves performing the action. Later, they imagine the same action, this time as observers from the side (as if watching a video). This method is believed to help improve technical skills.

### *General relaxation methods*

**Autogenic training** – Based on mental drills: in each one, individuals enter a state of high concentration on their body limbs and the processes taking place. In the first exercise they concentrate on the feeling of weight in the limbs; in the second, on the feeling of heat in the limbs; in the third, on regulating heart rate, and in the fourth, on passive concentration on breathing.

**The Jacobson method (progressive relaxation)** – Patients come to understand the differences between a relaxed and a contracted muscle. Patients lie comfortably on their back, contract and relax their body muscles in a logical order from the top down (i.e., head, face, neck, and so on). Each contraction lasts from four to six seconds.

**Biofeedback** – Perhaps the most advanced relaxation method in use today. Patients are directly attached to an electronic instrument that gives them immediate, ongoing information about biological activities in the body. It teaches individuals to become aware of the effects of their movements on internal body processes such as perspiration and pulse rate, as well as of ways to control muscular tension in various parts of the body. Biofeedback is provided by one or more instruments, each working on a different body system, heightening awareness of feelings of calm, pressure, tension,

etc. This method is used for relaxation based on the principle that reducing levels of physiological activity in a certain place or specific system also induces other bodily systems to relax. The use of biofeedback is still in its early stages, but research is slowly discovering its many physiological and psychological benefits such as general relaxation, lowering high levels of muscular tone, and reducing anxiety.

**Yoga** – A method from the Far East. Those who practice yoga try to separate mind and body, concentrating on their breathing process and performing physical relaxation, thus, reducing both emotional and muscular tension.

**Guided imagery** – Used by many for a variety of purposes.

Physical and emotional relaxation can be achieved by “living through” descriptions of calming panoramic views and focusing thoughts on relevant feelings, for example, walking along the beach and paying close attention to the colour of the sky and sea, the salt air smell, the sound of the waves breaking and the feeling of the sun beating down.

**Massage** – Relaxation can be attained through external means such as massage, warm baths (including whirlpool baths) or mechanical instruments that stimulate blood flow and the removal of waste products.

**Meditation** – A method from the Far East known to reduce tension, anxiety, and fatigue, and imbue users with physical and psychical calm, and serenity. It heightens attention and improves human relations. In some methods, exercisers concentrate on repeating one specific word (a mantra) while maintaining a comfortable and relaxed position.

# 5: THE BODY AND THE SELF IN THE GYM

The illustrations included in the following chapters denote the correct and safest positions for performing the exercises. Obviously, the potential physical and emotional benefits derived from gym activity are equal for both men and women. Some ergonomic and health tips are also included. For greater satisfaction, knowledge, and enjoyment, and to reduce risks of injuries and damage, it is recommended to adopt the holistic approach as one performs each exercise.

## 5.1. THE EXERCISE DESCRIPTIONS

The order of exercises in Chapters 6 to 12 was determined by looking at the body from the front, bottom to top (legs, abdomen, chest, arms, forearms, shoulders), and then from the rear, from top to bottom (shoulders, back, and buttocks). The exercises are arranged from easy to difficult so that basic exercises are presented at the beginning of each chapter, followed by more advanced exercises. Chapter 13 presents a number of exercises for developing power using special multipurpose apparatus designed to develop muscle groups. Chapter 14 provides an explanation of the aerobic apparatus employed in the gym, including special features and the various programs they offer.

Each exercise includes a description of correct execution and useful hints for preventing potential injury. Special attention is given to the *Start-/end-position*, *Range of movement and performance*, and *Movement analysis*.

**Start-/end-position** – The position of the body as the exercise begins and ends. The illustration gives a visual reference point for assuming the proper position, and exercisers who carefully imitate these positions are able to perform the exercises cleanly without damage and with minimal risk of injury.

**Range of movement and performance** – The proper way the exercise should be performed with additional safety emphases including optimal range of movement and tempo or rate of activity. The descriptions make use of the basic terminology as defined previously (see pp. 55–59 under “Basic Concepts in Physical Fitness Theory”).

**Rate of work** – The internal count you should adopt for breathing during the activity. The “4-count” refers to concentric muscular work, usually during exhalation. The “6-count” refers to eccentric contraction of the muscle, usually during inhalation. It is recommended to adhere to the rate differentials for concentric and eccentric work.

**Movement analysis** – The dominant muscle groups participating in the activity and the manner in which they contract from the start-/end-position to the mid-position and back. The description reviews the joints in which the movement occurs. The movement analysis differentiates between three types of muscular contractions:

**Concentric contraction** – The effort made while the main muscle is shortening (contracting).

**Eccentric contraction** – The effort that is made while the main muscle is lengthening.

**Isometric contraction** – Mentioned occasionally, refers to effort made with no change in muscle length.

In preparing to perform the exercises, we should first differentiate between two key concepts:

**Axis of action** – Occurs on the apparatus itself. This is the axis on which a resistance arm has been attached that we operate during the exercise.

**Axis of movement** – Occurs in the exerciser's body and refers to the joint of main muscles where the action takes place. It is recommended to have the axis of movement face the axis of the action during performance of the exercise, wherever possible, for optimal concentration of the load on the relevant muscles rather than overloading the joint.

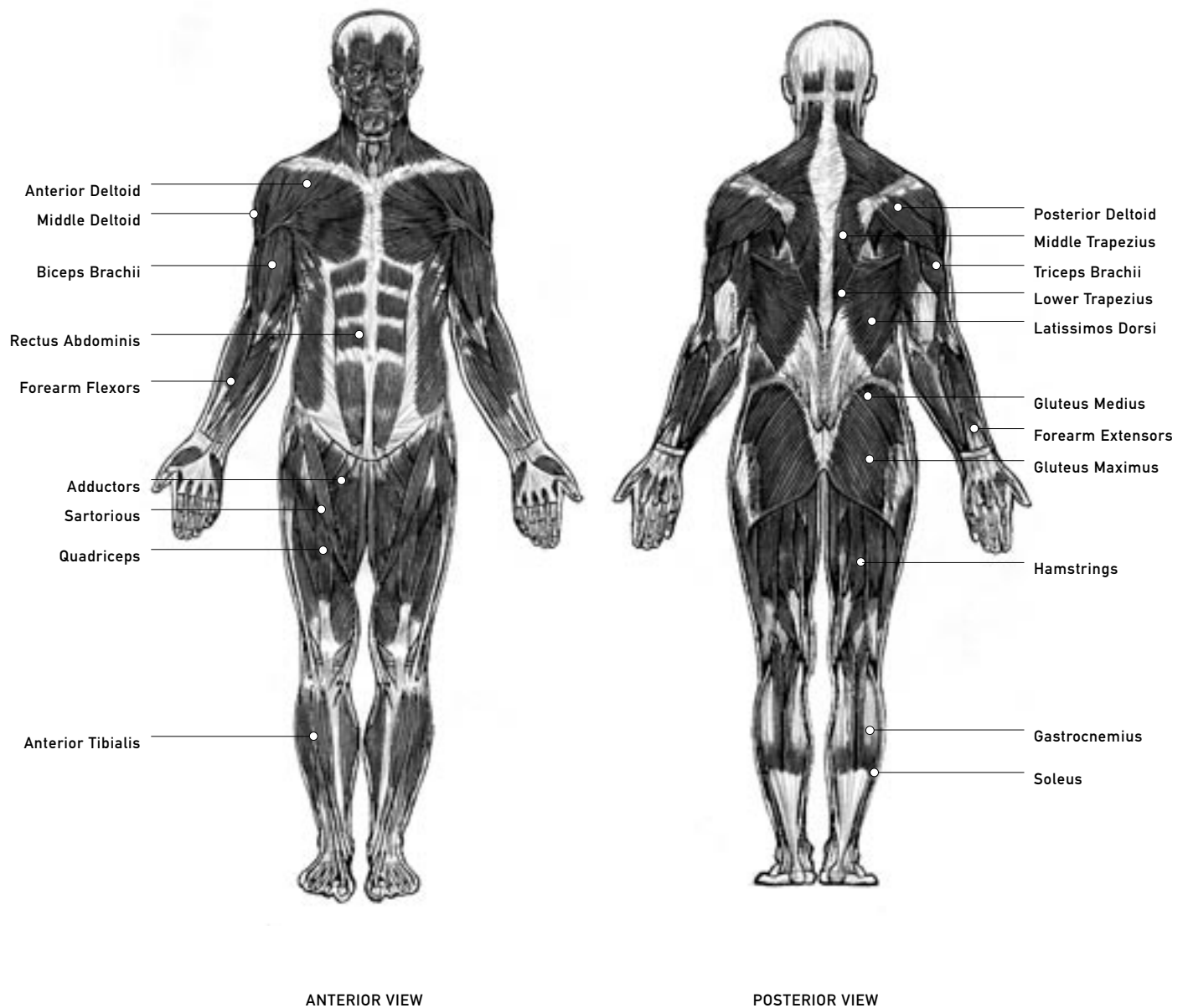
In multi-joint exercises that involve a number of joints in a movement at the same time, an effort should be made to arrange all the active joints and the action axis as close to one straight line as possible.

Descriptions of various body parts make mention of the following terms:

1. **Cervical vertebrae** – Seven very delicate vertebrae in the neck, designated by the letter “C.”
2. **Cervical lordosis** – The natural concavity of the neck in the area of the cervical vertebrae.
3. **Overarching cervical lordosis** – A movement that stretches the cervical lordosis beyond its normal curve.
4. **The seventh cervical vertebra (C7)** – The bottommost of the cervical vertebrae, characterized by a prominent projection at the base of the neck. It is easy to feel this bump, which is why it is used as a place marker.
5. **The shoulder girdle** – The area of the body across both shoulders.
6. **The trunk** – The whole body including back, abdomen, chest and shoulder girdle.
7. **The sternum** – The chest bone to which the ribs are attached.
8. **The lumbar vertebrae** – Five spinal vertebrae in the waist (lumbar) area, designated by the letter “L.”
9. **Lumbar lordosis** – The natural concavity of the lumbar vertebrae.
10. **Overarching lumbar lordosis** – Arching that goes beyond the natural lordosis in the area.
11. **The coccyx (tailbone)** – The lowest bone in the spinal column.
12. **The patella** – The prominent bone covering the front of the knee.

## 5.2. SKELETAL MUSCLES

Illustration 5.1. Anterior and posterior views of the external skeletal muscles.



5.3. BODYJOINTS

Illustration 5.2. Movement analyses of the exercises will be described according to the joints.

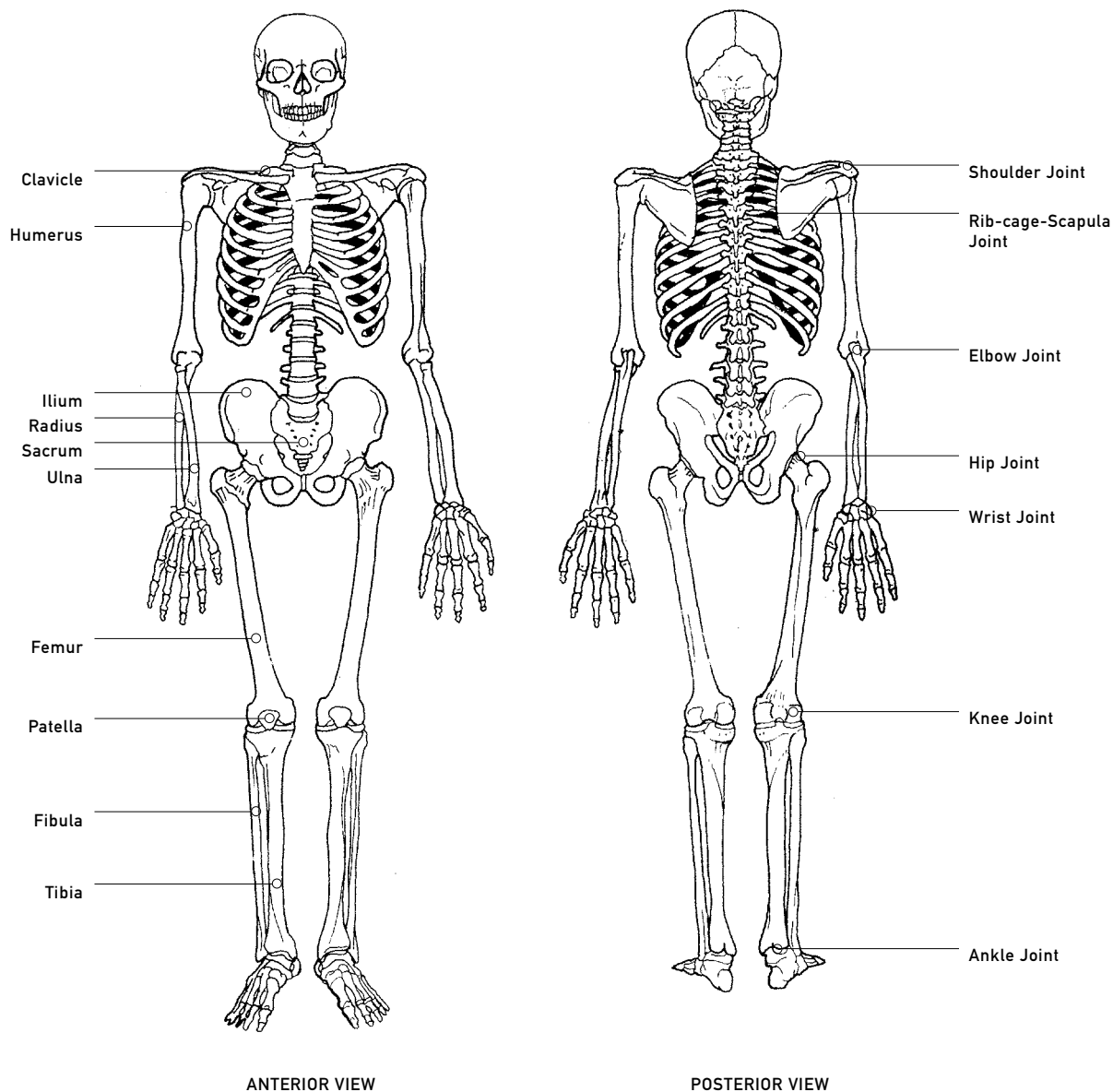


Illustration 5.3. Spinal Column: Posterior View.

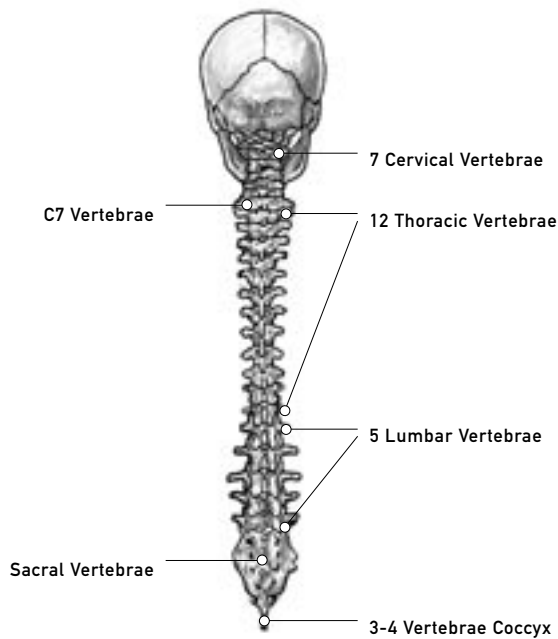
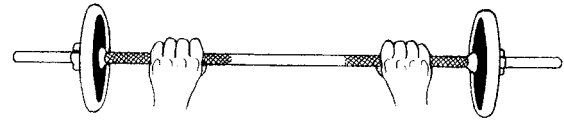
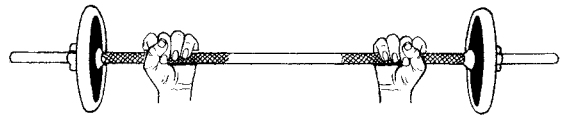


Illustration 5.4. Different types of grips.



a.) Closed Overhand Grip



b.) Closed Underhand Grip



c.) Mixed Grip

## 5.4. TYPES OF GRIPS

Descriptions of exercises that entail holding a bar include the type of handgrip recommended. Each grip is for a different objective and purpose. The following descriptions include the most common types of grips:

1. **Shoulder-width grip** – Hands are approximately shoulder-width apart. Unless otherwise noted, this is the type of grip to use.
2. **Narrow grip** – The distance between hands is less than shoulder-width.
3. **Broad grip** – The distance between hands is greater than shoulder-width.
4. **Overhand grip** – The bar is held with thumbs facing each other.
5. **Closed grip** – The bar is held so that all the fingers wrap around the bar and the thumbs complete the wrapping on the other side of the bar. (See Illustration 5.4a.)
6. **Open grip** – The bar is held so that all the fingers except the thumbs wrap around the bar. The thumbs are held away from the bar and do not touch it.
7. **Underhand grip** – The bar is held so that the thumbs face in opposite directions. (See Illustration 5.4b.)

8. **Mixed grip** – The bar is held with an overhand grip with one hand and an underhand grip with the other. Also called “alternating grip.” (See Illustration 5.4c.)

## 5.5. GENERAL RECOMMENDATIONS FOR TRAINING IN THE GYM

In Chapter 4, we noted the physical and psychological differences between trained and untrained individuals. To obtain the benefits of working out, exercisers should follow a number of recommendations:

1. It is always better to choose enjoyable activity so as to maintain motivation.
2. Exertion should alternate between aerobic (for developing cardiopulmonary endurance) and anaerobic (for developing power endurance) activities.
3. It is important to vary aerobic activities (e.g., running, bicycling, stair stepping).
4. It is preferable to focus on non-competitive activity. Avoid aggression, unethical behaviour and other negative “unsportsmanlike” characteristics of sport and competition.
5. It is recommended to work at 30 to 60 per cent of maximal ability (depending on the fitness component and the exerciser’s level).
6. Activity duration should range from one to one-and-a-quarter hours, at least three times a week.

## 5.6. TECHNICAL RECOMMENDATIONS FOR EXERCISING IN THE GYM

Training technique is crucial for ensuring training effectiveness and achieving goals. Therefore, the following guidelines should be adhered to:

**Controlled work pace** – Training effectiveness requires working at a slow and controlled pace. Throughout each movement, exercisers should control resistance (the weight being lifted) and not let the weight pull them, especially in the eccentric action stage of the movement. Working at a slow and controlled pace helps to increase power and reduce risk of injury. Be sure to count four or six beats per movement. Training slowly enables exercisers to achieve the most benefit, both in terms of effectiveness (it adheres to the

principle of overload) and safety. This recommendation does not apply to training for greater “explosive power,” which emphasizes speed. For explosive power, care should be taken to warm up properly beforehand in order to reduce the chances of physical injury.

**Isolating specific muscles for exercising** – For training to be effective, it is essential to activate only those muscles we want to develop in a given exercise. Many exercisers forget this basic rule and use swinging momentum and movement compensation from other muscles, mainly trunk movements to complete their activity. Such exercise is not effective and may also be harmful. Overcoming high resistance in this manner is a form of cheating ourselves, since the muscles we are trying to develop are actually working against much less resistance than we think they are or that they need.

### **Maintaining regular breathing versus holding one’s breath**

– While performing exercises, the type of movement determines the form of breathing. Expanding the chest during activity is the time to inhale and contracting the chest is the time to exhale. This distinction is important because it is usually thought that we always have to exhale during the exertion stage. But that’s not the case when the exertion stage includes expanding the chest, such as in “Dumbbell lateral raise” (see exercise 10.5). We may experience the “*Valsalva manoeuvre*,” when we hold our breath, especially during exertion. This is a dangerous phenomenon that entails a temporary stoppage of blood supply to the brain caused by contraction of the diaphragm and closure of the throat. The result is dizziness, red face and, in extreme cases, fainting and loss of consciousness. Proper breathing during exertion prevents the Valsalva manoeuvre.

### **Keeping action axis (machine) and movement axis (active joint)**

**parallel** – In all single-joint exercises (where only one joint is involved in the movement), the action axis should always face the movement axis. Lack of parallel placement makes it impossible to complete the movement. Subsequently, resistance is not uniform, performance of the movement is inefficient, and load on the joints is excessive. Therefore, make sure that the action pivot faces the movement axis or is as parallel as possible.

### **Knowing the apparatus and adjusting it to the body dimensions**

– There are many types of apparatus that can be adjusted to individual exercisers and their physiques. Frequently, even experienced exercisers may not be familiar with the various options the apparatus offers, or ways to make adjustments

for individual use. For example, knee extensor equipment enables exercisers to move the backrest further back so that the action axis (in the machine) can be adjusted to the movement axis in the knee. It is also possible to alter the position of the resistance arm along the lower leg. Lack of operating knowledge may cause both short- and long-term damage. It is also not recommended to find “creative” movement uses for machines that compromise safety. Familiarize yourself with the options of each machine and organize yourself accordingly!

**Maintaining optimal range of movement** – Movements should be made in the proper direction and with the correct range. During all types of movement, it is important to avoid deviating from the desired range of movement (which is usually towards excess). Moving beyond the correct range often means involving muscles not relevant to the given exercise and is undesirable energy expenditure. Furthermore, there is a danger of wearing away cartilage (usually located at the ends of the bone) by locking joints (i.e., attaining full extension). On the other hand, too short a range of movement should be avoided because it does not utilize potential power. According to the biomechanical “muscle length–tension curve” principle, the more optimal muscle length, the greater the potential to develop force. If a muscle is held too short or too long, its ability to develop force diminishes.

**Maintaining movement symmetry** – When holding a bar with both hands at the same time, it is sometimes possible to discern movement asymmetry; for example, when pulling upper pulleys or doing chest presses. Most exercisers have a dominant side (right or left), which is reflected in daily activities as well. It is possible, in high loads, to see one dominant hand doing more than half of the pulling (the upper pulley) or pressing (in bench press). Allowing this dominance results in movement asymmetry, which leads to disproportionate development of the two sides of the body. Therefore, it is important to maintain movement symmetry while performing all exercises.

**Maintaining postural symmetry** – Performing exercises that activate both sides of the body simultaneously requires symmetrical posture. When performing squats, for example, lack of symmetry in foot placement causes higher loads on one side of the back. When working on aerobic apparatus that use pedals, such as E.F.X. (Elliptical Fitness Crosstrainer), feet should be placed at identical distances on either side of the action axis. Certain situations during the

exercise, such as bending the trunk, turning the head and pushing one leg out, increases postural asymmetry.

**Straightening wrists in press exercises** – During chest press exercises, many exercisers tend to “break” the wrist (creating an angle between the wrist and forearm). Combined with high pressure on the nerve roots in the joint, this may cause inflammation. Therefore, it is important to maintain fully extended wrists as a continuation of the forearms. During presses, be sure that the bar rests on the pad of the palm near the thumb and that all the fingers, including thumb, are on one side of the bar. A full grip with all fingers, including thumb, increases the hand surface area used and reduces wrist joint load.

**Using auxiliary leg-rests** – For most types of apparatus equipped with auxiliary *leg-rests*, the apex of resistance is at the beginning of the movement. In order to avoid high loads on joints and tendons at the start of the activity, the apparatus supplies an auxiliary leg-rest to reduce the load; for example, when performing *sitting presses*. Not using the leg rest at the beginning and end of the activity causes unduly high loads on the joints and tendons and may lead to avoidable injuries. In some cases (mainly among older exercisers), it is not possible to get into the starting position without using the auxiliary leg-rest because of limited range of movement of the joint.

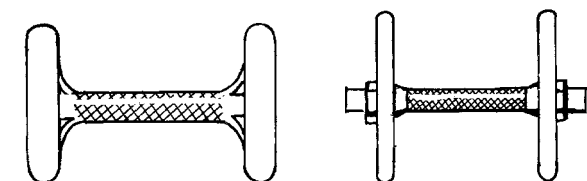
**Using a back support belt only when needed** – The first and foremost purpose of the *back support belt* is to prevent air pressure that builds up in the chest during exertion from moving into the abdominal cavity. The belt also reduces the pressure on the lower back and the risk of hernia. In addition, the belt prevents back vertebrae from being crushed and also helps to maintain distance between vertebrae to prevent a herniated disc. A belt should be used only when the load is vertical and the work is on the lower extremities or in exercises where posterior pelvic rotation is impossible, such as in Barbell squat (exercise 6.4), Bent leg *deadlifts* (exercise 6.12), or Good morning (exercise 11.9). Using the belt when it is not necessary weakens the postural muscles (abdominals and *erector spinae*). Furthermore, the belt does not allow the important posterior pelvic tilt movement. Therefore, it is important to strengthen the abdominal and other stabilizing muscles to avoid developing a dependence on the belt or to use the belt as a substitute for stabilizing muscles.

# 5.7. FREE WEIGHTS

## Types and Characteristics of Free Weights

There are two main types of free weights: cast weights and adjustable weights.

Illustration 5.5. Types of free weights.

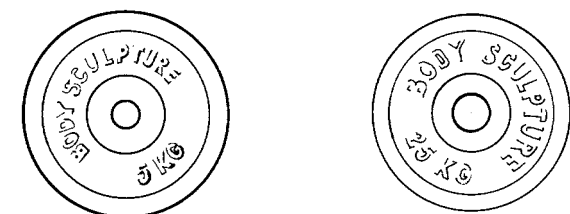


a.) Cast Weights

b.) Adjustable Hand Weights

*Free weights* are usually composed of a bar and plates that are attached. The difference between regular weight plates and Olympic-style weight plates is the diameter of the hole for the bar, which is larger in the latter.

Illustration 5.6. Types of plate weights.



a.) Regular Plate Weight

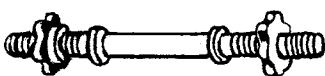
b.) Olympic Style Plate Weight

## Bars

All free weights are held by bars. The function of the rough area on the bars is to improve grip and prevent slippage caused by sweat while performing the activity.

The 30-cm-long bar with necks and collars weighs about 2.25 kg. It is also called a *short hand weight* bar.

Illustration 5.7. Short Hand Weight Bar

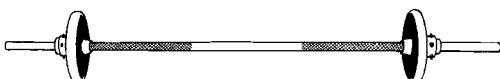


In calculating resistance, bar weight is an integral part of total resistance.

**Standard free weight bar** – Weighs about 11.25 kg and is 1.5 m long.

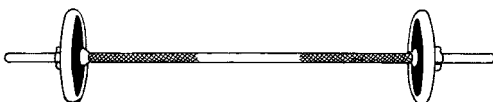
The weight plate is slipped onto the neck, which prevents it from sliding further inward towards the hands. External collars that slide up to the weight plates to prevent them from slipping off the sides.

Illustration 5.8. Standard Free Weight Bar



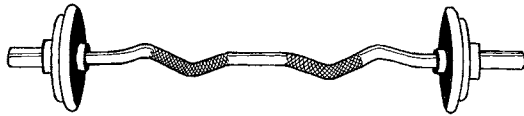
**Olympic bar** – The longest type of bar for training in the gym. It is 2.10 m long and weighs 20.05 kg, without collars. The main difference between the Olympic and the regular bar is the diameter. Therefore, only Olympic-style plates, with larger holes, can be fitted onto the Olympic bar.

Illustration 5.9. Olympic Bar



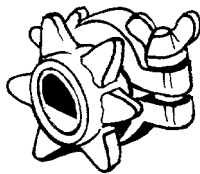
**W-shaped bar** – An angled bar for developing specific muscle groups in the arms, depending on the type of grip used. A regular W-shaped bar is 1.30 m long and weighs 7.2 kg.

Illustration 5.10. W-shaped Bar

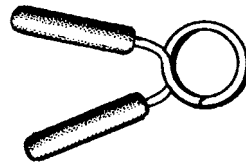


**Collar** – A standard collar weighs about 200 grams.

Illustration 5.11. Types of collars.



a.) Olympic Collar



b.) Spring Collar

## 5.8. COMPARING WORK WITH FREE WEIGHTS AND POWER APPARATUS

**Training safety** – The various types of power apparatus allow exercisers to reach their goals while maintaining optimal safety. These machines have a set, repetitive movement pattern that prevents deviations from recommended movement ranges or work angles that might cause injuries. This is one of the salient advantages of power machines over free weights, especially among beginners and more advanced exercisers working at high and maximal loads. Work with free weights at high loads has to be done under the supervision of a buddy or spotter, whereas work on machines is safe, even when done by an individual alone.

**Movement variety** – Free weights offer the option of performing a variety of movements and exercises for different muscle groups using the same weights, which do not need to be changed. Most power apparatus, on the other hand, is

intended for specific muscle groups or for practising specific skills or movements.

**Load precision** – Free weights enable exercisers to work more accurately with high resistances than do the various power machines, except for pneumatic devices that operate with air pressure. Changes in resistances on certain machines are made in large increments; for example, the first plate in a given apparatus weighs 7.5 kg and the next one is also 7.5 kg (that is, a 100% differential between the first and second stages). It is possible with free weights to add weights of only 250 grams or less.

**Movement accuracy** – Activity with free weights is closer to simulating common daily movements or movements specific to whatever sport interests the exerciser. Machines, on the other hand, are based on set movement patterns and are, therefore, more limited in emulating specific activities.

**Isolating special muscle groups** – One of the options inherent in using free weights is the ability to isolate muscle groups and to devise individual activity. For example, if we wish to “sculpt” each head of the triceps separately in the posterior part of the upper arm (for aesthetic purposes in this case, since sculpting the triceps is considered especially “pretty”), then it is more effective to use free weights. Activity on apparatus is usually intended for many or large muscle groups; and special, expensive equipment is needed to isolate specific muscles.

**Movement complexity** – Some types of apparatus require control, timing, and even special technical skill. This is especially true for asymmetric equipment whereby each arm or leg operates independently. For example, in *machine seated pec deck fly/bent-arm fly* (exercise 8.2), both hands have to meet in the centre with perfect timing. In free weight exercises, such as *standing barbell biceps curl* (exercise 9.3), the movement is simple and does not require exquisite timing or any special complexity. Activity and movement with free weights are much simpler.

**Equal exertion throughout the range of movement in isokinetic apparatus** – In work with free weights, mainly at high loads, exercisers often reach what is called the “*stick point*,” the point at which the muscle reaches full effort and the movement stops. This phenomenon occurs due to changes during movement of angles and the resistance (change of momentum) that have to be overcome. As resistance changes, there is always a specific angle whereby the action is more difficult than at others and, thus, even a relatively

easy exercise may reach a stick point. Exertion that entails varying effort throughout the range of the same movement causes different motor units in the muscles to develop asymmetrically. Some power apparatus is isokinetic in which the power curve is identical throughout the range of movement performance. The former apparatus overcomes changes in momentum thanks to different systems of levers, elliptical frames, and transmissions that allow alterations in the intensity of resistance while performing the exercise. This results in less efficient movement angles of the muscle; the resistance level rises and at the resistance angles in which the muscle pulls efficiently the resistance levels declines. Due to technical development in power instruments, the muscles exert equal effort throughout each range of movement, and strength is developed continuously as well as uniformly. In this sense, isokinetic machines have a definite advantage over free weights.

**Supervision** – A large majority of the power machines are intended to provide a high level of safety with minimum need for instructor supervision. Work with free weights, especially at high loads, requires much closer supervision. For example, in bench presses, supervisors have to make sure exercisers are performing the exercise correctly and that there is no risk of the bar slipping, or the exerciser having difficulty returning the bar to its place. Even if injury cannot be prevented, instructors are at least available to provide assistance if necessary.

**Area and infrastructure** – Power instruments take up a lot of room; for placement and for safety distances. Some require special preparations such as high tension outlets or pneumatic piping, including a compressor. Free weights take up less room and do not need any special preparation, except that the floor should be strong enough in case hand weights are dropped.

**Wear and tear and maintenance** – Free weights almost never wear out, they have no maintenance costs, and rarely have to be replaced, whereas power apparatus require ongoing maintenance.

**Price** – Free weights are inexpensive. Apparatus, on the other hand, are often expensive and the difference between the two always remains large.

In the final analysis, the two types of activity should be combined to ensure good results, stimulate interest, and motivate exercisers to do their best.

## 6: EXERCISES FOR THE LEGS

The legs play an essential role in daily functioning: they bear body weight and make locomotion possible. Long legs are usually considered more aesthetic and attractive than short ones. One way of creating an impression of longer legs is to wear high heels or elevator shoes. A safer and more recommended approach to improved leg appearance is adding muscle mass and reducing accumulated fat tissue. Legs are our connection to the ground. When they are strong we have better control, physically, symbolically, and spiritually, in the sense of “being connected to the ground.” Despite this fact, many exercisers prefer to invest more effort in developing their upper extremities. This type of disproportionate exercise results in: muscular arms, inflated chest, broad back – and skinny legs, so-called “chicken legs.” Such a training decision seems to be based on irrelevant considerations: clothing fashions and media tendency to highlight the upper part of the body as a more visible indication of beauty and sexuality, for both women and men. Many exercisers overemphasize the aesthetic aspect of their training but ignore the functional importance of their legs. To gain an idea of the importance of legs, observe films or photographs of animals in the wild with disproportionately large, strong legs. To take an extreme example, the elephant’s legs are so strong that the animal can sleep standing!

Most leg movement occurs on the *sagittal* plane with the knee serving as the axis of action. Any attempt to change the plane of movement may cause injury. The natural leg movements are flexion and extension with some medial and lateral rotation. When the knee exceeds the foot line (that is, when the gravity line falls outside the base of support), it is the knee joint and not the

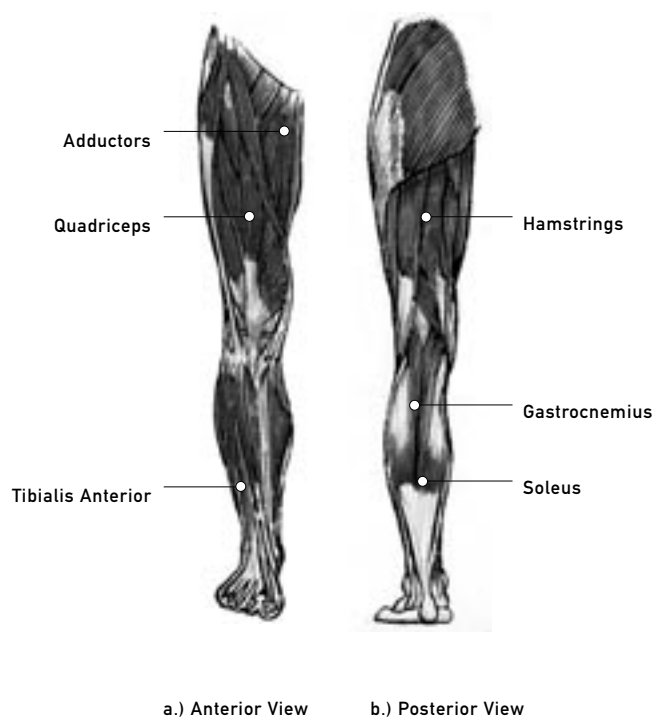
leg muscles that bear the brunt of the load. Incorrect training creates a real danger of long-term knee damage such as erosion of the patella (the bone covering the front of the knee) or overload on the cruciate ligaments (that support the knee joint). The right way to strengthen the knee is to strengthen the muscles and tendons that support and stabilize it. A common mistake among exercisers is reflected in the belief that, “If training includes running, one does not have to do leg muscle exercises.” This notion confuses the development of muscle endurance, which is evident in middle- and long-distance running, with strength increase for greater power and more muscle mass.

### *The main muscles of the lower extremity*

In this section, exercises are organized according to the joint divisions of the lower extremity, that is, in ascending order: ankle, knee, hip, and a combination of all three leg joints. We start with the ankle joint and the *gastrocnemius* and *soleus* muscles in *Machine seated calf raise* and *Standing dumbbell calf raises on plates*. This is followed by exercises for the muscles that move the knee joint (quadriceps and hamstrings) in the *Machine seated leg extension*, which works mainly on quadriceps, and the *Machine seated leg curl*, which works mainly on hamstrings. Next are the hip activators in the *Machine seated hip adduction* and the *Machine seated hip abduction* exercises. A number of complex exercises are discussed, that involve all leg muscle groups simultaneously: *Supine vertical leg machine hip sled (Leg press 45–60 degree incline)*, *Barbell squat to bench*, *Barbell squat*, and *Front lunge with*

*dumbbells, Step-ups with barbell, and Bent leg deadlifts* (see pp. 116–22 and 125–26 for other exercises that develop leg muscles under “Common Exercises for Developing Power in Multipurpose Apparatus” in Chapter 13).

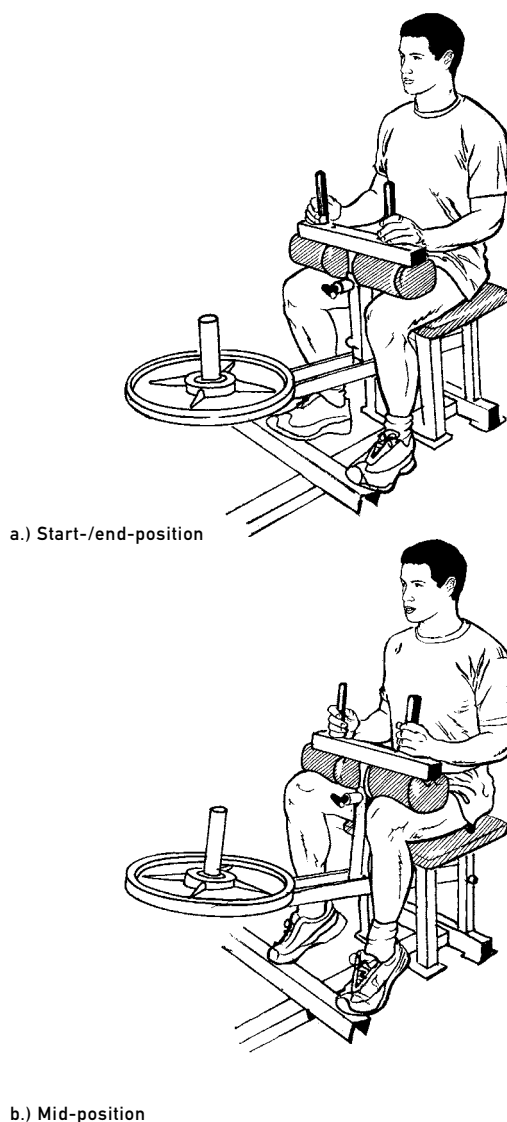
Illustration 6.1. Main muscles of the lower extremity.



## 6.1. GASTROCNEMIUS AND SOLEUS MUSCLES

The gastrocnemius is mainly an endurance muscle. Up to 86 per cent of its fibres utilize aerobic energy, which means that development requires long-term training. The soleus is the synergist for the gastrocnemius. Gastrocnemius and soleus muscles play a central role in walking as well as in common athletic activities such as jumping, landing, and running. In today’s sedentary culture, these activities are decreasing, which makes gastrocnemius and soleus degeneration and weakness a clear and current health issue.

Illustration 6.2. Exercise 6.1. Machine seated calf raise



### EXERCISE 6.1. MACHINE SEATED CALF RAISE

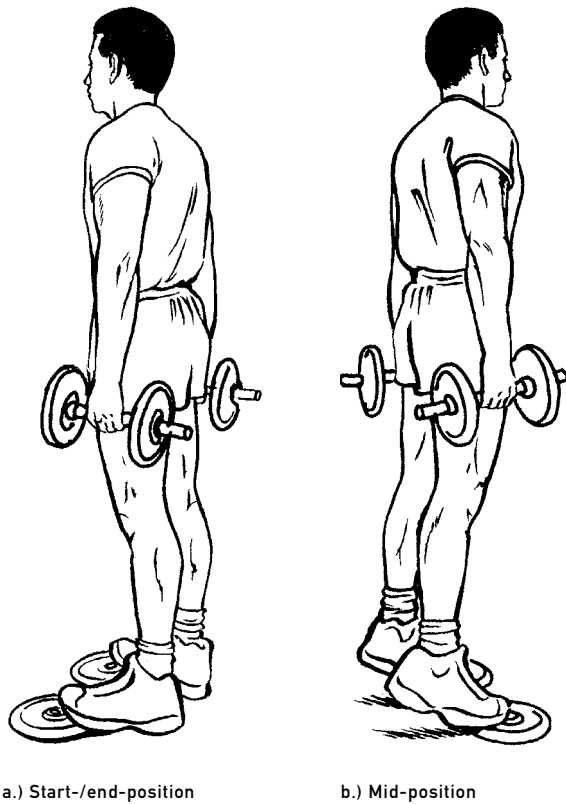
**Start-/end-position** Sit erect on seat, legs parallel and hip width apart. Knee joints should be at a 90-degree angle, balls of the feet and toes are on a raised platform. It is advisable to start from a state of tension.

**Range of movement and performance** From start- to mid-position: Raise heels as high as possible against the weight.

Hold for two seconds at peak contraction (high-point).  
 Avoid sideways movement of thighs and lower leg.  
 Return to end-position, lower heels to below toe level. The movement is from ankle *dorsiflexion* ("flex") in a maximally tensed muscle to maximal *plantar-flexion* ("point"). During upward movement, exhale to a 4-count, and inhale to a 6-count during downward movement.

**Movement analysis** From start- to mid-position: Ankle – plantar flexion by gastrocnemius and soleus works concentrically.  
 From mid- to end-position: Ankle – dorsiflexion by gastrocnemius and soleus contracts eccentrically.

Illustration 6.3. Exercise 6.2. Standing dumbbell calf raise on plates



a.) Start-/end-position

b.) Mid-position

## EXERCISE 6.2. STANDING DUMBBELL CALF RAISE ON PLATES

This exercise strengthens the gastrocnemius and the soleus. When the ankle is locked (full extension), the gastrocnemius works harder, and when knee is slightly flexed, the soleus works harder. The exercise can be performed on weight plates as in the illustration or on a step. If the exercise is performed on a step, caution is needed in returning to the end-position in order to avoid excessive ankle dorsiflexion and overstretching the Achilles tendon. There is the danger of balance loss and falling, especially when executing it on a step. Holding hand weights, as illustrated, helps to maintain balance and allows adaptation to the difficulty level to the exerciser's ability. Novices wishing to perform the exercise without weights can maintain balance by lightly holding onto any object fixed to the wall or floor. But the support should not be used to perform the movement! It is not recommended to add shoulder weights to the load because of potential damage to the lower back. Exercises can be varied by altering the foot position, which will stimulate different muscle fibres of the gastrocnemius: when toes are turned in, the work load is more on the lateral (outer) side of the gastrocnemius; when toes are turned out, the work load is transferred onto the medial (inner) side of the muscle. This exercise can also be performed using body weight resistance on the "Total Trainer" (see Chapter 13).

**Start-/end-position** Stand with toes and balls of feet on the plate and heel and foot arch in the air (a state of flex).

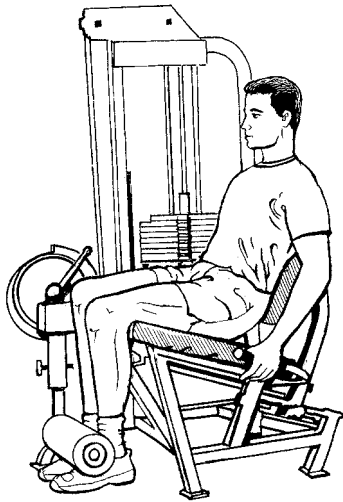
**Range of movement and performance** From ankle dorsiflexion and gastrocnemius lengthened, rise to maximal plantar-flexion (point), with maximal contraction of gastrocnemius. It is recommended to hold the position for two seconds at peak contraction and then return to end-position. While descending, be careful not to "bang" your heel on the floor. Elevate while exhaling to a 4-count; inhaling to a 6-count while descending.

**Movement analysis** From start-/end- to mid-position: Ankle – dorsiflexion of gastrocnemius and soleus working concentrically. From mid- to end-position: Ankle – plantar-flexion of gastrocnemius and soleus contracting eccentrically.

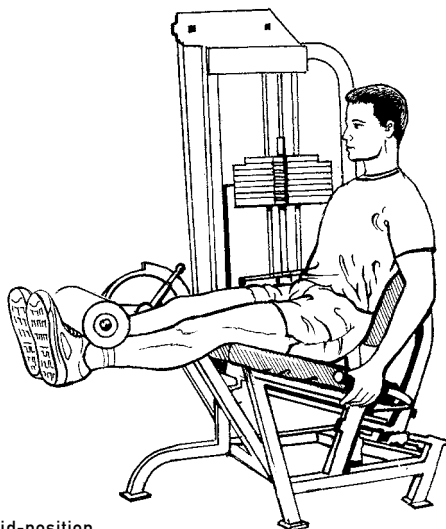
## 6.2. KNEE JOINT ACTIVATORS

This group of muscles, composed mainly of the quadriceps and hamstrings, activates flexion and extension of the knee joint. The knee activators create and maintain joint stability. Well-developed quadriceps is a clear indication of aerobic activity. It is a good idea to develop the quadriceps before buying a pair of shorts!

Illustration 6.4. Exercise 6.3. Machine seated leg extension



a.) Start-/end-position



b.) Mid-position

## EXERCISE 6.3. MACHINE SEATED LEG EXTENSION

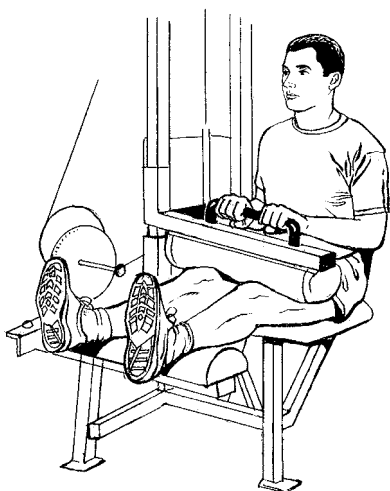
This exercise can be performed by both novice and advanced exercisers. In the final ten degrees approaching full extension, the *Vastus medialis* (the middle of the four heads of the quadriceps) works especially hard. Work within this range of movement helps to strengthen the knee joint. At the end of the set, the lever arm should be raised before leaving the apparatus. It is possible to straighten knees to full extension in apparatus with inclined seats because one does not reach the locked position (see Illustration 6.4).

**Start-/end-position** Sit and be sure that the action axis faces the movement axis. Avoid leaning back heavily, only rest your back in order to avoid creating excessive lumbar lordosis (over-arching of the lower back). The leg rest (resistance lever) is placed above the ankle against the bottom third of the shinbone to avoid pressure on the joint. During the eccentric action returning from mid- to end-position, the weight should not fall free. The handles beside the seat are for support and stability only. There is no need to press down! Use the side handles only when using extremely heavy weights (for advanced exercisers developing maximal strength).

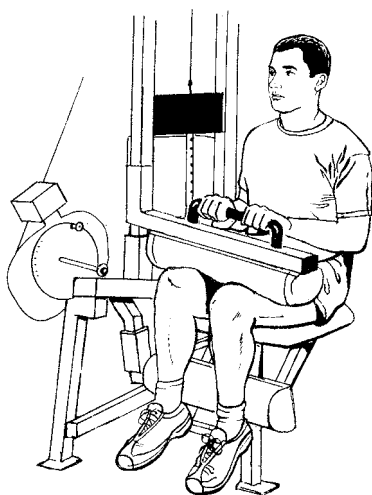
**Range of movement and performance** In extension, straighten the knee – it can be locked (full extension). During the activity, avoid over-arching the back (lumbar lordosis). Exhale during extension and inhale while lowering the leg. Leg extension is done to a 4-count and return to end-position is done to a 6-count.

**Movement analysis** From start- to mid-position: Knee – extension is with quadriceps working concentrically. From mid- to end-position: Knee – flexion is with quadriceps contracting eccentrically.

Illustration 6.5. Exercise 6.4. Machine seated leg curl.



a.) Start-/end-position



b.) Mid-position

#### EXERCISE 6.4. MACHINE SEATED LEG CURL

Various apparatus in the weight room offer the option of performing this exercise in three positions: standing, lying, or sitting. Standing is neither comfortable nor balanced, but for the athletic population, a standing leg curl is actually more beneficial as the person needs to maintain core stability while flexing the knee. Lying poses a safety risk because of increased lower back load. Thus, the sitting position illustrated here is an optimal combination of safety and proper isolation of knee flexors.

**Start-/end-position** If the sitting position is used, it is important to neutralize excessive loads on lower back as much as possible and avoid anterior pelvic tilt or over-arching of the trunk. The action axis should face the movement axis. The leg rest should be placed above (proximal to) the Achilles tendon. If the action and movement axes are not parallel, move the leg rest forward or backward until they are. The lever arm (the resistance arm on the apparatus or the curling pillow roll) should face the knee behind the Achilles tendon and not be too close to the gastrocnemius to avoid pressure on the muscles. Before exercising, ensure that the lever arm is fixed in place and does not slide up or down on the lower leg.

**Range of movement and performance** Sitting (see Illustration 6.5) in extension, flex to ninety degrees. Make sure the load is centred on the hamstrings and not on the knee. Inhale during flexion and exhale during extension (straightening the leg). The tempo should be slow and controlled, to a 4-count in flexion and a 6-count in the return extension.

**Movement analysis** From start to mid-position: Knee – flexion by hamstrings and gastrocnemius working concentrically. From mid- to end-position: Knee – extension by hamstrings and gastrocnemius contracting eccentrically.

### 6.3. HIP JOINT MOVERS

The hip joint is part of the pelvis. The muscle groups moving the hip joint include *iliopsoas* (connects the femur to the lumbar spinal processes), *gluteus maximus*, and the adductor and abductor muscle groups.

The five muscles constituting the hip adductors are located in the groin area. They are *adductor brevis*, *adductor longus*, *adductor magnum*, *gracilis*, and *pectineus*. The adductors make up one third of the cross-section of the thigh and, therefore, training these has a direct effect on shaping the thigh. The function of these muscles is to bring the hip towards the mid-line of the body and to assist in posture. Adduction is performed on the frontal and transverse planes. As there is very little movement on the sagittal plane (almost no flexion or extension), such movement in daily life is rare. Due to their sensitivity and location in the groin area, training entails a real risk of strain or overload. Safe ranges of movement have to be observed in training, muscles should be activated in the hip joint and not the pelvis, and the

spinal column should not provide compensation. Be careful to avoid *hyperadduction* or *hyperabduction*, which may turn the lumbar vertebrae and damage discs and the spinal cord. It is also important to avoid large swinging movements that might cause tears in the hip adductors or inflammations in the hip joint.

The hip abductors are on the lateral side of the hip. The three hip adductor muscles are: *gluteus medius*, *gluteus minimus*, and *tensor fascia*. The function of these muscles is to move the hip away from the midline of the body. As in adduction, hip abduction almost never occurs on the sagittal plane and, therefore, is less common in daily activities. Due to the location of the abductors and their connection to the pelvis, overstretching and overloading are definite risks. Be sure to maintain optimal ranges of movement during training; avoid hyperadduction, hyperabduction, side flexion, swinging, or shaking the pelvis.

During activity to develop the adductors or abductors in sitting or standing positions, ensure that there is no cumulative pressure load on the lower back or knees and make certain to maintain control over resistance, tempo, and ranges of movement.

## EXERCISE 6.5. MACHINE SEATED HIP ADDUCTION

**Start-/end-position** Sit with thighs apart in the retainer cushions. The cushions should be placed against the medial (inner) side of the thighs near (not on) the knee. If the apparatus can adjust to leg movement, it should be adjusted to optimal movement range. If there is no such option, try to reach optimal range of movement by using a smaller range. Tilt the pelvis to the rear; only the lower part of the back leans against the backrest. There is no need to lean shoulders on the backrest. Avoid hyperarching of lumbar lordosis and concentrating too much effort and load on that area. Hold the handles lightly, head is slightly raised.

**Range of movement and performance** Sitting, bring thighs on the transverse plane towards the front until the leg retainers touch. Hold the position for about one second. Control the movement and avoid banging the retainers together. Slowly return to optimal thigh adduction. During adduction, exhale to a 4-count; on the return, inhale to a 6-count.

**Movement analysis** From start- to mid-position: Hip – adduction by hip adductors working concentrically. From mid- to end-position: Hip – abduction by hip adductors contracting eccentrically.

Illustration 6.6. Exercise 6.5. Machine seated hip adduction

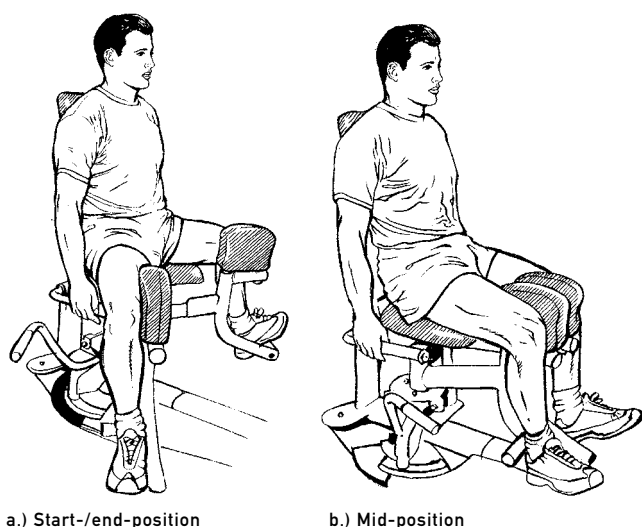
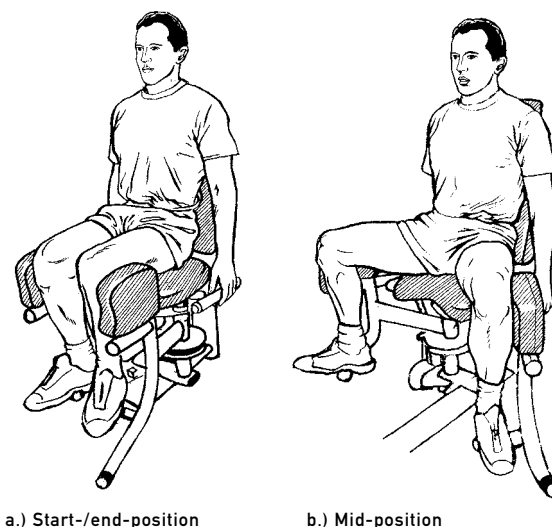


Illustration 6.7. Exercise 6.6. Machine seated hip abduction



## EXERCISE 6.6. MACHINE SEATED HIP ABDUCTION

**Start-/end-position** Sit with legs in the retainers so that the cushions touch the lateral (outer) part of the thighs near (not on) the knees. Tilt pelvis to the rear and lean lower back against the back rest, with head raised slightly. Avoid arching the back creating excessive lumbar lordosis. Grasp the handles lightly.

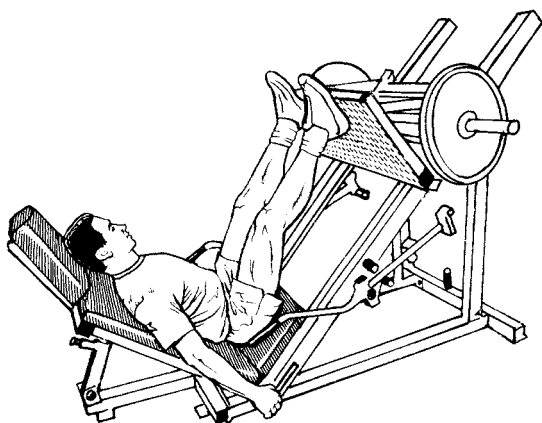
**Range of movement and performance** On the transverse plane, push thighs outward (abduction) to the optimal range and hold the position for a second or so. Control the movement to avoid hyperabduction or excessive pressure on the hip joint. During abduction, exhale to a 4-count; in the return movement inhale to a 6-count.

**Movement analysis** From start- to mid-position: Hip – abduction by gluteus medius and tensor fascia working concentrically. From mid- to end-position: Hip –adduction by medial gluteus and tensor fascia contracting eccentrically.

## 6.4. MULTI-JOINT LEG EXERCISES

The following exercises require a very high level of physical fitness and skill because they activate a number of leg muscle groups simultaneously. The exercises are in ascending order of difficulty and technical complexity.

Illustration 6.8. Exercise 6.7. Supine vertical leg machine hip sled (Leg press 45- to 60-degree incline)



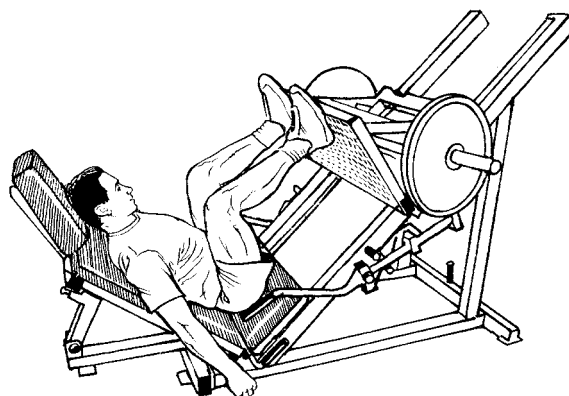
a.) Start-/end-position

## EXERCISE 6.7. SUPINE VERTICAL LEG MACHINE HIP SLED (LEG PRESS 45- TO 60-DEGREE INCLINE)

In this exercise, the lower we place our feet on the foot press surface, the greater the load is on the knee joint; the dominant muscle is the quadriceps. If we place our feet higher on the foot board, the load is greater on the hip joint and the dominant muscles are the hip extensors. It is possible to modify the foot rest angle on the foot board or the press incline angle. The smaller the hip joint angle in relation to the trunk, the greater is the load on the gluteals.

**Start-/end-position** The recommended position for this exercise is for the feet to be positioned on the foot board so that they exceed the knee line, that is, the toes are off the board. Push with the heels instead of the balls of the feet in order to minimize pressure on the knees. At the same time, avoid placing the feet too far forward on the boarding in order to not overload the lower back. Each exerciser has to find the position on the foot board that provides optimal balance for distributing the load on the knee joint, hip joint, and lumbar vertebrae.

**Range of movement and performance** Release brakes on the sides and flex knees to about 90 degrees between lower leg and thigh. The knee should not exceed the foot line. Hold for one second and straighten the knees. Avoid locking

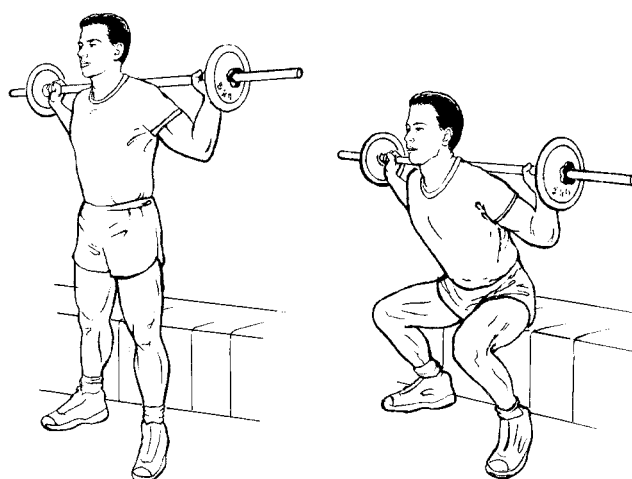


b.) Mid-position

knees forcefully. During the descent, work on the quadriceps is carried out to a 6-count, on the ascent to a 4-count. Inhale during the descent (flexion), exhale during the straightening (extension).

**Movement analysis** From start- to mid-position: Hip – flexion by gluteus maximus and hamstrings contracting eccentrically. Knee – flexion by quadriceps contracting eccentrically. From mid- to end-position: Hip – extension by gluteus maximus and hamstrings working concentrically. Knee – extension by gluteus maximus working concentrically.

Illustration 6.9. Exercise 6.8. Barbell squat to bench



a.) Start-/end-position

b.) Mid-position

Novices should not add barbell resistance. During the training period, the bar and weights can be added as shown in the illustration. The seat or bench should be about 40 cm high. A similar exercise can be performed using body weight or barbell resistance using the “Total Trainer” (see p. 112).

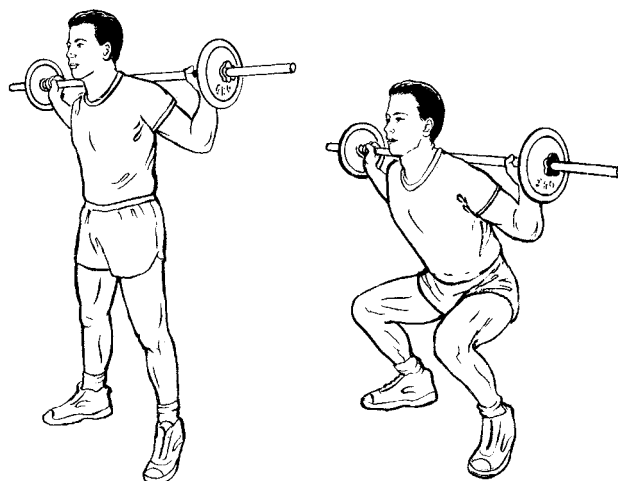
#### EXERCISE 6.8. BARBELL SQUAT TO BENCH

**Start-/end-position** Legs should be parallel, shoulder width apart or slightly more, and toes turned slightly out. Hold the bar above or below vertebra C7, between the scapulae. The bar should not press on the cervical vertebrae. Look forward and tilt head slightly upward in order to shorten the cervical trapezoid.

**Range of movement and performance** Bend knees until buttocks are almost touching the bench or seat – do not sit or rest on it! During the exercise the head remains erect and the back straight. Modifying leg width angle between sets varies the training and involves the adductor muscles. During descent (knee flexion), inhale to a 6-count, and during straightening (extension), exhale to a 4-count.

**Movement analysis** From start- to mid-position: Hip – flexion by gluteus maximus and hamstrings contracting eccentrically. Knee – flexion by quadriceps contracting eccentrically. Ankle – dorsiflexion by gastrocnemius and soleus contracting eccentrically. From mid- to end-position: Hip – extension by gluteus maximus and hamstrings working concentrically. Knee – extension by quadriceps working concentrically. Ankle – plantar flexion by gastrocnemius and soleus working concentrically.

Illustration 6.10. Exercise 6.9. Barbell squat



a.) Start-/end-position

b.) Mid-position

#### EXERCISE 6.9. BARBELL SQUAT

The *squat* is one of the most familiar and important exercises for developing power. It strengthens mainly the thigh muscles and gluteals. Holding and stabilizing the bar also strengthens the back *erector spinae* and the abdominals. Weight plates should be placed under the heels of exercisers with short Achilles tendons who cannot keep their balance as they squat on their heels

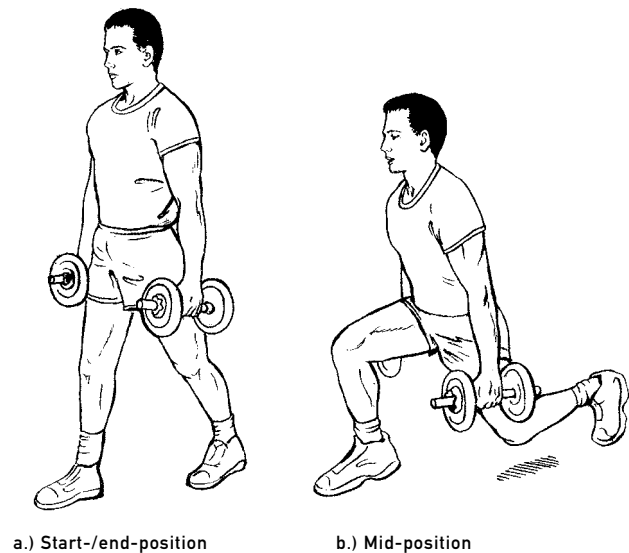
or for those who, for whatever reason, cannot keep their heels on the ground during the squat. Before exercisers perform squats for the first time, instructors should ask them to sit on their heels. If they can maintain their balance in that position, heels do not have to be raised. Raising the heel adds a load on the knees.

**Start-/end-position** Legs should be parallel, at or slightly more than shoulder width apart, toes point slightly outward. The bar can be held above or below the C7 vertebra and between the shoulder blades. Avoid pressing the bar against the cervical vertebrae. Look forward and tilt head slightly upward in order to shorten cervical trapezoid.

**Range of movement and performance** Descend to an angle of 90 degrees between thigh and lower leg, trunk erect, and heels on the floor. Avoid bending forward or backward, and jutting buttocks. It is important that knees do not exceed the foot line, so as not to overload the knees. During the movement, head remains raised. In the descent, work to a 6-count, and in the extension, to a 4-count. Inhale during flexion (bending) and exhale during extension (straightening).

**Movement analysis** From start to mid-position: Spine – maintenance of erect position by erector spinae working isometrically. Hip – flexion by gluteus maximus and hamstrings contracting eccentrically. Knee – flexion by quadriceps contracting eccentrically. Ankle – dorsiflexion by gastrocnemius and soleus contracting eccentrically. From mid- to end-position: Spine – maintenance of erect posture by erector spinae working concentrically. Hip – extension of gluteus maximus and hamstrings working concentrically. Knee – extension of quadriceps working concentrically. Ankle – plantar flexion of gastrocnemius and soleus working concentrically.

Illustration 6.11. Exercise 6.10. Front lunge with dumbbells



## EXERCISE 6.10. FRONT LUNGE WITH DUMBBELLS

There are two types of lunges: static and dynamic. In static lunges, we repeat the same movement without moving the front leg back. In dynamic lunges, the leg moves forward and backward with each repetition. The illustration shows the start-/end-position of the dynamic squat. The exercise can be performed using only body weight as resistance, or hand weights can be added, as shown in the illustration. It is also possible to perform lunges with a weight bar on shoulders, as long as it is balanced well above the deltoids. This is a very difficult exercise because most of the load is exerted on one leg at a time (alternating). Obviously, it is important to perform the same number of repetitions and sets for each leg in order to prevent asymmetric development of quadriceps and gluteus maximus.

**Start-/end-position** In the dynamic lunge, stand straight with legs parallel and slightly apart. In the start-/end-position for the static squat, one leg is forward and both legs are in full extension (knee angle for both legs is 180 degrees).

### Range of movement and performance for the dynamic squat

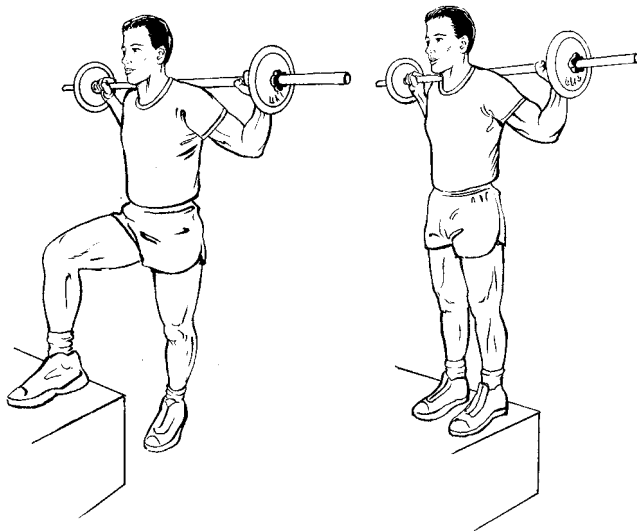
Move one leg forward to a squat position with knee angle of both legs reaching 90 degrees. Performance should be slow and controlled; head should remain raised throughout the

lunge. The limit of the lunge movement is a ninety-degree angle of the forward hip while the rear hip remains at 180 degrees. Ensure that the forward knee does not exceed the forward foot line to prevent overloading the *cruciate* ligaments and the patella. During the lunge, avoid sideways knee movements to the right or left. Holding hand weights during the exercise is recommended for those who have difficulty keeping their balance in the lunge movement. Body weight in the exercise is on the forward leg, while the rear leg maintains body balance. Avoid leaning on it too much. Descend (flexion) to a 6-count while inhaling. Ascend (extension) to the end-position to a 4-count while exhaling.

**Range of movement and performance in the static squat** The exercise is the same as for the dynamic squat except for thrusting one leg forward before the squat and returning into place after the squat.

**Movement analysis** From start to mid-position: Hip – flexion of forward hip by gluteus maximus and hamstrings contracting eccentrically. Knee – flexion of forward knee by quadriceps contracting eccentrically. Forward ankle – dorsiflexion by gastrocnemius and soleus contracting eccentrically. From mid- to end-position: Hip – extension of forward hip by gluteus maximus and hamstrings working concentrically. Knee – extension of forward knee by quadriceps working concentrically. Forward ankle – plantar flexion by gastrocnemius and soleus working concentrically.

Illustration 6.12. Exercise 6.11. Step-ups with barbell



a.) Start-/end-position

b.) Mid-position

## EXERCISE 6.11. STEP-UPS WITH BARBELL

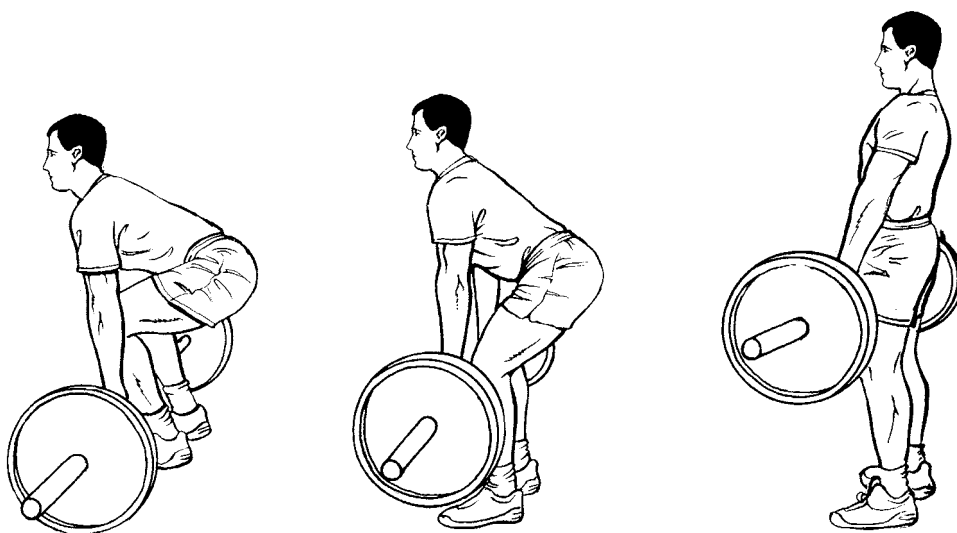
This exercise is widely used by professional exercisers and athletes. In addition to strengthening leg muscles, it also activates back erector spinae. Due to the load on the back in stabilizing the body and the high level of skill required to perform the exercise, it is not recommended for beginners. The seat or bench should be about 40 cm high. *The description presented here is for the right leg.* It is important to ensure an equal number of repetitions and sets for each leg to avoid asymmetric development of leg muscles. Exercisers who find it difficult to maintain balance during the exercise can use hand weights instead of barbells – as illustrated for the squats.

**Start-/end-position** Stand in front of bench with the right foot resting on the bench and left foot on the floor. The barbell should be balanced and resting on the trapezius.

**Range of movement and performance** Raise left foot to the bench and place it next to the right foot, the mid-position standing on the bench. In a slow and controlled movement, return the left foot to the floor and the end-position. The return movement should be gradual. Avoid letting the leg fall freely and bang on the floor, which might impact on the spinal column. During ascent, exhale to a 4-count and during descent inhale to a 6-count. It is also possible to exhale during both ascent and descent, inhaling at the mid-positions, that is, when both legs are on the floor or the bench.

**Movement analysis** From start to mid-position: Hip – extension by gluteus maximus and hamstrings working concentrically. Knee – extension by quadriceps working concentrically. Ankle – dorsiflexion by gastrocnemius and soleus working concentrically. From mid- to end-position: Hip – flexion by gluteus maximus and hamstrings contracting eccentrically. Knee – knee flexion by quadriceps contracting eccentrically. Ankle – plantar flexion by gastrocnemius and soleus contracting eccentrically.

Illustration 6.13. Exercise 6.12. Bent leg deadlifts



a.) Start-/end-position

b.) Mid-position

## EXERCISE 6.12. BENT LEG DEADLIFTS

This exercise is popular among weightlifters and athletes wishing to strengthen a maximum number of muscle groups with one single exercise. Since it requires a high level of skill, control, and strength, it is not recommended for beginners. The exercise activates leg and gluteal muscles, with back erector spinae assisting to complete the action. The three stages of the exercise are: start-/end-position, lift, and straightening.

**Start-/end-position** Place legs shoulder width apart, knees bent, feet on floor, toes pointing slightly outward, hips low. Grasp bar using overhand closed grip (in higher weights used a combined grip), barbell rests on the floor. Distance between hands should be wider than shoulder width. Upper body leans forwards at about a 45-degree angle. Avoid hyperarching the neck (cervical lordosis). Trunk should be erect and tensed, chest held high and abdomen tucked in. Head remains raised and eyes focus straight ahead throughout the exercise.

**Range of movement and performance** In the lift stage, begin to straighten knees while hips remain low. Elbows remain extended throughout the exercise. The bar remains near

lower legs, knees and thighs. In the straightening stage, when the bar reaches knee height with the assistance of the leg muscles, pull the bar upward until it touches the front of the thighs, using the erector spinae back muscles. Shoulders remain above the bar as knees extend. Hold the extended position for about two seconds. Throughout the movement, upper body remains rigid. Trunk remains erect during the exercise and abdomen is retracted. Avoid hyperarching of cervical and lumbar lordoses during the exercise. All of the above processes occur simultaneously. The lift is performed to a 4-count while exhaling. Flexion of the back to the end-position is controlled and slow, preferably to a 6-count while inhaling.

**Movement analysis** From start to mid-position: Spine – held by erector spinae and abdominals working isometrically. Hip – extension by gluteus maximus and hamstrings acting concentrically. Knee – extension by quadriceps acting concentrically. Ankle – plantar flexion by gastrocnemius and soleus acting concentrically. From mid- to end-position: Spine – held by erector spinae and abdominals working isometrically. Hip – flexion by gluteus maximus and hamstrings contracting eccentrically. Knee – flexion by quadriceps contracting eccentrically. Ankle – dorsiflexion by gastrocnemius and soleus contracting eccentrically.

## 7: EXERCISES FOR THE ABDOMINAL MUSCLES

In the groundbreaking dictionary of the eighteenth-century lexicographer Samuel Johnson, “abdomen” is defined as that part of the body extending from the chest to the hips and containing the intestines. Two and a half centuries later, that definition is still fairly accurate, although anatomically, the abdomen also includes the posterior part of the lower back (Johnson, 1993). In ancient times, when food was not plentiful, men would proudly show off their large, swollen “bellies” as a symbol of economic success and wealth. In today’s Western societies of plenty and sedentary occupations, the “big belly” symbolizes, more than anything else, too much pampering, hedonism, and worst of all, degeneration. A prominent abdomen is harmful because carrying the excess weight in front causes bad posture and impairs health, especially in the spine. The recommended activity for burning fats is aerobics, which shrinks fat tissue in *all* fat storage areas at the same time, and not just in the abdomen. Certain anaerobic activities such as sit-ups can strengthen abdominal muscles but that is not enough to get rid of the “bulge.” No type of physical exercise, whether aerobic or anaerobic, can reduce fat concentrations in specific areas of the body. There is no such thing as activity for localized weight loss!

Aesthetically, the belly creates our body’s profile, just as the nose is the centrepiece of the face. According to many, both should be small and well formed, not large and amorphous. A flat belly is a beauty ideal in modern Western society – thin is beautiful – as can be attested to by those who audition for work as models. For this reason, men and women in Western society seem to have an overwhelming need for a well-shaped abdomen. Commercial companies exploit this aspiration to the

limit. Many exercisers, mainly beginners, tend to believe the advertisements and the media “brainwash” about miraculous shortcuts to “washboard-flat” abdomens. Everywhere one looks there is some charlatan or “quack” promising “instant” ideal, flat stomachs: electric massagers, electrodes for muscular stimulation, sit-up contraptions that are no more than play rockers for pseudo-sit-ups, “fat-absorbing” or “fat-melting” “wonder pills,” teas, laxatives; the list goes on. Some do not harm consumers, and they actually do make them thinner – in their wallets! Other gadgets may have an immediate short-term effect but their long-term effects are definitely harmful to health. In the search for the flat stomach, this author can attest that there is no earth-shaking news. There are no shortcuts!

Attaining the “ideal stomach” requires exercising to develop strong abdominal muscles, combined with a reduction in subcutaneous fat through proper diet and aerobic activity. Surprisingly, Sumo wrestlers do have strong, highly developed abdominal muscles but they are hidden by a thick layer of fat tissue. In this vein, one should not ignore the fact that exercisers with endomorphic (“roly-poly”) body builds will have a lot of difficulty reaching the “flat” goal because of genetic influence. At the same time, even for endomorphs, washboard stomachs are not “mission impossible”! Using a combination of aerobic activity, appropriate diet, abdominal muscle exercisers, and a lot of willpower, even endomorphs can overcome their genetic tendencies! Throughout years of personal educational work the author has met many such people. Becoming fat is mainly a matter of accumulating fat tissue under the skin (subcutaneously). Descriptions are usually based

on where in the body the fat builds up: big in the hips is “pear-shaped,” big in the belly in “apple-shaped” and big in the buttocks is “watermelon-shaped.” The average individual is a “fruit cocktail,” with fat distributed in three concentrations in one relationship or another. Only vigorous aerobic activity, together with wise nutrition, helps to reduce these fat concentrations.

## Abdominal muscles

We will review the abdominal muscles from the deepest to the most superficial level, that is, from the centre of the body towards its outer covering.

**Transverse abdominis** – Looks and acts like a natural girdle that fastens the internal organs in the abdominal cavity. The muscle is activated while standing or sitting, when we “tuck in” our belly during exhalation.

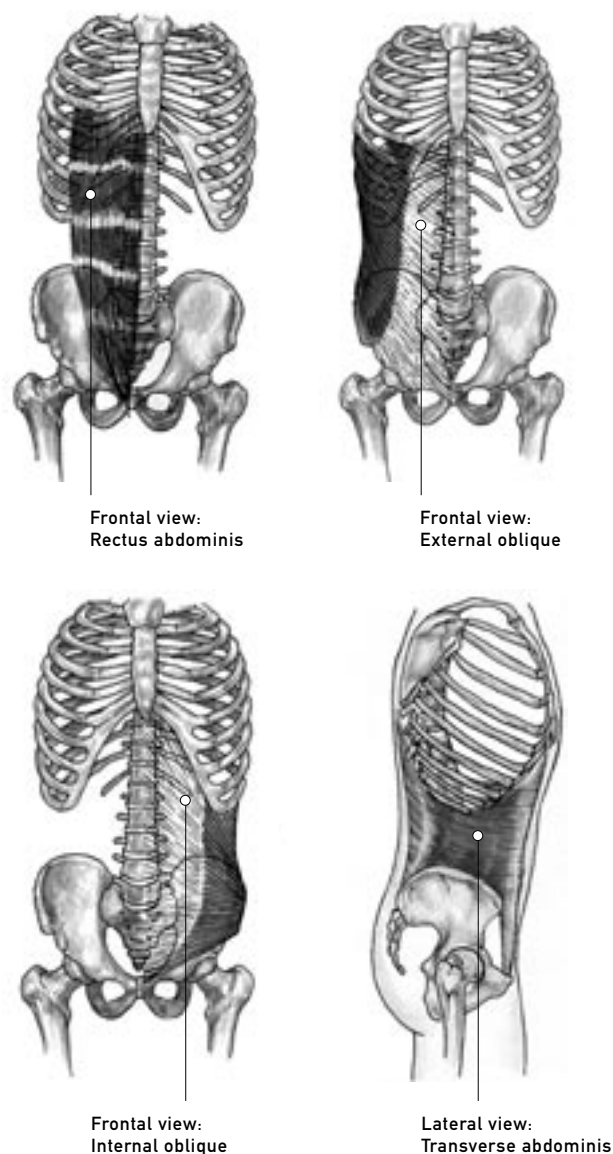
**The internal oblique muscle** – Has an upside-down V-shape. It helps to perform spinal rotation in walking and running movements. The muscle is activated when we bring one shoulder closer to the opposite hip.

**The external oblique muscle** – V-shaped. Together with the internal obliques it assists in spinal rotation. The internal and external obliques work in harmony. Muscle activation is evident when bringing one shoulder towards the opposite hip.

**Rectus abdominis** – A long muscle whose origin is in the upper area of the ribs and whose insertion is in the lower part of the hips. Crossing the muscle horizontally are three transverse tendons that divide the abdomen into four parts (giving the illustrious “washboard effect” to the abs). These tendons help to improve the range of spinal flexion and tighten the muscle in its concentric state. Muscle action occurs in regular sit-ups, but the “abs” will be visible only if there is no layer of subcutaneous fat to hide it. The term “lower abdomen” refers to the lower part of the rectus abdominis, below the navel. There is no lower abdominal muscle as such.

According to the structure just described, we can see four groups of abdominal muscles, shaped in such a way as to “fasten” the internal organs in the abdominal cavity and provide them with maximum protection.

Illustration 7.1. Views of the main abdominal muscles.



## Functions of the abdomen:

- To protect internal organs.
- To help secure and stabilize the pelvis.
- To maintain a normal state of lumbar lordosis (lower back concavity).

- To reduce intradisc pressure (on the discs between the spinal vertebrae).
- To balance load distribution in posture according to the “post principle” Biomechanically, for the spine to stand erect, all the muscles around it should be equal partners in maintaining its tonus in order to stabilize it and to reduce loads on the erector spinae muscle group.
- To serve as ancillary muscles in breathing, mainly in vigorous exhalation.
- To help prevent groin hernias by holding internal organs in place.
- Together with other muscles – to connect upper and lower parts of the body.

All the abdominal muscle groups always work together. At the same time, it is possible to strengthen one particular muscle by placing a relatively greater load on it. Before reviewing the exercises, exercisers need to be cautioned of high-risk and potentially harmful exercises such as *leg-flapping in a supine position, sit-ups with extended legs*, or performing *scissors exercises while hanging passively from a high bar*. These exercises can overload lower back muscles and cause unnecessary pain.

The term “sit-up” is misleading; it should more appropriately be called *supine to 30-degree sitting*. The abdominal muscles perform flexion of spinal lumbar vertebrae and, therefore, it is not the abdomen performing the sit-up but the spine. Nevertheless, the term “sit-up” it is used in this book because it has become so entrenched in the English language and in the professional jargon.

The exercises presented are the safest for optimal development of the abdominals while minimizing risk factors. They are organized by muscle groups, levels of difficulty, and complexity of performance. *Supine bent-knee crunch* and *Supine bent-knee incline abdominal board crunch* work mainly on the *rectus abdominis*. *Supine vertical leg raise with posterior pelvic tilt*, *Supine bent knee rectus abdominis with posterior pelvic tilt*, *Straight arm bar hang with posterior pelvic tilt*, and *Straight arm bar hang with posterior pelvic tilt leg raise* are helpful mainly for developing the lower part of *rectus abdominis* (“lower abs”) under the navel. These exercises are intended for advanced levels and are arranged according to exertion level. *Machine seated crunches* are an advanced exercise for developing the *rectus abdominis*. *Supine bent-knee sit-up*

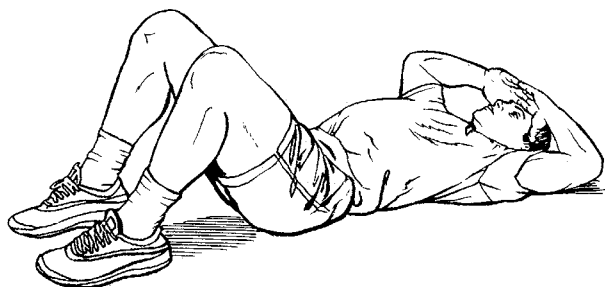
*with twist/cross* works mainly on the two oblique muscles. *Supine vertical leg alternation crunch with foot touches* combine work on the obliques and *rectus abdominis*. (See pp. 121 and 127 for suggestions on additional variations for developing the abdominals “Common exercises for developing power on multipurpose apparatus”: *Supine bent-knee flat bench Smith machine crunch* and *Kneeling forward crunch with pulley bar behind head*.)

The factors that determine the safest, healthiest position for performing sit-ups is a matter of controversy. One could propose that the perfect formula for performing sit-ups without involving unnecessary muscles has yet to be devised. After investigating the issue, this author developed a method based on his experience which, in his opinion, yields maximum results while minimizing potential damage. For any of the various types of sit-ups, place the hands on the forehead (or one hand on the forehead and the other on the nape of the neck), rather than the usual behind-the-neck position. Even though the hands-behind-the-neck position is intended to provide support for the head and serve as a “cradle,” a much more harmful process occurs in actual practice. Sit-ups in the cradle position exert pressure on the neck that often causes pains, headaches, and posture disorders. Placing the hands on the forehead precludes this danger but also increases the load on neck muscles. For novice exercisers, this may be a problem if their neck muscles are not strong enough. Beginners can ease the neck load by placing one hand on their forehead and the other on the neck for support. This method is only a suggestion and is not intended to rule out other methods. In most supine sit-up exercises for developing the “lower abdomen,” a part of the pelvis called the *sacrum* must be raised off the ground. The sacrum is the middle part of the pelvis, and it is necessary to perform *anterior pelvic tilt* or rotation to the front to separate it from the floor (see p. 27 for “Basic concepts in physical fitness theory” in the section on “Movements of the skeletal system, movements in the sagittal plane”). The supine position is with the sacrum off the floor while the coccyx (the lowermost bone of the spine which protrudes slightly above the buttocks) is raised about 3–4 cm (1–1 1/2 inches) off the floor.

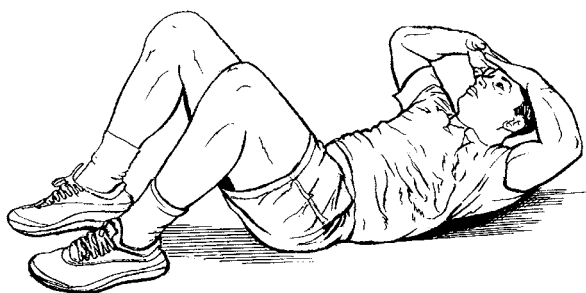
**Learning stages, identifying and controlling the lower abdomen area** – Lie on back, feet on the floor or a chair (not upholstered – it must be a hard surface). In the two variations, create a 90-degree angle at the knee to neutralize lumbar lordosis. Place one hand below the navel in order to feel the area of activity. Raise only the sacrum from the floor by tilting the pelvis to the rear and then returning the sacrum to the floor. The posterior pelvic tilt is performed by activating the hamstrings and pressing against the floor or chair with one's feet. After identifying the movement, try to recreate it using only the abdominal muscles without assistance from the hamstrings.

In all apparatus for developing abdominal muscles, the range of movement is short and there is no need to lean over as though you are “bowing-down.” Spinal flexion should be performed by the abdominal muscles only, without assistance from the hip joint.

Illustration 7.2. Exercise 7.1. Supine bent-knee crunch



a.) Start-/end-position



b.) Mid-position

Removing hands or legs from the movement axis (i.e., the spine) increases the difficulty level of this exercise.

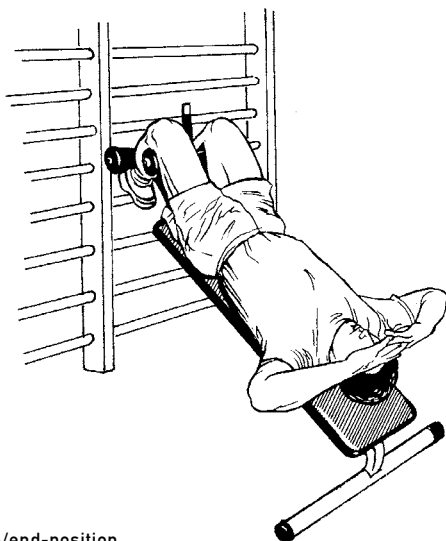
### EXERCISE 7.1. SUPINE BENT-KNEE CRUNCH

**Start-/end-position** Lie on back, feet on floor. Press lumbar area (the lowest part of the back) to the floor by bending knees (see illustration). If possible, place flexed legs on a chair so that both hip and knee are at 90-degree angles. Place hands on the forehead (see illustration), with the chin in. Maintain a fixed distance the size of an imaginary orange between chin and chest cage. Throughout the exercise, keep the neck long (a continuation of the trunk). It is better for beginners with weak abdominal and neck muscles to cross hands over the chest in order to neutralize the long action lever and to make the movement easier. Exercisers whose abdominals are sufficiently strong but whose neck muscles are still weak, should place one hand on their forehead, and the other behind the head to support the neck.

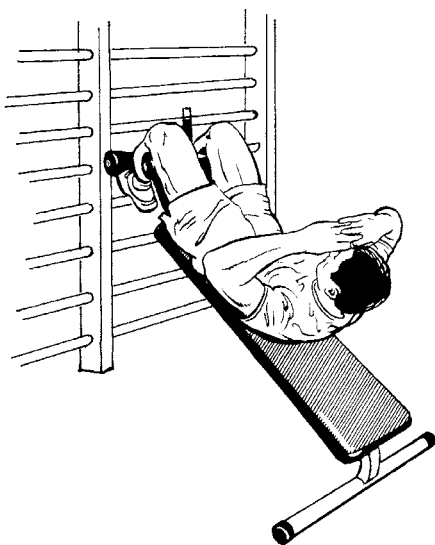
**Range of movement and performance** Flex upper part of spine until shoulder blades (scapulae) elevate (usually about 30°). Throughout the exercise, the neck should remain long – and keep holding that “orange” between chin and chest. The head should be a curved line continuation of the trunk – do not create an angle break at the neck. In ascending, ensure the movement uses only the abdominal muscles without utilizing a swinging motion, especially of the arms or head. Avoid head-nodding that may cause long-term damage including neck pains and headaches. When rising, avoid activating other unnecessary muscle groups such as hamstrings. Rise to a sitting position to a 4-count during exhalation; recline to a 6-count while inhaling.

**Movement analysis** From start to mid-position: Spine – flexion by the rectus abdominis and oblique muscles working concentrically. From mid- to end-position: Spine – extension by rectus abdominis and obliques contracting eccentrically.

Illustration 7.3. Exercise 7.2. Supine bent-knee incline abdominal board crunch



a.) Start-/end-position



b.) Mid-position

### EXERCISE 7.2. SUPINE BENT-KNEE INCLINE ABDOMINAL BOARD CRUNCH

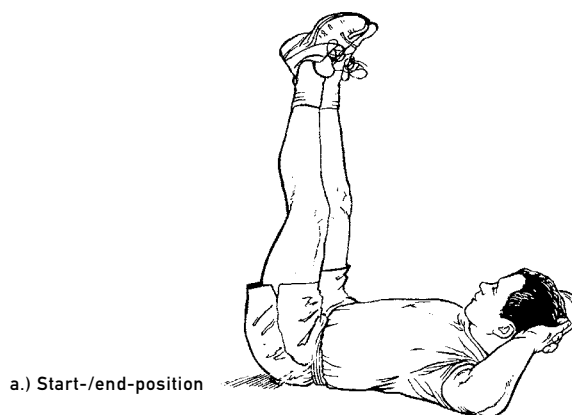
This exercise is very difficult and requires a relatively high level of physical strength and control. It is not intended for beginners or amateur exercisers.

**Start-/end-position** Lie back with legs bent at 90 degrees on a board with lower end on the floor and upper end attached to a ladder. Hands are interlaced on forehead or placed on chest to make the exercise easier. Head rests on the lower end of the board. Hold onto the board by interlacing legs between the two board cushions.

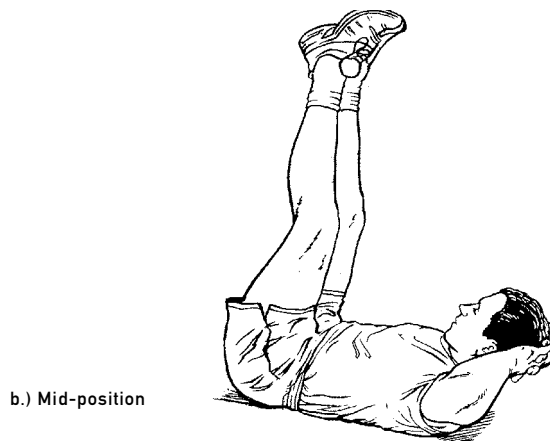
**Range of movement and performance** Flex upper part of spine so that the scapulae leave the surface. Avoid bouncing the pelvis in order to gain momentum or making unnecessary knee or hand movements. While rising, exhale to a 4-count. Descend slowly and with full control of the movement, inhale to a 6-count.

**Movement analysis** From start to mid-position: Spine – flexion by rectus abdominis and obliques working concentrically. From mid- to end-position: Spine – extension by rectus abdominis and obliques contracting eccentrically.

Illustration 7.4. Exercise 7.3. Supine vertical leg raise with posterior pelvic tilt.



a.) Start-/end-position



b.) Mid-position

### EXERCISE 7.3. SUPINE VERTICAL LEG RAISE WITH POSTERIOR PELVIC TILT

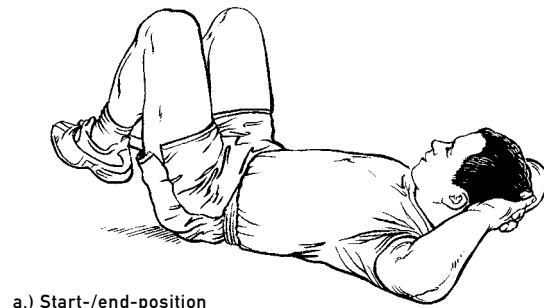
This exercise is for developing the lower part of the rectus abdominis, below the navel. Before beginning, it is worthwhile to identify the special movement with a focus on activity in the lower abdomen. In this way, we can neutralize any movement “compensation.” The movement in this exercise is low-key and highly focused. It is recommended that an instructor observe the exercise from the side to ensure that the exerciser avoids subconscious compensation and to ensure that the exercise is performed properly.

**Start-/end-position** Lie on back, hands intertwined behind head with elbows to the sides or crossed on chest (see illustration). Legs are vertical and straight, knees do not exceed navel line.

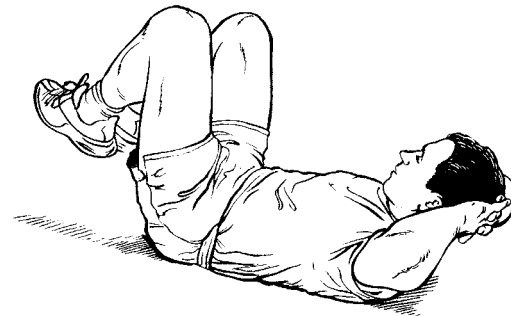
**Range of movement and performance** Tilt pelvis until only the sacrum is about 3 cm (an inch) off the floor. Hips ascend in the vertical plane only. Avoid bouncing the pelvis to gain momentum or moving knees forward or backward unnecessarily. Ascent is executed without assistance from arms or hip momentum. Make sure hands do not press on the neck. Raise pelvis in a 4-count while exhaling, and lower it in a 6-count while inhaling.

**Movement analysis** From start to mid-position: Spine – flexion by rectus abdominis, obliques and transverse abdominis working concentrically. From mid- to finish position: Spine – extension by rectus abdominis, obliques and transverse abdominis contracting eccentrically.

Illustration 7.5. Exercise 7.4. Supine bent-knee rectus abdominis with posterior pelvic tilt.



a.) Start-/end-position



b.) Mid-position

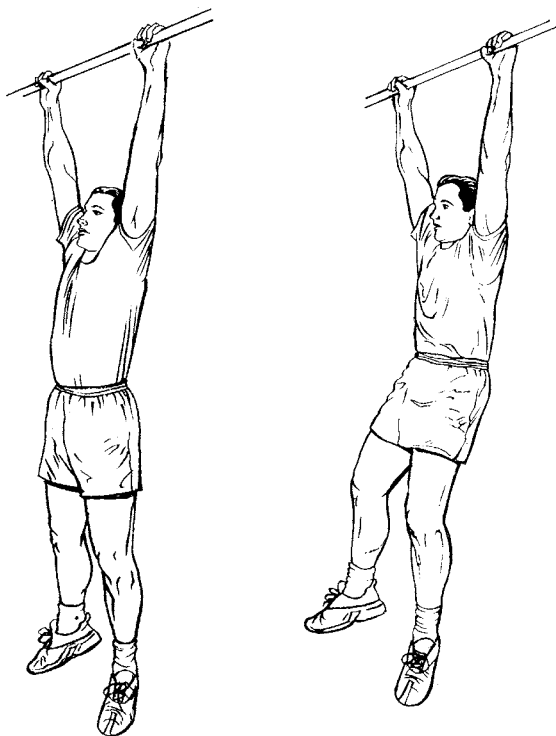
### EXERCISE 7.4. SUPINE BENT-KNEE RECTUS ABDOMINIS WITH POSTERIOR PELVIC TILT

**Start-/end-position** Lie on back, hips raised at a 90-degree angle, knees bent but not exceeding navel line. Feet are in the air, hands intertwined behind head. Hands hold head, without touching the floor to avoid pressure on neck during the exercise.

**Range of movement and performance** Lift only the sacrum from the floor by means of posterior pelvic tilt. Hold about two seconds and then lower sacrum to floor. Be sure thighs elevate only from abdominal muscle power rather than from knee flexion. Knees are lowered under abdominal muscle control. Elevate to a 4-count while exhaling, and descend to a 6-count while inhaling.

**Movement analysis** From start to mid-position: Spine – flexion by rectus abdominis, obliques and transverse abdominis working concentrically. From mid- to finish position: Spine – extension by rectus abdominis, obliques and transverse abdominis contracting eccentrically.

Illustration 7.6. Exercise 7.5. Straight arm bar hang with posterior pelvic tilt.



a.) Start-/end-position

b.) Mid-position

#### EXERCISE 7.5. STRAIGHT ARM BAR HANG WITH POSTERIOR PELVIC TILT

This exercise develops all the abdominal muscles safely – but is very difficult. Execution of the exercise requires complete coordination and sufficient hand strength to hold on for an extended period of time. One big advantage of the exercise is that, unlike other sit-up exercises, it exerts almost no pressure or load on the cervical vertebrae.

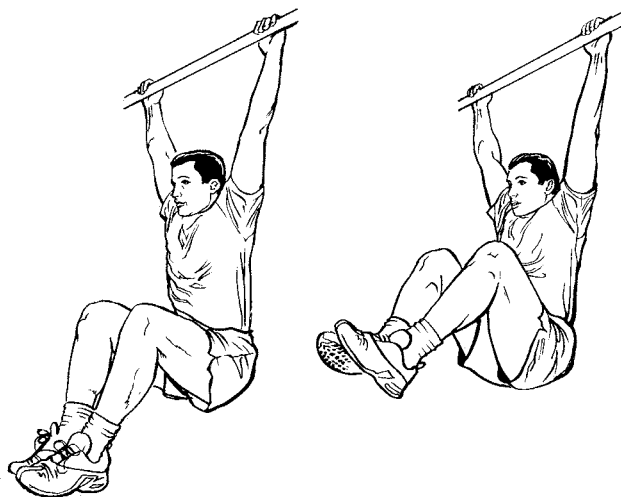
**Start-/end-position** Hang from chin-up bar (overhand grip), legs straight.

**Range of movement and performance** Posterior pelvic tilt by abdominal muscles only. In return, tilt pelvis to the front

(anterior pelvic tilt) under abdominal muscle control. Avoid bouncing pelvis to gain momentum or making unnecessary thigh or arm movements. During posterior pelvic tilt, exhale to a 4-count; during anterior pelvic tilt inhale to a 6-count.

**Movement analysis** From start to mid- position: Spine – flexion by rectus abdominis, obliques and transverse abdominis working concentrically. From mid- to end-position: Spine – extension by rectus abdominis, obliques and transverse abdominis contracting eccentrically.

Illustration 7.7. Exercise 7.6. Straight arm bar hang with posterior pelvic tilt leg raise.



a.) Start-/end-position

b.) Mid-position

#### EXERCISE 7.6. STRAIGHT ARM BAR HANG WITH POSTERIOR PELVIC TILT LEG RAISE

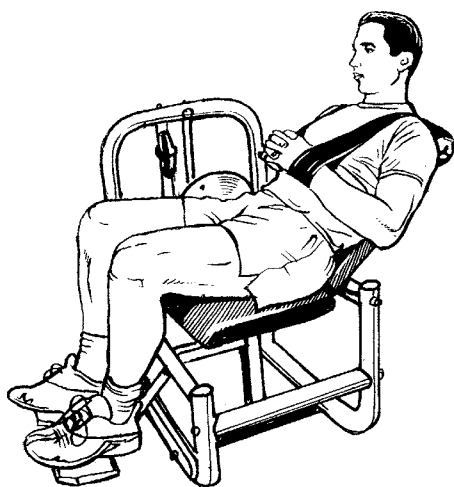
This exercise is more difficult than the preceding one because of the change in the centre of gravity. The movement is executed by the lumbar vertebrae only without added momentum from thighs or arms. By raising knees ninety degrees at the hip joint, most of the effort is on the hip flexors and very little is on the abdominals. Only when the knees are raised higher than ninety degrees is the effort performed by the abdominal muscles.

**Start-/end-position** Hang from chin-up bar, overhand grip, with legs bent ninety degrees at hip and ninety degrees at knees.

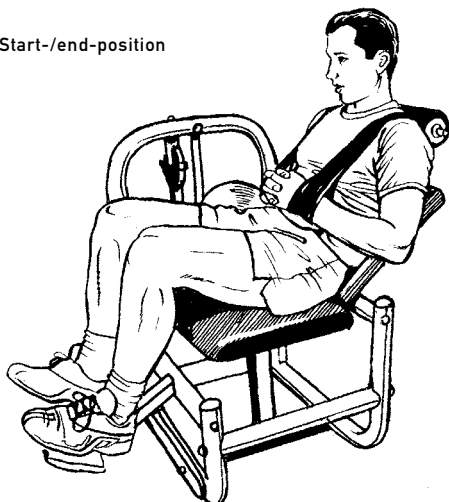
**Range of movement and performance** Tilt pelvis to rear and raise knees towards chest. Avoid bouncing pelvis to gain momentum and making unnecessary thigh or arm movements. Exhale to a 4-count while raising legs in a posterior pelvic tilt while lowering legs and inhaling to a 6-count.

**Movement analysis** From start to mid-position: Spine – flexion by rectus abdominis, obliques and transverse abdominis working concentrically. From mid- to end-position: Spine – extension by rectus abdominis, obliques and transverse abdominis contracting eccentrically.

Illustration 7.8. Exercise 7.7. Machine seated crunches.



a.) Start-/end-position



b.) Mid-position

## EXERCISE 7.7. MACHINE SEATED CRUNCHES

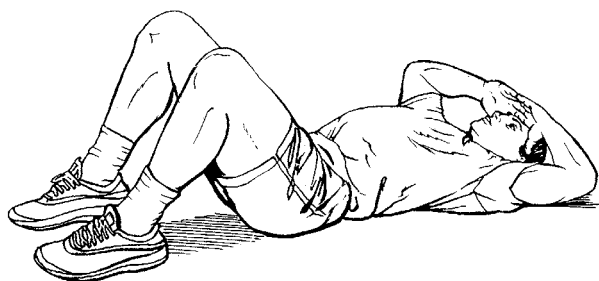
In this exercise, it is of utmost importance to organize the body on the machine before beginning in order to prevent loads and pressures on lower back and cervical vertebrae. On all machines for developing the abdominals, the range of movement is short and does not requiring a bowing-down motion. Spinal flexion should be performed by the abdominal muscles only, without assistance from the hip joint.

**Start-/end-position** Position yourself on the machine so that the action axis, which is the lumbar vertebrae, faces the movement axis, which is the large circle on the apparatus. Raise the legs from the floor and place them on the apparatus foot rest. Slip hands into straps and rest the resistance bar on the upper part of the scapulae. Rest hands on chest. Shoulders should be in the air rather than leaning on the backrest to avoid creating excessive lumbar lordosis. As the exercise begins, the abdomen should be drawn in.

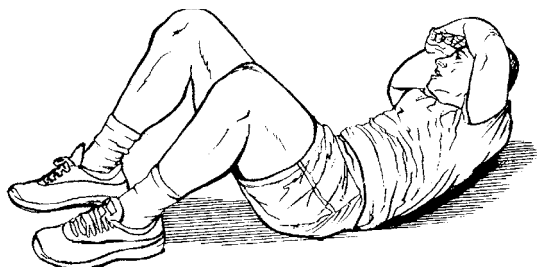
**Range of movement and performance** Flex lumbar vertebrae while tensing abdominal muscles without moving or straining legs on floor. The range of movement is very short and focused mainly on the abdominals in the area of spinal vertebrae L1 to L5. Be sure that flexion is executed by the abdominals only without assistance from arm muscles or by pulling on the straps. In extension, return slowly and with control until only the lower back is leaning on the backrest. In the return movement, avoid excessive lumbar lordosis. During flexion, exhale to a 4-count, and during extension, inhale to a 6-count.

**Movement analysis** From start to mid-position: Spine – flexion by rectus abdominis and obliques working concentrically. From mid- to end-position: Spine – extension by rectus abdominis and obliques contracting eccentrically.

Illustration 7.9. Exercise 7.8. Supine bent-knee sit-up with twist/cross.



a.) Start-/end-position



b.) Mid-position

## EXERCISE 7.8. SUPINE BENT-KNEE SIT-UP WITH TWIST/CROSS

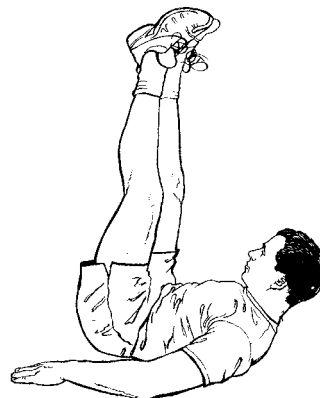
**Start-/end-position** Lie on back with feet on floor and lumbar region flat on floor (see illustration). It is also possible to flex knees in the air or place them on a chair at a 90-degree angle in order to avoid intervertebral lumbar disc pressure. Hands are on forehead (see illustration) and the chin is pulled in. Try to maintain a fixed distance of an (imaginary) orange between chin and chest.

**Range of movement and performance** Bring one elbow up towards opposite knee while rotating body. It is important to raise the shoulder blade from the floor rather than using arm power for lifting. Avoid turning your head to the sides, which may cause pressure on the neck. Throughout the exercise, keep neck long. During flexion, exhale to a 4-count, and in return movement, inhale to a 6-count.

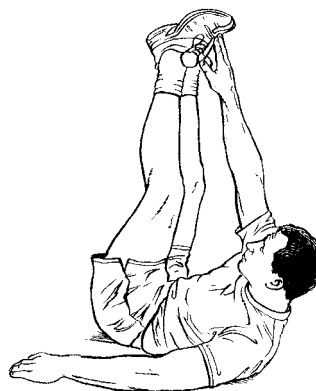
**Another variation** To make the exercise easier, do the following: Place one arm on floor next to body while rising to flexion, dragging arm in the direction of rising. Advanced exercisers can place the second hand on their forehead to neutralize momentum movement. Beginning exercisers can place their second hand behind the neck or on the chest.

**Movement analysis** From start to mid-position: Spine – flexion with rotation by obliques and rectus abdominis working concentrically. From mid- to end-position: Spine – extension with rotation by obliques and rectus abdominis contracting eccentrically.

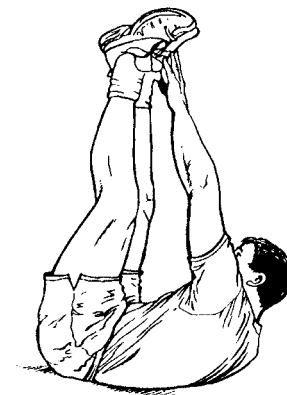
Illustration 7.10. Exercise 7.9. Supine vertical leg alternation crunch with foot touches.



a.) Start-/end-position



b.) Mid-position



### EXERCISE 7.9. SUPINE VERTICAL LEG ALTERNATION CRUNCH WITH FOOT TOUCHES.

This exercise integrates all the abdominal muscles –transverse abdominis, both obliques and rectus abdominis, with an emphasis on the upper and lower parts at especially high intensities. During the exercise, load is exerted on the cervical extensors and can be reduced by bringing the chin to the chest.

**Start-/end-position** Lie on back, legs vertical and straight up. Pelvis tilts to the rear with coccyx in the air, shoulder blades are off floor.

**Range of movement and performance** Place one arm beside the body, and try to touch the outside of one foot with the opposite hand. Alternate hands and legs, be sure to avoid straining the neck, make sure shoulder blades are off floor, and avoid rolling the body. During flexion towards the opposite foot, exhale to a 4-count, and during return movement, inhale to a 6-count. Be sure to inhale and exhale throughout the exercise.

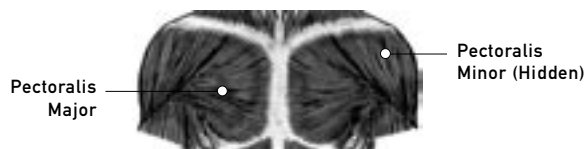
**Movement analysis** From start to mid-position: Spine – flexion through rotation, by obliques, rectus abdominis and transverse abdominis working concentrically. From mid- to end-position: Spine – extension through rotation, by obliques, rectus abdominis and transverse abdominis contracting eccentrically.

## 8: EXERCISES FOR THE CHEST MUSCLES

The chest muscles (*pectorals* or *pecs*) are the unabashed symbol of masculinity among men and femininity among women. Studies of adolescent and adult preferences for gym activity indicate a clear tendency among both genders to develop the chest muscles. A prominent chest is a beauty ideal and one of today's sex symbols. Some women are willing to surgically implant silicon to enhance their sexual appeal. Many exercisers invest a disproportionate amount of time in developing their pectorals, evidently for the same reason. Considering the obvious aesthetic and sexual appeal of the chest, it is important to clarify how important the pectorals really are functionally.

### *The chest muscles*

Illustration 8.1. The chest muscles.



Frontal view of the pectorals

The main action of the chest muscles is horizontal adduction, what is called a “hugging” movement. Today, when we no longer have to hunt for food or wrestle with wild animals for survival, the pectorals do not play the significant role they held in the past. In other words, beyond their aesthetic and sexual appeal, well-developed pectorals have very little functional use. Moreover,

overdevelopment of the chest muscles may actually cause posture disorders. Overtraining the pecs causes them to shorten so that they may pull the shoulders forward.

The pectoral muscles consist of two layers, the deeper called *pectoralis minor* (which is hidden) and the superficial, outer layer called *pectoralis major*. Due to its size, pectoralis major is usually divided into two work areas, upper pectoralis and lower pectoralis but, contrary to belief, “upper” and “lower pectorals” are not separate. Overshortening the pecs creates an imbalance in muscle tone (which means tension) among pectorals (pectoralis minor, for the most part), scapular adductors, and posterior deltoids. This disproportional development of the pecs causes the head to be thrown back to compensate for the altered dynamic balance. The results are intradisc load, pressure on cervical vertebrae, and the beginnings of visible posture disorders. Furthermore, high pectoral tonus and mass make extended aerobic activity more difficult because of the weight involved in repeatedly lifting the thorax and rib cage. Thus, exercisers are advised to be aware of the consequences of overdeveloped pecs and to consider the wiser option of improving the range of shoulder joint movement together with balanced power training.

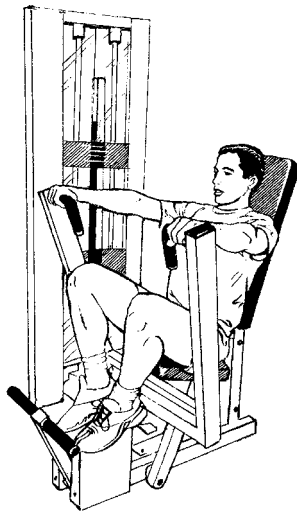
The exercises that appear in this chapter are a representative sample of “classic” exercises. It is important to adhere to safety precautions to minimize injury risk factors.

Exercises are arranged according to activity type, body position, and difficulty level (for other exercises for developing pectoral muscles, see pp. 119–20 and 123–24 under “Common exercises for developing power on multi-purpose apparatus”).

Illustration 8.2. Exercise 8.1. Machine seated chest press.



a.) Start-/end-position



b.) Mid-position

### EXERCISE 8.1. MACHINE SEATED CHEST PRESS

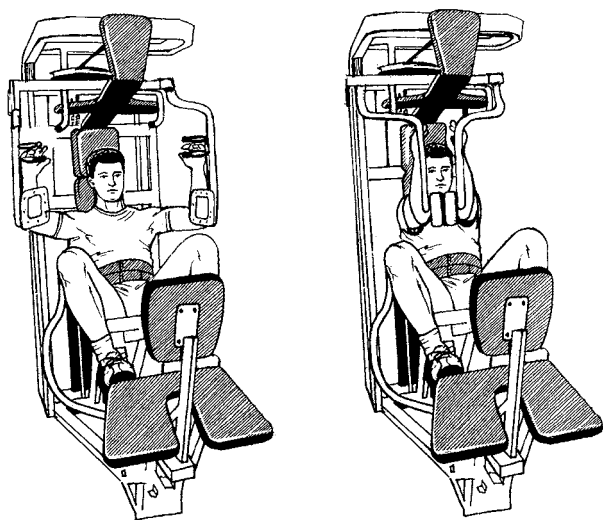
This is a classic exercise for beginners because it is safe and easy to perform. Before beginning, be sure resistance is not too high and that the cables are taut. It is recommended that older or younger populations use the auxiliary foot rest to ease high resistance weights at the beginning of the movement. Advanced exercisers, whose shoulder joints are flexible enough to perform hyperextension in the exercise, can manage without the foot rest.

**Start-/end-position** Sit on the machine, holding the handles with overhand grip and placing the feet on the foot rest. Be sure the hand forms a direct extension of the forearm with no wrist flexion in order to avoid pressure on the root nerves and tendons. Close the thumb under the handle to avoid slipping. Adjust seat height so that handles are at chest nipple height because the press is on the horizontal plane facing the pectoral muscle in the shoulder joint which is the axis of movement. Chin is held in and head is held up. For maximal development of pectorals, perform the activity with shoulders at a ninety-degree angle and elbows also at a ninety-degree angle. Maintain a broad grip (horizontal handles)(see illustration).

**Range of movement and performance** The apparatus has two work angles. In a wide grip most of the effort is on the pectoral muscles. In a narrow grip (vertical handles), the rear arm muscle (triceps) acts as synergist to pectorals. During the activity, body position does not change. Push handles away from chest until arms are straight, exhaling to a 4-count. Return movement is to a 6-count while inhaling.

**Movement analysis** From start to mid-position: Sterno-scapular joint: abduction by serratus anterior working concentrically. Shoulder – horizontal arm adduction by pectoralis major and anterior deltoid working concentrically. Elbow – extension by triceps working concentrically. From mid- to end-position: Sterno-scapular joint: adduction by serratus anterior contracting eccentrically. Shoulder – horizontal arm abduction by pectoralis major and anterior deltoid contracting eccentrically. Elbow – flexion by the triceps contracting eccentrically.

Illustration 8.3. Exercise 8.2. Machine seated pec deck fly / Bent-arm fly.



a.) Start-/end-position

b.) Mid-position

#### EXERCISE 8.2. MACHINE SEATED PEC DECK FLY / BENT-ARM FLY

Performing the pec deck fly on the machine specifically targets pectoralis. The high load on the muscle may result in chest cramps and discomfort as well as “pins and needles” when breathing because of pressure on the sternum (the central bone in the chest). For these reasons, this exercise is not for beginners, whose chest muscles are weak. They should attempt this exercise only after three months of working out in the gym. The relative advantage of this exercise is its simplicity in terms of movement and the speed of the visible training effect. In order to isolate the chest muscles, be sure to push the apparatus cushion with the medial protuberance of the *humerus* (the protrusion on the inner side of the elbow). Avoid pushing with the forearm. Varying the height of the medial protuberance on the cushion facilitates maximal development of the pectoral muscle fibres. Avoid grasping the bar arms with the hands. This causes the hands to do the work and the shoulders to perform the elevation. The load is then mainly shifted to the cervical vertebrae instead of the pectoral muscles. Exercisers whose body dimensions do not allow them

to reach the resistance bars with their elbows would be advised to skip this exercise and substitute one on another apparatus, such as the sitting chest press.

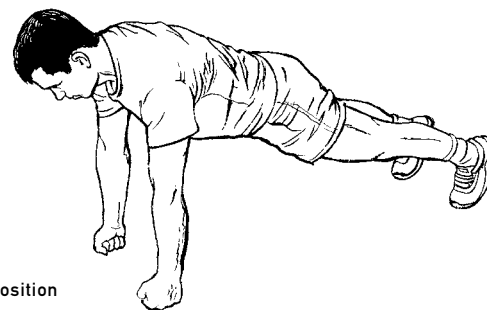
The auxiliary foot rest on the machine is intended to help exercisers neutralize resistance at the start and end of the exercise (see p. 47 for a detailed explanation of the use of auxiliary foot rests).

**Start-/end-position** Sit with feet on the foot plates (rather than leaving them on the auxiliary foot rests), elbows at shoulder height, lever cushions touching medial protuberance of the elbow.

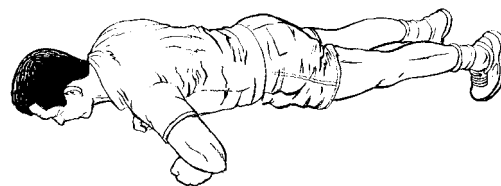
**Range of movement and performance** Adduct arms horizontally. Perform the movement carefully and with control and avoid banging the apparatus arms together. Stop a few millimetres *before* the machine arms meet. Be sure the elbows are placed at pectoral height and not above shoulder height in order to not overload the cervical vertebrae. Adduction is performed to a 4-count while exhaling, abduction to a 6-count while inhaling.

**Movement analysis** From start to mid-position: Sterno-scapular joint – abduction by serratus anterior working concentrically. Shoulder – horizontal adduction of shoulders and arms by pectoralis major and anterior deltoid working concentrically. From mid- to end-position: Sterno-scapular joint – adduction by serratus anterior contracting eccentrically. Shoulder – transverse abduction of shoulder and arms by pectoralis major and anterior deltoid contracting eccentrically.

Illustration 8.4. Exercise 8.3. Knuckle push-ups.



a.) Start-/end-position



b.) Mid-position

### EXERCISE 8.3. KNUCKLE PUSH-UPS

This is the most commonly used exercise for developing arm and chest muscles without apparatus and can be performed anywhere. It is recommended to perform *fist push-ups*, because pressure on the knuckles is preferable to pressure on the wrist. Overloading the wrists at a ninety-degree angle to the forearm may cause pain and result in the long run in inflammation of the ganglia (nerve centres). Fist push-ups, by contrast, shift pressure and load to the muscles and away from the wrist, which is a delicate and complex joint not made for bearing loads for long periods. It is possible to place cushions under the finger joints or perform the exercise on a mattress in order to reduce pressure and feelings of discomfort on the knuckles.

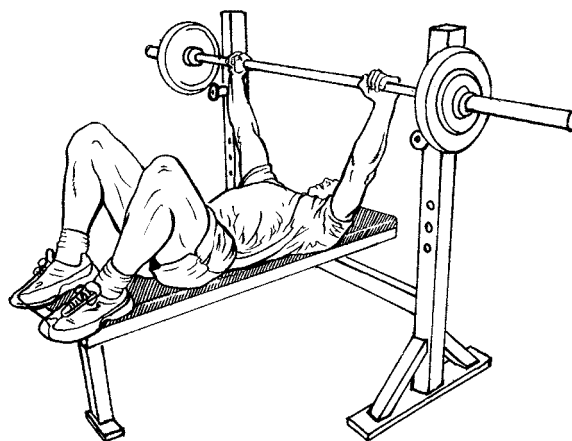
**Start-/end-position** Stand on fours, resting toes behind and fists in front, body is held straight from head to heels, diagonally-horizontally to the floor.

**Range of movement and performance** Flex elbows to about ninety degrees or until chest is a fist-length away from the floor. When straightening, avoid locking the elbows (full extension) so as not to wear away elbow cartilage. During push-ups, the body remains one straight unit from the head through the spine, without assistance or sinking of the pelvis. Avoid head movements that create unnecessary pressure and loads on the neck. Inhale during flexion (descending), to a 6-count, while exhaling during extension (ascending) to a 4-count.

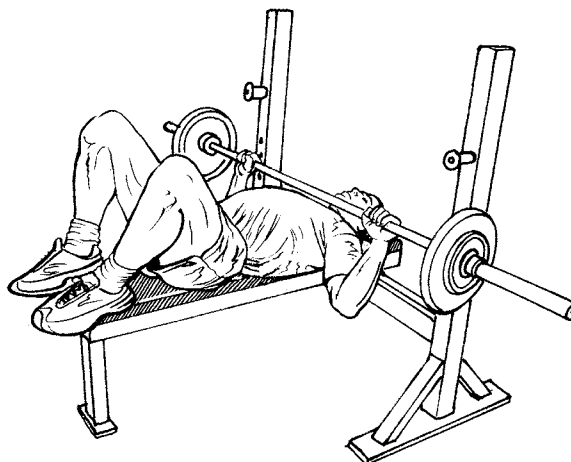
**Possible load variations** The greater the spread of the arms, the more the chest muscle is opened. The smaller the spread between arms and the closer the elbows are held to the ribs, the more the triceps (rear arm muscles) are opened. Legs can rest at various heights to alter the centre of gravity and to increase the load on chest and arm muscles.

**Movement analysis** From start to mid-position: Sterno-scapular joint – adduction by serratus anterior contracting eccentrically. Shoulder – transverse abduction of arms by pectoralis major and anterior deltoid contracting eccentrically. Elbow – flexion by triceps contracting eccentrically. From mid- to end-position: Sterno-scapular joint – abduction by serratus anterior working concentrically. Shoulder – transverse adduction of arms by pectoralis major and anterior deltoid working concentrically. Elbow – extension by triceps working eccentrically.

Illustration 8.5. Exercise 8.4. Supine bent-knee flat bench barbell press.



a.) Start-/end-position



b.) Mid-position

### EXERCISE 8.4. SUPINE BENT-KNEE FLAT BENCH BARBELL PRESS

This exercise is especially popular for strengthening the pecs, the posterior arm muscles, and the anterior deltoid muscles. It is quite risky to perform at high loads without supervision. In any case, it is recommended have a spotter. Bench press championships are held and, according to “competitive regulations,” buttocks must remain on the seat, and the feet are on the floor in order to increase press ability.

The version presented here is safer since placing feet on the floor creates hyperarching of the lower back and

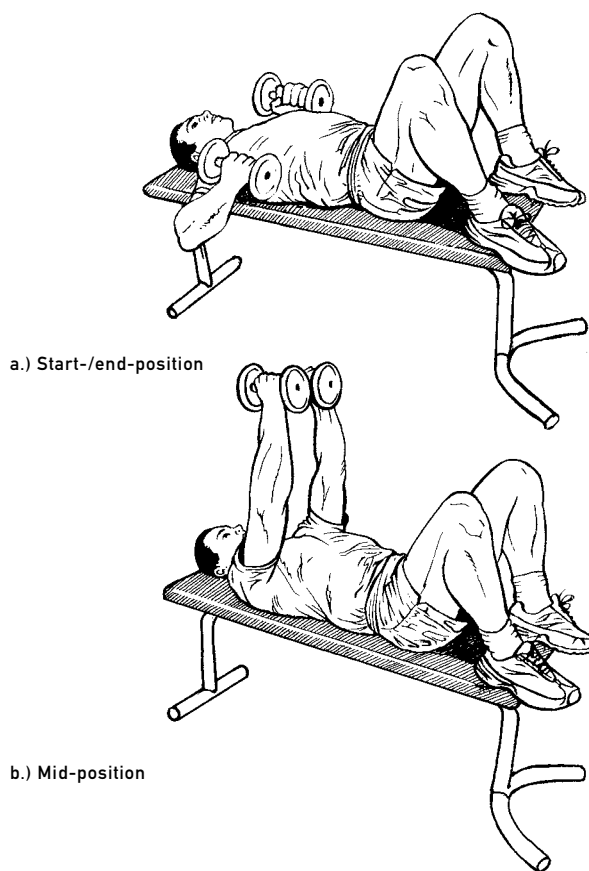
excessive intradisc pressure on lumbar lordosis. It is recommended to perform the exercise with knees flexed in the air since this position neutralizes arching; but it also detracts from one's feeling of stability on the bench. The greater the hand spread on the bar, the more open the pectoralis muscle and the smaller the distance, the more the triceps are open. Other options for varying hand spread include changing seat position, which affects the press angle (decline or incline) in order to develop all parts of the upper and lower pectorals.

**Start-/end-position** Lying on back, place the feet on the bench or flex knees in the air above navel. Hold the bar with an open or closed overhand grip, at slightly more than shoulder width apart. Remove the bar from the stand and stabilize it above the chest with elbows straight but not locked.

**Range of movement and performance** Lower the bar slowly and carefully until it is a centimetre above the chest. Try to prevent the bar from touching the chest in order to avoid banging. Then raise the bar slowly until arms are straight. When the set is completed, return the bar to the stand. Body position does not change during the exercise. Arm flexion while lowering the bar should be executed to a 6-count, while inhaling, extending the elbows and pressing the bar should be performed to a 4-count while exhaling. The bar should be removed from and replaced on the stand with the assistance of a spotter.

**Movement analysis** From start to mid- position: Shoulder – horizontal arm abduction by pectoralis major and anterior deltoid contracting eccentrically. Sterno-scapular joint – adduction by the serratus anterior contracting eccentrically. Elbow – flexion by triceps contracting eccentrically. From mid- to end-position: Shoulder – horizontal arm adduction by pectoralis major and anterior deltoid working concentrically. Sterno-scapular joint – abduction by serratus anterior working concentrically. Elbow – extension by triceps working concentrically.

Illustration 8.6. Exercise 8.5. Supine bent-knee flat bench dumbbell press.



### EXERCISE 8.5. SUPINE BENT-KNEE FLAT BENCH DUMBBELL PRESS

To develop both the upper and lower pectoralis, this exercise should be performed at varied press angles by altering bench angle (decline or incline). A common error among many exercisers is to “ring” the dumbbells at the end of the movement (mid-position). The friction can chip the weight coverings and endanger the eyes. Avoid banging the dumbbells together at mid-position.

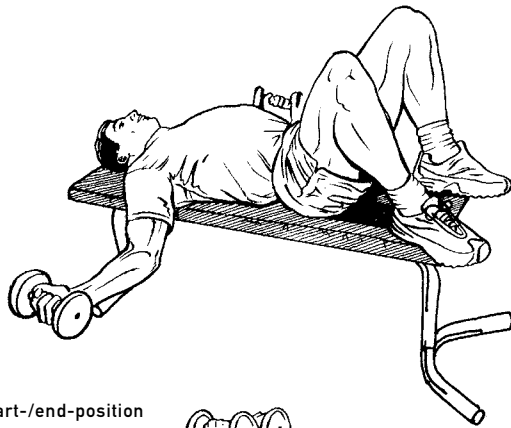
**Start-/end-position** Lie on back on a narrow bench in order to allow shoulder movement. Head rests completely on the bench. Flex knees in the air above navel to reduce lordosis, or place feet on the bench to improve the feeling of stability at high loads. Grasp weights in an open overhand grip, arms flexed and elbows at shoulder height (see illustration).

**Range of movement and performance** Press weights upward until elbows are straightened. Avoid locking elbows and ringing

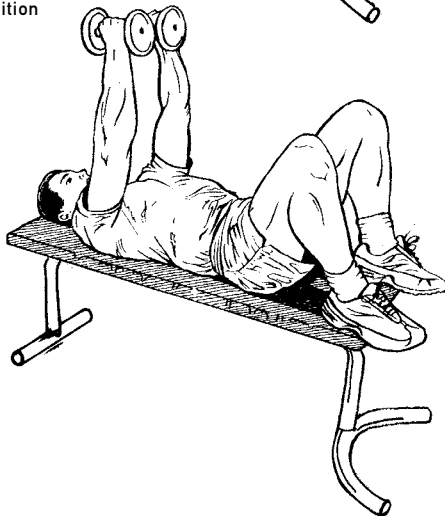
the dumbbells. Hold the same body position throughout the exercise and control the range and tempo of the movement. At the end of the set, there is a tendency to drop the weights onto the floor, which may crack the floor. Instead, place them carefully on a rubber shock absorbing plate. Straighten elbows to a 4-count while exhaling; flex elbows to a 6-count while inhaling.

**Movement analysis** From start to mid-position: Shoulder – horizontal adduction of arms by pectoralis major and anterior deltoid working concentrically. Sterno-scapular joint – abduction by serratus anterior working concentrically. Elbow – extension by triceps working concentrically. From mid- to end-position: Shoulder – horizontal abduction of arms by pectoralis major and anterior deltoid contracting eccentrically. Sterno-scapular joint – adduction by serratus anterior contracting eccentrically. Elbow – flexion by triceps contracting eccentrically.

Illustration 8.7. Exercise 8.6. Supine bent-knee flat bench dumbbell fly.



a.) Start-/end-position



b.) Mid-position

## EXERCISE 8.6. SUPINE BENT-KNEE FLAT BENCH DUMBBELL FLY

To develop both the upper and lower pectoralis, the bench angle (decline or incline) should be altered, which affects the press angles. The elbow fixator group works during the entire exercise.

**Start-/end-position** Lie on back on a narrow bench in order to allow shoulder movement. Head rests completely on the bench. Place feet on the bench to reduce lumbar lordosis and to give a greater feeling of stability at high loads. Alternatively, knees can be flexed in the air above the navel. Grasp weights in a closed overhand grip, arms almost straight, spread to the sides at shoulder-line height.

**Range of movement and performance** Perform horizontal adduction, bringing the weights towards the midline in a broad arch until hands are almost touching. Avoid banging the weights together and locking the elbows. Return weights to end-position in horizontal abduction, in a broad arch that is slow and controlled. Maintain the same body position throughout the exercise and control the range and tempo of the movement. At the end of the set, gently place the weights on a rubber shock absorbing plate. Horizontal adduction is performed to a 4-count while exhaling, and abduction occurs to a 6-count while inhaling.

**Movement analysis** From start to mid-position: Shoulder – horizontal adduction of arms by pectoralis major and anterior deltoid working concentrically. Sterno-scapular joint – abduction by serratus anterior working concentrically. From mid- to end-position: Shoulder – horizontal abduction of arms by pectoralis major and anterior deltoid contracting eccentrically. Sterno-scapular joint – adduction by serratus anterior contracting eccentrically.

## 9: EXERCISES FOR ARMS AND FOREARMS

The arms serve many different functions in daily life. We use them for powerful actions such as lifting, pushing, or pulling, as well as for gentle movements requiring precise coordination such as writing, drawing, and playing musical instruments. The arms are essential for transmitting visual signals, whether raised as a show of aggression, a “V” for victory, or spread wide as a sign of friendship. Arms and hands play an integral part of human language and we often employ them unconsciously while speaking. Although arms were once essential tools for prehistoric humans in their struggle for survival, this role has been reduced in the majority of modern societies. Strong arm development is no longer a matter of survival and there is little need for especially strong arms. At the same time, the arms, as with the legs, are perceived as symbols of strength and can be sexually arousing. It is not surprising, therefore, that well-developed biceps, perhaps more than any other muscle in the body, often serve as a commercial symbol for products that are supposed to radiate power. The fashion industry, which is well aware of the marketing and commercial potential inherent in muscular arms, offers a broad array of shirts and t-shirts that draw attention to muscular, well-shaped upper limbs.

Developing strong, shapely arm muscles does not necessarily require the use of weight machines and heavy equipment. They can also be built up through aerobic activities such as swimming and mountain climbing. Strong arms help reduce loads on the back. When arms are weak, the back has to bear the brunt of the loads, and this may cause damage over time.

### *The main arm muscles*

The exercises presented here illustrate ways to develop anterior (mainly biceps) and posterior (mainly triceps) arm muscles, through integrating reflective thinking in the process. They are presented from the centre of the body to the periphery, from the upper (proximal) part of the arm towards the lower (distal) part: anterior arm, posterior arm, and forearm. Each group of exercises is also arranged by complexity, beginning with auxiliary apparatus and ending with hand weights. To strengthen the *anterior arm*, we will perform *Machine seated preacher curl*, followed by *Standing cable low pulley arm curl*. We will use both arms for *Standing barbell biceps curl* and for *Standing reverse Ez curl*. Working on each arm separately, we will execute *Seated dumbbell biceps curl* and *Seated concentration curl*.

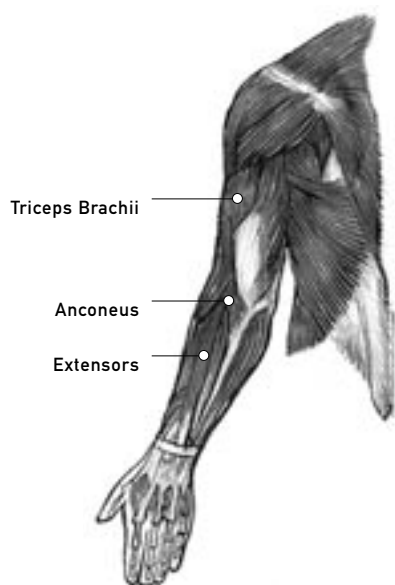
To strengthen the posterior arm, we will work on both arms in *Machine seated triceps extension* and *Standing high pulley triceps pushdown* and finish with *Supine bent-knee flat bench triceps extension* (French press) and *Close narrow grip dips*. To develop each posterior arm individually using free weights, we will begin with *Seated overhead triceps extension* and *Supine bent-knee flat bench dumbbell triceps extension* and conclude with *Bent standing triceps kick back*.

To develop the forearm muscles, we will perform flexion and extension. To develop the flexor muscles, we will execute *Seated barbell wrist curl*. To develop the forearm extensors, we will do *Seated barbell wrist extension*, as well as *Standing arms-extended wrist-roller wrist curl* and/or *Standing olympic plate hand extension (squeeze)*.

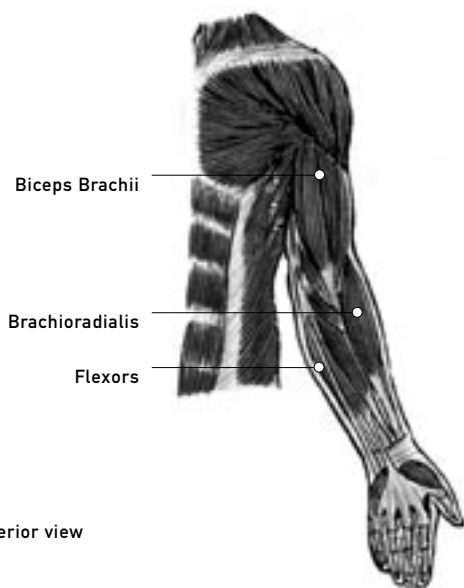
For additional exercises for developing arm muscles, see p. 116, Common exercises for developing strength on multi-purpose apparatus: Assisted dips (against body weight).

#### Arm muscles

Illustration 9.1. Posterior and anterior views of the muscles of the arms



a.) Posterior view



b.) Anterior view

### 9.1. ANTERIOR ARM

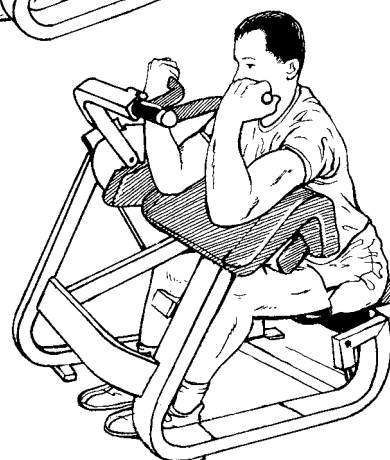
Anterior arm muscles participate in flexion of the forearm. The *biceps brachii* is the muscle that gives the upper arm its “look” from the front. This is the prominent muscle symbolizing power; the one we are proud of and love to show off whether we are actors, models, athletes, or simply members of the population at large. However, it would be a mistake to believe that biceps represent beauty only, when in fact, they integrate functionality and aesthetics. They are crucially important in most sports, including apparatus, gymnastics, ball games, and weightlifting. Biceps brachii is directly responsible for all flexion movements of the forearm and involved in daily activities such as lifting, pulling, and carrying.

The brachialis lies under the biceps. The brachioradialis muscle is located on the lateral (outside) of the elbow.

Illustration 9.2. Exercise 9.1. Machine seated preacher curl.



a.) Start-/end-position



b.) Mid-position

This exercise isolates biceps brachii. Exercisers should warm up before starting this exercise. Be careful at the end of the flexion movement to prevent damage occurring in the anterior deltoid muscle; and, at the conclusion of extension, avoid locking the elbows. Keep the same body position throughout the exercise without movement in the sterno-scapular joint.

### EXERCISE 9.1. MACHINE SEATED PREACHER CURL

**Start-/end-position** Sit on the bench with the chest leaning on body rest and feet spread on the floor. Hold the bar in an underhand closed grip with elbows symmetrically placed on the cushion. Be sure that both arms participate equally in each repetition of the exercise. Ensure that the arms rather than the neck do the work.

**Range of motion and performance** Flex elbows and raise the bar to a distance of about ten centimetres from the anterior deltoid muscle. Flexion is performed to a 4-count while exhaling. Straighten elbows slowly to a 6-count while inhaling.

**Movement analysis** From start to mid-position: Elbow – flexion by biceps brachii, brachialis, brachioradialis, wrist flexors and fingers working concentrically. From mid- to end-position: Elbow – extension by biceps brachii, brachialis, brachioradialis, wrist flexors and fingers contracting eccentrically.

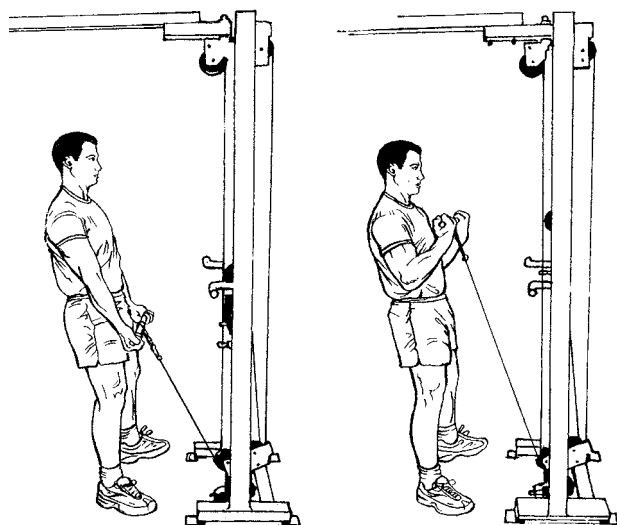
### EXERCISE 9.2. STANDING CABLE LOW PULLEY ARM CURL

**Start-/end-position** Stand about half a metre from the apparatus. Face the apparatus and keep the back straight, head up, and eyes looking ahead. Flex knees slightly, tilt pelvis to rear, lean shoulders towards the rear and hold elbows close to body. Grasp the bar in an underhand grip; weights slightly in the air and cable taut.

**Range of motion and performance** Raise the bar in a controlled arching movement by flexing the elbows to a distance of about ten centimetres from the anterior deltoid muscle. Avoid jerking the bar upward or moving arms to the rear or sides. Be careful at the end of flexion to avoid injuring the anterior deltoid muscle. Keep the same body position throughout the exercise and avoid hyperextension of the back when overcoming resistance. In the return movement, extend elbows slowly. Flexion is performed to a 4-count while exhaling, extension to a 6-count while inhaling.

**Movement analysis** From start to mid- position: Elbow – flexion by biceps brachii, brachialis, brachioradialis, wrist flexors and fingers working concentrically. From mid- to end-position: Elbow – extension by biceps brachii, brachialis, brachioradialis, wrist flexors and fingers contracting eccentrically.

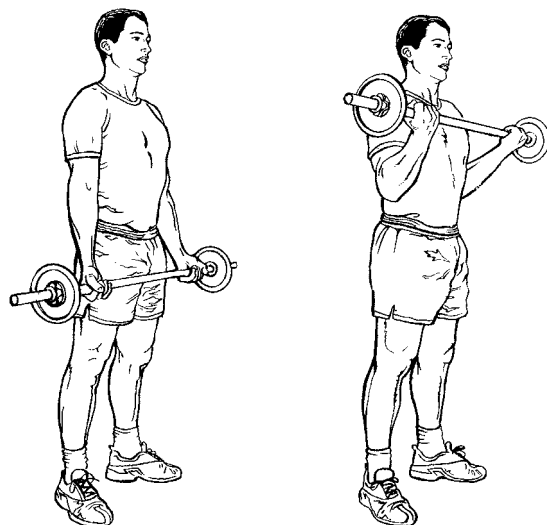
Illustration 9.3. Exercise 9.2. Standing cable low pulley arm curl.



a.) Start-/end-position

b.) Mid-position

Illustration 9.4. Exercise 9.3. Standing barbell biceps curl.



a.) Start-/end-position

b.) Mid-position

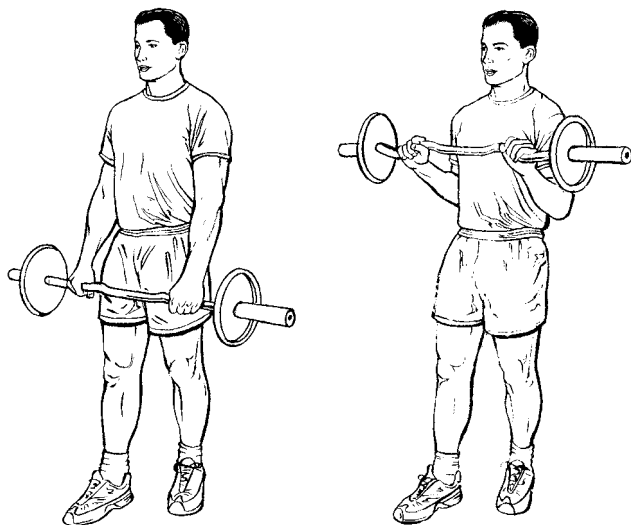
### EXERCISE 9.3. STANDING BARBELL BICEPS CURL

**Start-/end-position** Grasp the bar in an underhand closed grip; hands spread slightly more than shoulder width apart. Legs are also slightly more than shoulder width apart. Knees are flexed a bit, pelvis is tilted to the rear, back is straight, head raised, eyes focused forward. Upper arms are against ribs and vertical to the floor. The bar rests on the anterior thigh, with elbows straight.

**Range of motion and performance** Flexing the elbows, raise the bar in an arching movement to a distance of about ten centimetres from the anterior deltoid muscle. Avoid jerking the bar upward or moving arms to the back or side. Avoid a swinging momentum or flexing of the trunk to the rear and putting excessive load on the lumbar region. Be careful at the end of flexion not to injure the anterior deltoid muscle and in extension or lock the elbows. Keep the same body position throughout the exercise. Flexion is to a 4-count while exhaling. In return extension, slowly straighten elbows with control to a 6-count while inhaling.

**Movement analysis** From start to mid-position: Elbow – flexion by biceps brachii, brachialis, brachioradialis, wrist flexors and fingers, working concentrically. From mid- to end-position: Elbow – extension by biceps brachii, brachialis, brachioradialis, wrist flexors and fingers, contracting eccentrically.

Illustration 9.5. Exercise 9.4. Standing reverse Ez curl.



a.) Start-/end-position

b.) Mid-position

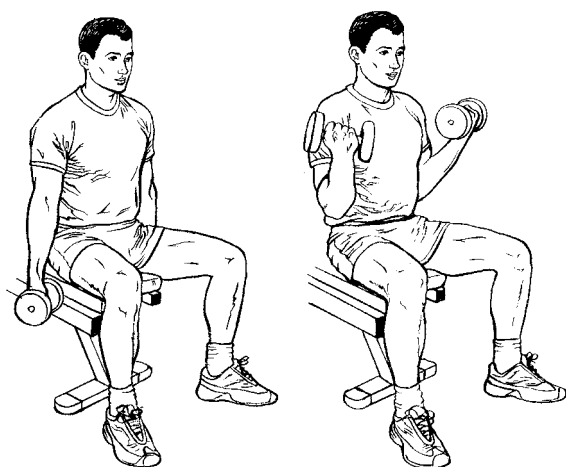
### EXERCISE 9.4. STANDING REVERSE EZ CURL

This exercise strengthens arm flexor, finger and wrist extensor muscles. It is a favourite among boxers and professional bench press competitors because it enhances wrist joint strength and stability. It is recommended to start and end the exercise with one leg forward for beginning exercisers and with high loads. This position reduces the tendency towards hyperarching lumbar lordosis during the exercise.

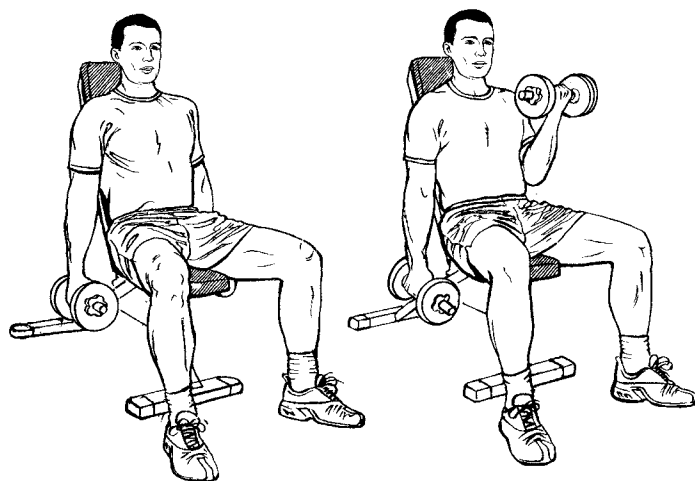
**Start-/end-position** Grasp the bar in an overhand closed grip; hands slightly more than shoulder width apart. Feet are also spread slightly more than shoulder-width apart, knees are slightly flexed, back is straight, head is raised, and eyes are look straight ahead. Upper arms are held close to ribs and vertical to the floor. The bar rests on the anterior thigh, with elbows straight.

**Range of motion and performance** Flexing the elbows, raise the bar in an arching movement to a distance of about ten centimetres from the anterior deltoid muscle. Avoid jerking the bar up or moving the arms backward or sideways. Be careful at the end of flexion to avoid injuring the anterior deltoid muscle and, in extension, locking the elbows. Keep the same body position throughout the exercise. Flex to a 4-count while exhaling. In the return extension, straighten elbows slowly with control to a 6-count while inhaling.

**Movement analysis** From start to mid-point: Elbow – flexion by brachioradialis, brachialis, biceps brachii, wrist extensors and fingers working concentrically. From mid- to finish point: Elbow – extension by brachioradialis, brachialis, biceps brachii, wrist extensors and fingers contracting eccentrically.



a.) Start/end-position regular grip    b.) Mid-position regular grip



c.) Start/end-position  
hammer grip in supination

a.) Mid-position hammer  
grip in supination

## EXERCISE 9.5. SEATED DUMBBELL BICEPS CURL

This exercise isolates biceps brachii and brachioradialis. It is best to perform the exercise after warm-up.

**Start-/end-position** Sit on the bench; feet on the floor shoulder width apart and back supported by the bench rest. Head is raised to avoid overloading cervical vertebrae and does not lean on the backrest even if it is possible to do so. Grasp the weights in a closed underhand grip. Arms rest beside the body with elbows straight and hands facing forward. It is also possible to perform the exercise with a hammer grip in which the hands are in a closed grip turned to the body while the resistance-bar and thumbs face forward.

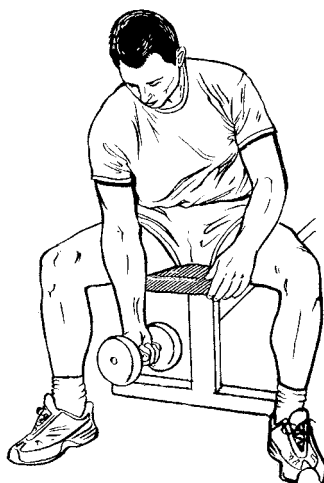
**Range of motion and performance** By means of elbow flexion, raise the weights in an arching movement to a point about ten centimetres from the anterior deltoid muscle. Be sure that the effort is made only by the arms without neck muscle involvement. Avoid jerking the weight or moving arms backward or sideways. Repeat the same movement with the second arm, then alternate right and left. Be careful at the end of flexion to avoid injuring the anterior deltoid muscle and, at the end of extension, locking the elbows. Maintain the same body position throughout the exercise. Flexion is to a 4-count while exhaling. The return extension straightens elbows in a slow, controlled movement to a 6-count while inhaling.

**Movement analysis** From start to mid-point: Elbow – flexion by biceps brachii, brachialis, brachioradialis, wrist flexors and fingers working concentrically. From the mid- to end-point: Elbow – extension by biceps brachii, brachialis, brachioradialis, wrist flexors and fingers contracting eccentrically.

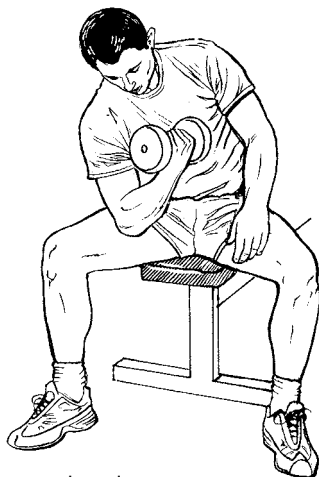
The exercise can be performed with various grips: begin with the hammer grip and finish with a regular grip, begin with a hammer grip and finish with a hammer grip, or perform the exercise in supination (turning the thumb out).

**Movement analysis for the hammer grip** From start to mid-point: Elbow – flexion by brachioradialis, biceps brachii, and brachialis working concentrically. From mid- to end-point: Elbow – extension by brachioradialis, biceps brachii, and brachialis contracting eccentrically.

Illustration 9.7. Exercise 9.6. Seated concentration curl.



a.) Start-/end-position regular grip



b.) Mid-position regular grip

## EXERCISE 9.6. SEATED CONCENTRATION CURL

The uniqueness of this exercise is the isolation of the biceps brachii in a manner that allows exercisers to control performance range and angles. The load on the vertebrae during this exercise is higher than in standing curls. It is best to warm up in preparation for the exercise.

**Start-/end-position** Sit on the bench with feet on the floor a little more than shoulder width apart. Grasp the weights in a closed underhand grip. The elbow rests on the inner side of

the thigh. Make sure the exertion remains in the arms and does not involve the neck.

**Range of motion and performance** Flexing elbows, lift the weight in an arching movement to a point about ten centimetres from the anterior deltoid muscle. Avoid jerking the weight up. Be sure to avoid back movements or thigh adduction or abduction and maintain the same body position. At the end of flexion, be careful not to injure the anterior deltoid muscle and at the end of extension or lock the elbows. Flexion is executed to a 4-count while exhaling. The return extension straightens elbows slowly to a 6-count during inhalation. Change hands each set.

**Movement analysis** From start to mid-position: Elbow – flexion by biceps brachii, brachialis, brachioradialis, wrist flexors and fingers working concentrically. From mid- to end-position: Elbow – extension by biceps brachii, brachialis, brachioradialis, wrist flexors and fingers contracting eccentrically.

## 9.2. POSTERIOR ARM

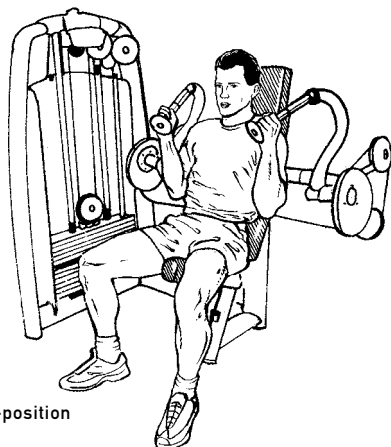
The posterior arm muscles participate in forearm extension. *Triceps brachii* give the posterior arm its classical “look.” Certain models and movie stars develop this muscle in order to look especially fit. Madonna, for example, was so successful in developing and shaping this muscle that the triceps is sometimes called the *Madonna muscle*.

The triceps and the elbow muscle (*Anconeus*) play a central role in elbow extension. This movement can be seen in actions such as throwing, striking, stabbing, and heaving. Prehistoric man used this muscle extensively when throwing spears while hunting.

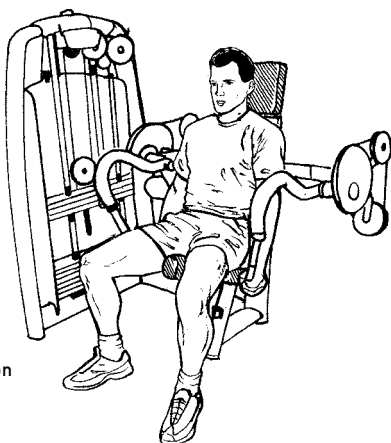
Soldiers make much use of this muscle in shooting pistols (it stabilizes the hand against recoil) and in climbing out of trenches. In various sports, the triceps play an essential role: basketball, team handball, and volleyball, as well as in the martial arts and gymnastics on apparatus and is the reason so many athletes work especially intensely on exercises that develop the posterior arm muscles.

Later in the life cycle, there is a tendency for fat tissue to accumulate in this area, mainly among women. For this reason, many exercisers strive to build up considerable muscle mass in the posterior arm area.

Illustration 9.8. Exercise 9.7. Machine seated triceps extension.



a.) Start-/end-position



b.) Mid-position

#### EXERCISE 9.7. MACHINE SEATED TRICEPS EXTENSION

This exercise is recommended mainly for beginners because of its inherent safety and lack of movement complexity. Advanced exercisers can also perform the exercise using each arm separately.

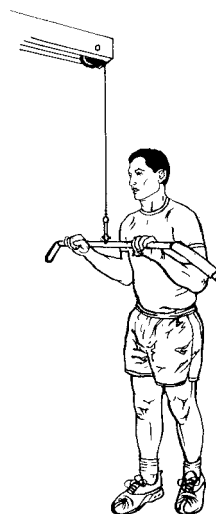
**Start-/end-position** Adjust seat height so that elbows are positioned at the height of the action axis on the apparatus. Lean against the back rest; head raised without support. Elbows should lie symmetrically on the arm rest, each elbow facing its action axis. Place sides of hands on the handle cushions. Be sure not to let one arm dominate and to maintain the same load for both arms during the exercise.

**Range of motion and performance** Extend forearms far from the body until they are straight, and hold the totally extended position for a second. Be sure the effort remains only in the arms and does not run into the neck. Extension is

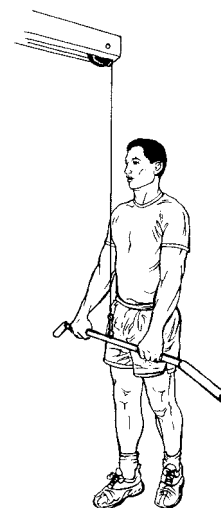
performed to a 4-count while exhaling. Elbow flexion is performed slowly, with control to a 6-count while inhaling.

**Movement analysis** From start to mid-position: Elbow – extension by triceps and elbow muscle working concentrically. From mid- to end-position: Elbow – flexion by triceps and elbow muscle contracting eccentrically.

Illustration 9.9. Exercise 9.8. Standing high pulley triceps pushdown.



a.) Start-/end-position



b.) Mid-position

#### EXERCISE 9.8. STANDING HIGH PULLEY TRICEPS PUSHDOWN

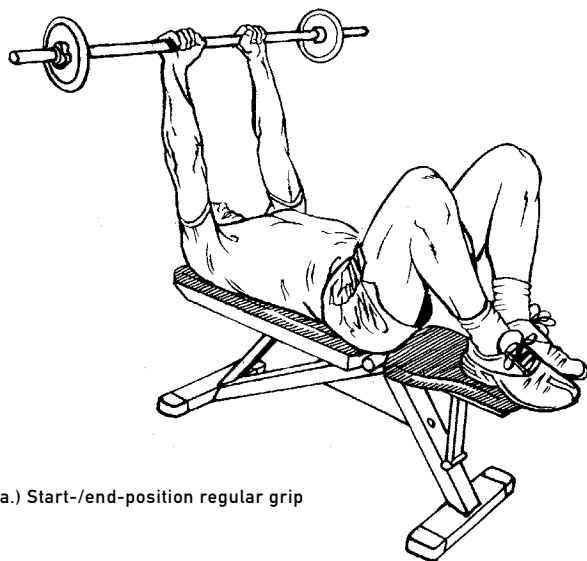
This exercise strengthens the arm extensors, the wrist flexors and extensors, and the fingers. At high loads the abdominals serve as fixator muscles. It is possible to perform the same exercise holding onto the rope (cable) instead of the bar in order to give developmental preference to the lateral (outside, prominent) head of the triceps.

**Start-/end-position** Hold the bar in a closed overhand grip at chest height. Upper arms are close to ribs and vertical to the floor. Hands are at least fifteen centimetres apart. The wrist is a straight extension of the forearm – make sure there is no angle break at the elbow. Legs are spread at somewhat more than shoulder width or one leg a step forward. Knees are slightly flexed, back is straight, head is raised and eyes are focused straight ahead. Maintain the same body position throughout the exercise.

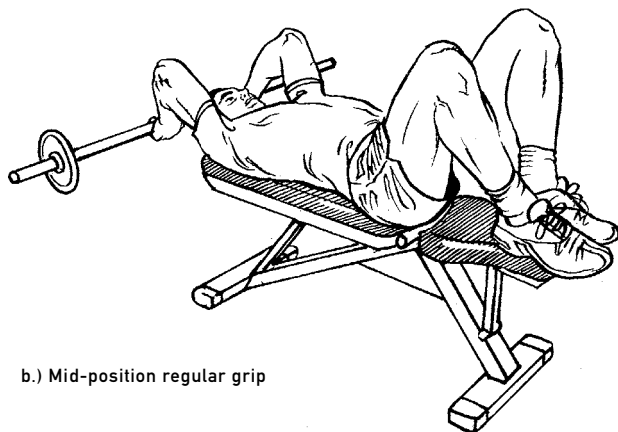
**Range of motion and performance** While holding elbows close to body, extend the elbow and push the bar down until elbows are fully extended. Be sure to use only elbow extensors and avoid leaning on the bar. Be careful at the end of extension not to lock elbows. Throughout the exercise, avoid creating an angular break between elbow and wrist. Extension is to a 4-count while exhaling. Elbow flexion in the return movement should be slow and controlled to a 6-count while inhaling.

**Movement analysis** From start to mid-position: Elbow – extension by triceps, elbow muscle and wrist flexors and fingers working concentrically. From the mid- to end-position: Elbow – flexion by triceps, elbow muscle and wrist flexors and fingers contracting eccentrically.

Illustration 9.10. Exercise 9.9. Supine bent-knee flat bench bar triceps extension (*French press*).



a.) Start-/end-position regular grip



b.) Mid-position regular grip

## EXERCISE 9.9. SUPINE BENT-KNEE FLAT BENCH BAR TRICEPS EXTENSION (*FRENCH PRESS*)

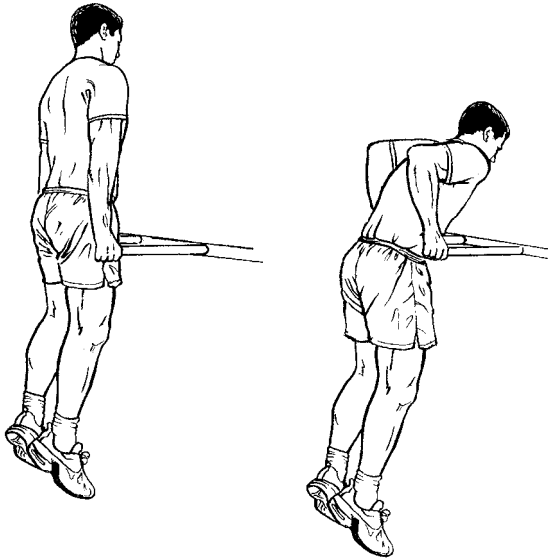
This exercise strengthens the arm extensors as well as finger muscles and wrist flexors. There are a number of variations according to difficulty level: bringing bar to chin; bar to forehead; bar behind the head; bar to forehead where head is slightly beyond the bench; and bar behind head when head is slightly beyond the bench (see illustration). It is recommended to perform the exercise with a spotter or another exerciser observing, especially when taking and returning the bar to the stand. In the final sets at high loads, the presence of a spotter is essential.

**Start-/end-position** Lie on back on the bench, head slightly beyond the bench. Feet are on the bench to prevent excessive lordosis arch and to give a feeling of stability at high loads; knees can be flexed in the air above navel (see illustration). Hold the bar in a closed overhand grip, elbows straight and above the nipple line. Hands are about twenty centimetres apart.

**Range of motion and performance** Flex elbows while slowly lowering bar beyond head to bench height, hold a second, then extend in return. Be careful at the end of the extension not to lock elbows. Throughout the exercise be sure to maintain a constant distance between hands and away from head. Maintain the same body position from beginning to end and do not exert too much pressure on neck. Flexion is performed to a 6-count while inhaling. Straightening elbows in return is done to a slow, controlled 4-count while exhaling.

**Movement analysis** From start to mid-position: Elbow – flexion by triceps, elbow muscle, wrist flexors and fingers contracting eccentrically. From mid- to end-position: Elbow – extension by triceps, elbow muscle, wrist flexors and fingers working concentrically.

Illustration 9.11. Exercise 9.10. Close narrow grip dips.



a.) Start-/end-position regular grip

b.) Mid-position regular grip

### EXERCISE 9.10. CLOSE NARROW GRIP DIPS

This exercise strengthens triceps as well as pectorals and anterior deltoid. As tremendous strength is required to lift one's body weight, the exercise is not intended for beginners. The reason is that great pressure is exerted on the sternum, and high loads on the shoulder joints may cause pain and inflammations. An easier way to perform the exercise is to place the feet on a bench under the parallel bars, and thus, shorten the movement range, and reduce the load on the muscles and shoulder joint.

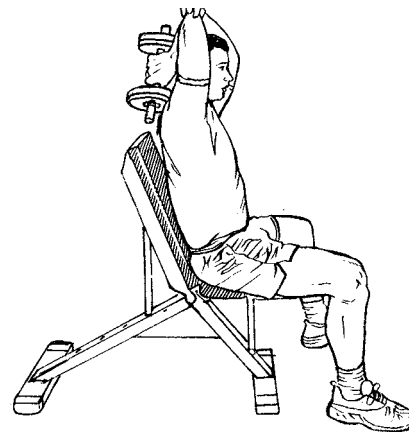
**Start-/end-position** Grasp the parallel handles with a mid-grip (thumbs forward) with body in a vertical position. The head is raised, the neck is long rather than sunken into the shoulders, and the elbows are straight. Maintain the same body position throughout the exercise.

**Range of motion and performance** Flex elbows and descend beyond ninety degrees in the elbow joint. Since the shoulders lean forward during the movement, the load on the shoulder is significantly less than when the shoulder is fixated. Avoid letting the elbows turn outward during the exercise; keep them against the ribs, and avoid rocking the body. Flexion is performed to a 6-count while inhaling.

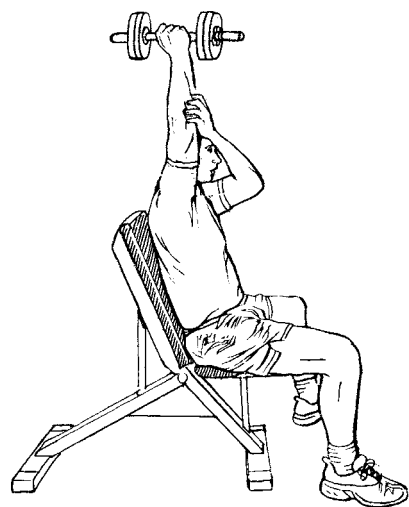
Elbow extension in the return movement is slow and controlled to a 4-count while exhaling.

**Movement analysis** From start to mid-position: Sterno-scapular joint – elevation by trapezius and pectoralis minor contracting eccentrically. Shoulder – abduction and extension by pectoralis major and anterior deltoid contracting eccentrically. Elbow – flexion by triceps and anconeus (elbow muscle) contracting eccentrically. From mid- to end-position: Sterno-scapular joint – depression by trapezius and pectoralis minor working concentrically. Shoulder – adduction and flexion by pectoralis major and anterior deltoid working concentrically. Elbow – extension by triceps and anconeus working concentrically.

Illustration 9.12. Exercise 9.11. Seated overhead triceps extension.



a.) Start-/end-position regular grip



b.) Mid-position regular grip

### EXERCISE 9.11. SEATED OVERHEAD TRICEPS EXTENSION

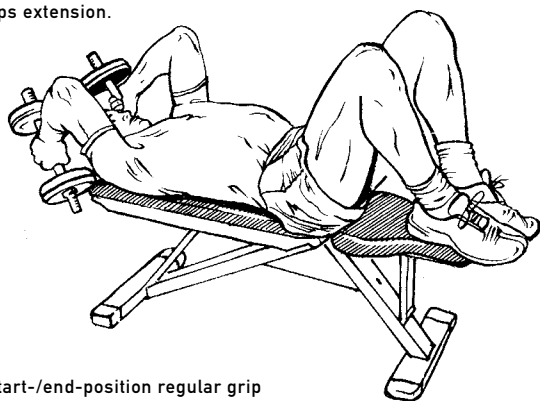
This exercise strengthens the arm extensors as well as finger and wrist flexor muscles. As the activity is not symmetrical, one needs to be careful to avoid pressure on lower back. Stabilizing and supporting the working arm with the other hand helps to reduce pressure on the neck. The weight remains in the exercising hand until the required repetitions are completed. Only then is it transferred to the second hand. The set is complete when both arms have finished performing the planned number of repetitions.

**Start-/end-position** Sit on the seat with feet on the floor shoulder width apart. Only the lower back is supported by the back rest; avoid leaning the trunk on the back rest to prevent arching of the back. Grasp the weight in a closed overhand grip over the head with elbow completely flexed and pointing straight up. The free hand supports flexed elbow. The head is raised and the eyes focus straight ahead. Maintain the same body position throughout the exercise.

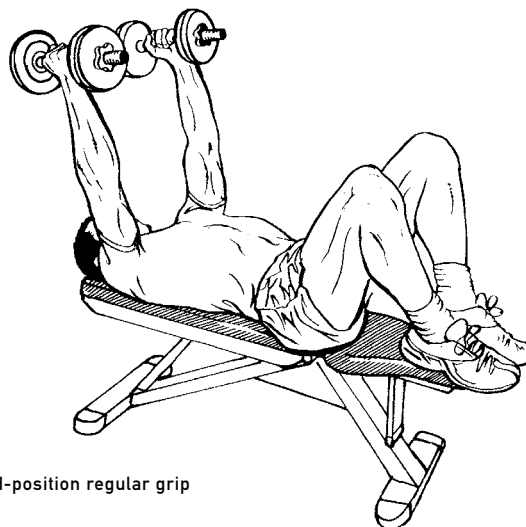
**Range of motion and performance** Extend elbow and raise the weight until the elbow is straight. Keep the shoulder fixed with arm bone (humerus) vertical to the floor. Be careful at the end of extension to avoid locking the elbows. Extension is performed to a 4-count while exhaling. Elbow flexion in return is performed slowly and with control to a 6-count while inhaling.

**Movement analysis** From start to mid-position: Elbow – extension by triceps and anconeus (elbow muscle) working concentrically. From mid- to end-position: Elbow – flexion by triceps and elbow muscle contracting eccentrically.

Illustration 9.13. Exercise 9.12. Supine bent-knee flat bench dumbbell triceps extension.



a.) Start-/end-position regular grip



b.) Mid-position regular grip

### EXERCISE 9.12. SUPINE BENT-KNEE FLAT BENCH DUMBBELL TRICEPS EXTENSION

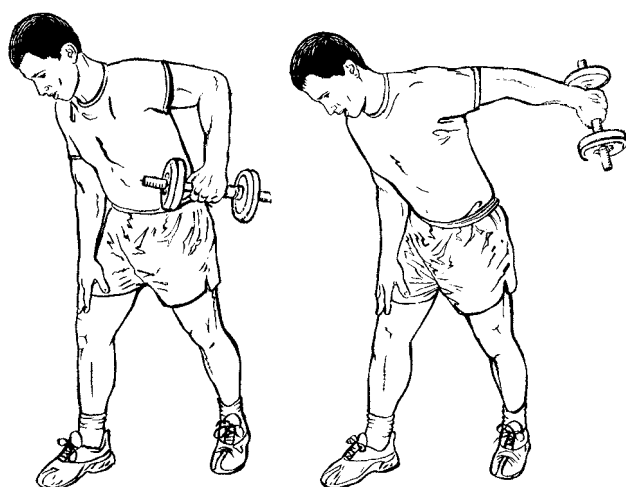
This exercise strengthens arm extensors as well as finger muscles and wrist extensors. The exercise requires control as well as skill and is not for beginners.

**Start-/end-position** Lie on the back with head resting fully on the bench. Place feet on the bench to prevent excessive lumbar arching (lordosis) and to give a feeling of stability at high loads; or, knees can be flexed in the air above navel. Hold hand weights in a hammer grip; elbows are flexed and weights are at the sides of the head.

**Range of motion and performance** In elbow extension, raise weights until elbows are straight. At the end of extension, avoid locking the elbows. Hold for one second and flex elbows while returning slowly with control. Maintain the same body position throughout the exercise and take care not to bang the forehead while lowering the weights. Avoid exerting pressure on the neck. While flexing the elbows, keep the arms at a set width and far from the head. At the end of the set, lay the weights carefully on a shock-absorbing rubber plate. Extension is executed to a 4-count during exhalation. Return elbow flexion is to a 6-count while inhaling.

**Movement analysis** From start to mid-position: Elbow – extension by triceps and anconeus (elbow muscle) working concentrically. From mid- to finish position: Elbow – flexion by triceps and elbow muscles contracting eccentrically.

Illustration 9.14. Exercise 9.13. Bent standing triceps kick back.



a.) Start-/end-position  
regular grip

b.) Mid-position regular grip

### EXERCISE 9.13. BENT STANDING TRICEPS KICK BACK

This exercise offers massive, difficult work for the triceps, giving a feeling of “filling” all three muscle heads. It is commonly used by exercisers who want a feeling of “burning” the muscle. Throughout the action, the elbow remains above shoulder height considerably strengthening the posterior deltoid muscle that acts as fixator. The weight remains in the training hand until the required number of repetitions is completed, and only then is it transferred to the other hand. The set is completed when both arms have performed the preplanned number of repetitions.

**Start-/end-position** Rest the free forearm on thigh, a bench, a ladder, or any other suitable object. The opposite hand is at about waist height, so that the trunk is inclined forward at about a ten-degree angle. Hold the weight in a hammer grip; the elbow is as high as possible at a sixty-degree angle, and the arm is close to body.

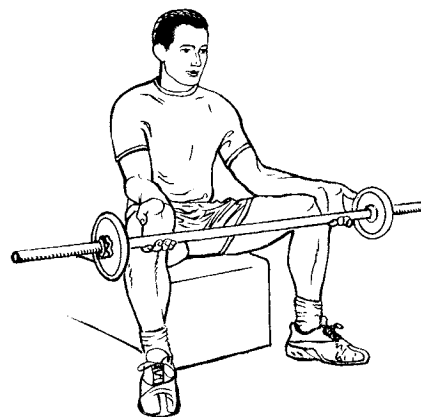
**Range of motion and performance** Extend the elbow to fully, hold for one second and flex in a slow, controlled return movement. Maintain the same body position throughout the exercise. Extension is executed to a 4-count while exhaling and flexion to a 6-count while inhaling.

**Movement analysis** From start to mid-position: Elbow – extension by triceps and anconeus (elbow muscle) working concentrically. From mid- to end-position: Elbow – flexion with triceps and elbow contracting eccentrically.

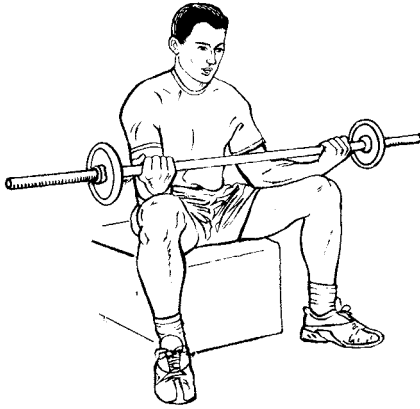
## 9.3. FOREARM

The forearm muscles are the flexors and extensors of the wrist and fingers. The forearms have many daily functions namely: grasping, lifting, pulling, pushing, and carrying. The forearms are indirectly trained when performing most of the exercises for developing upper trunk (such as pull-ups, push-ups, push-ups against weights while standing/sitting). While working the forearms, avoid maximal ranges of movement and sharp work angles in order to prevent pressure on the nerves and loads on the wrist joint. This may cause inflammation and pain. The wrist is one of the most complex joints in the body, serving a conduit through which many muscles, tendons, and nerves pass on their way to the fingers. This is also the reason the wrist is so important. The joint is built of subjoints that make fine motor coordination (accurate movements) possible such as writing, drawing, and playing musical instruments. Too much load on the joint may impair these fine motor abilities. The exercises presented here are commonly used for developing the forearm, but at the same time. Beginning exercisers are advised not to perform these exercises because of sensitivity in their wrist joints.

Illustration 9.15. Exercise 9.14. Seated barbell wrist curl.



a.) Start-/end-position regular grip



b.) Mid-position regular grip

#### EXERCISE 9.14. SEATED BARBELL WRIST CURL

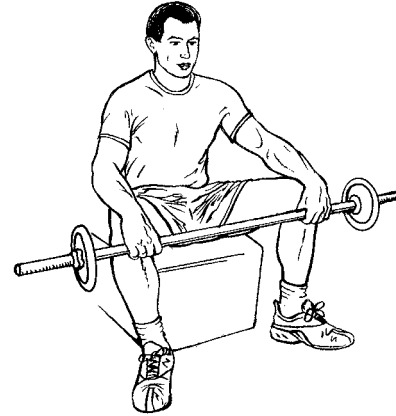
In this exercise, three muscles participate in wrist flexion, and only two in extension. For this reason, the two movements differ in terms of loads and abilities. The exercise can also be executed with hand weights whereby each hand can be worked on individually and alternately.

**Start-/end-position** Sit on the edge of the bench and hold the bar in an open underhand grip, hands at least twenty-five centimetres apart. The feet are on the floor, the forearms rest on the thighs, the wrists are beyond the knee in a state of extension, and the bar rests on fingers. The upper part of body is leaning forward and the shoulders are relaxed.

**Range of motion and performance** Lift the bar from the finger tips by flexing fingers and wrists upward; hold for one second, then return in a slow, controlled movement. Throughout the exercise, elbows and forearms remain on thighs. Avoid flexing the elbows or making use of the strength of other muscle groups. Flexion is executed to a 4-count while exhaling, extension in the return movement to a 6-count while inhaling.

**Movement analysis** From start to mid-position: Wrist – flexion by fingers and wrist flexors working concentrically. From mid- to end-position: Wrist – extension by fingers and wrist flexors contracting eccentrically.

Illustration 9.16. Exercise 9.15. Seated barbell wrist extension.



a.) Start-/end-position regular grip



b.) Mid-position regular grip

#### EXERCISE 9.15. SEATED BARBELL WRIST EXTENSION

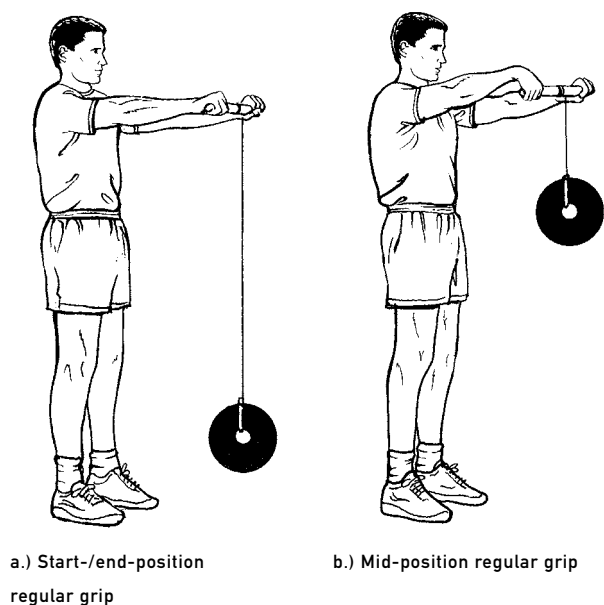
This exercise helps to strengthen the wrist extensor muscle group, which is usually weaker than the wrist flexor group. The exercise can also be performed with hand weights whereby each hand can be worked on individually and alternately.

**Start-/end-position** Sit on the edge of the bench and hold the bar in a closed overhand grip; the hands at least twenty-five centimetres apart. The feet are on the floor, forearms rest on thighs, wrists hang over knees in a position of flexion, and bar rests on fingers. The upper body is leaning forward and shoulders are relaxed.

**Range of motion and performance** Lift the bar from the fingertips with an upward (extension) movement of the wrist, hold for a second then return in a slow, controlled movement. Throughout the exercise, elbows and forearms remain on thighs. Avoid flexing elbows or using other muscle groups. Extension is to a 4-count while exhaling. Flexion is to a 6-count while inhaling.

**Movement analysis** From start to mid-position: Wrist – extension by wrist extensors working concentrically. From mid- to end-position: Wrist – flexion by wrist extensors contracting eccentrically.

Illustration 9.17. Exercise 9.16. Standing arms-extended wrist-roller wrist curl.



## EXERCISE 9.16. STANDING ARMS-EXTENDED WRIST-ROLLER WRIST CURL

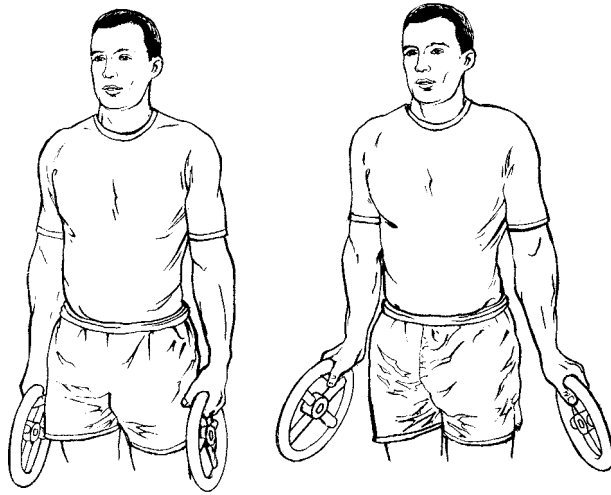
This exercise is popular among exercisers because it is challenging and unusual. It is important to execute it with low-level resistance in order to isolate the wrist flexors. During the exercise, avoid straining the neck, and back flexion or extension that causes excess load on lumbar vertebrae. To avoid strain in the shoulder girdle, you may use some kind of support (cushions) for the cubits. The overhand grip (see illustration) works more on the wrist extensors while the underhand grip strengthens wrist flexors. The exercise is performed with both hands alternating, one holding the bar and the other turning it, and then switching. It should be noted that the anterior deltoid works considerably as a fixator throughout the exercise

**Start-/end-position** Stand erect, arms straight out in front, somewhat lower than shoulder height. Legs should be at slightly more than shoulder width apart, knees slightly flexed, back straight, head raised and eyes focused straight ahead. A relatively short bar (40 cm) is held in an overhand grip. An eighty to a hundred-centimetre length of rope with a weight (plate) attached at the bottom is connected to the midpoint of the bar.

**Range of motion and performance** Right and left wrists alternately perform extension while rolling up the rope on the bar. The exercise ends when the weight touches the bar or when there is no more rope to roll up. Keep arms at the same height and make sure they are parallel to the floor. Throughout the exercise, maintain the same body position and avoid elevation movements or straining the neck. Return movement should be controlled without letting the weight slide down by itself. Inhale and exhale as necessary.

**Movement analysis** From start to mid-position: Wrist – extension by wrist flexors on the side of the radius and the ulna working concentrically. From mid- to end-position: Wrist – Flexion by wrist flexors on the side of the radius and the ulna contracting eccentrically with minimum resistance, because the bar is being held by the other hand working isometrically.

Illustration 9.18. Exercise 9.17. Standing Olympic plate hand extension (squeeze).



a.) Start-/end-position  
regular grip

b.) Mid-position regular grip

### EXERCISE 9.17. STANDING OLYMPIC PLATE HAND EXTENSION (SQUEEZE)

This exercise requires special weight plates that can be held comfortably and safely. The use of regular weight plates is not recommended because they may slip out of the hands. The exercise can be performed by each hand separately or by both together.

**Start-/end-position** Stand erect, hands straight down at sides of the body, holding plates with the fingertips. Spread legs somewhat wider than shoulder width apart, knees slightly flexed, back straight, head raised and eyes focused straight ahead. Maintain the same body position throughout the exercise and avoid shoulder elevation movements or neck exertion.

**Range of motion and performance** Wrist extension is performed against the plate weight. Hold for a second and bring wrist back in a slow, controlled movement. During the exercise, avoid flexing the elbows or using other muscle groups. Wrist extension is to a 4-count while exhaling, the return flexion to a 6-count while inhaling.

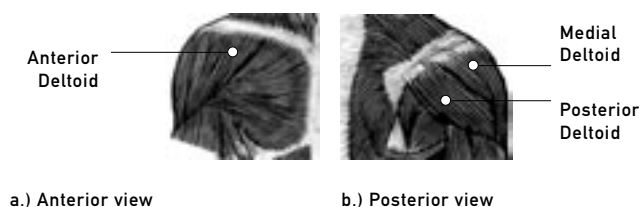
**Movement analysis** From start to mid-position: Wrist – extension by wrist extensors working concentrically. From mid- to end-position: Wrist – flexion by wrist extensors contracting eccentrically.

# 10: EXERCISES FOR THE SHOULDERS

The shoulders serve as the basis for the many functions of the arms. The shoulder joint has tremendous mobility that facilitates a wide array of activities but it is also prone to injuries, including “dislocated shoulder.” Shoulder dislocation refers to a condition whereby the ball, forming the top-end of the *humerus*, moves out of the joint socket as a result of exceeding the range of motion or suffering an external blow. It is not recommended for anyone (even fitness instructors) to attempt to return the bone to its place. Treatment should be provided only by a qualified professional. Strengthening the shoulder muscles is essential for stabilizing the shoulder joint. Shoulder muscles are also known as the “frame muscles” because they form the boundaries of the body in terms of width when viewed from the back or the front. These shoulder muscles are popular in training among both genders. They are important for maintaining proper posture, as any observer can see. When the shoulders slouch, the head is thrown back in order to balance the line of gravity, and posture is impaired. Muscular shoulders are a distinct sign of masculinity. Men’s shoulders are broader than women’s primarily for reasons of survival. Primeval man, responsible for hunting and carrying home the prey, developed shoulder muscles that were bigger and stronger than those of women. The expression “a shoulder to lean on” denotes the sense of security, the strength and the romanticism that the shoulder represents. The gender difference has created familiar cultural images that are reflected in clothing styles that emphasize wide shoulders, reminiscent of uniforms donned by American football and Canadian hockey players.

## THE SHOULDER MUSCLES

Illustration 10.1. Posterior and anterior views of the shoulder muscles.



The shoulder is made up of three muscles which are, in fact, three heads of the same muscle. Each head performs movement on a different plane.

**Anterior deltoid** – Mainly performs arm flexion on the sagittal plane.

**Medial deltoid** – Performs frontal abduction of the arm.

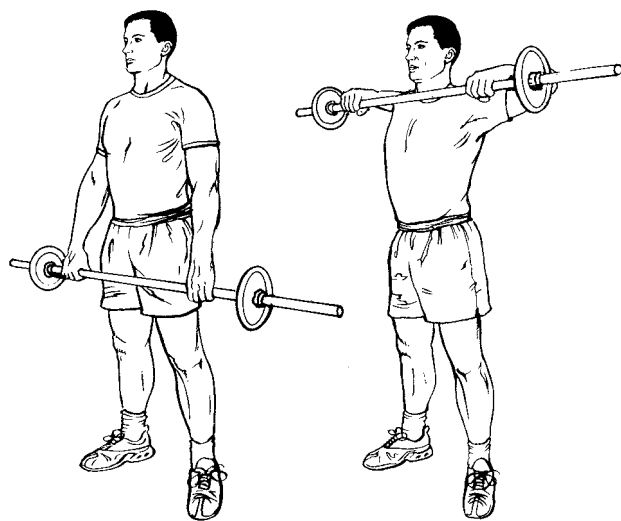
**Posterior deltoid** – Performs horizontal abduction of the arm.

The exercises here are the “classic” exercises for developing the three shoulder muscles and the *trapezius*. When instructions note that the pelvis is rotated to the rear, the reference is to the state after the posterior pelvic tilt. This movement is described in the section on movements on the sagittal plane (see p. 57).

The exercises are presented according to muscle division and level of difficulty: *Standing barbell upright row* and *Standing dumbbell front raise* strengthen mainly the anterior deltoid. *Standing barbell shoulder press*, *Machine seated lateral raise*, and *Standing dumbbell lateral raise* strengthen mainly the medial deltoid. *Seated*

*barbell behind-the-neck press* and *Prone posterior raise* strengthen mainly the posterior deltoid (see pp. 241 and 270 for additional exercises to develop shoulder muscles under “Common Exercises for Developing Power in Multipurpose Apparatus”).

Illustration 10.2. Exercise 10.1. Standing barbell upright row.



a.) Start-/end-position

b.) Mid-position

### EXERCISE 10.1. STANDING BARBELL UPRIGHT ROW

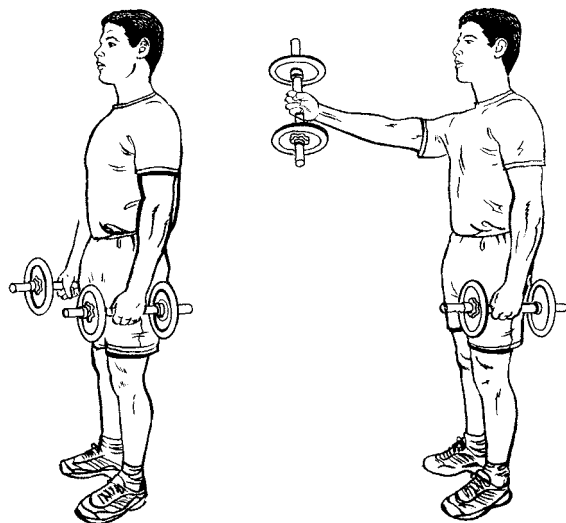
It is important to avoid hyperarching the cervical or lumbar lordosi when performing this exercise. It is recommended to maintain posterior pelvic tilt and contracted stomach muscles. Make sure that the bar does not slip with heavy loads. This exercise should be performed only with an overhand grip. The exercise can also be performed with free weights in each hand or on a lower pulley apparatus.

**Start-/end-position** Hold the bar in a closed overhand grip in front of body near thighs, above quadriceps. Arms should be straight and separated slightly more than shoulder width. Elbows and wrists should be straight. Legs are spread slightly more than shoulder width, and knees are slightly bent. Head is upright with eyes looking straight ahead.

**Range of motion and performance** Raise the bar towards the chin with a controlled movement, past abdomen and chest, up to collarbone line. At peak lift, elbows are higher than wrists and above the shoulders. Avoid using leg power and be sure to perform the lift simultaneously with both hands. Maintain the same body position throughout the exercise. Elbows lead the movement and the lift is performed to a 4-count while inhaling. The bar is then lowered in a slow, controlled movement, to a 6-count while exhaling. When the grip is wide, shoulder and elbow range of motion decreases. When the grip is narrow, range of shoulder and elbow movement increases and, therefore, the load is greater on elbow flexors.

**Movement analysis** From start to mid-position: Sterno-scapular joint – lateral rotation and elevation by cervical trapezius working concentrically. Shoulder – abduction by medial and anterior deltoids working concentrically. Elbow – flexion by biceps, brachialis and brachioradialis working concentrically. From mid- to end-position: Sterno-scapular joint – medial rotation and depression by cervical trapezius contracting eccentrically. Shoulder – adduction by medial and anterior deltoid muscles contracting eccentrically. Elbow – extension by biceps, brachialis and brachioradialis contracting eccentrically.

Illustration 10.3. Exercise 10.2. Standing dumbbell front raise



a.) Start-/end-position

b.) Mid-position

## EXERCISE 10.2. STANDING DUMBBELL FRONT RAISE

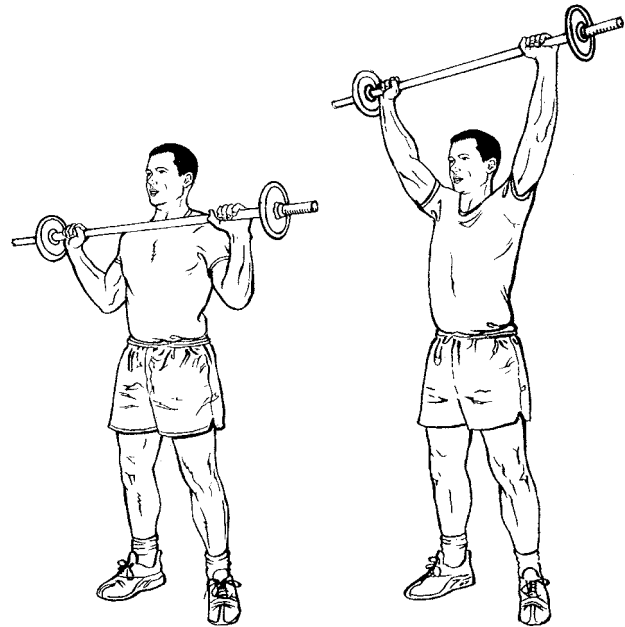
This exercise is intended for advanced exercisers because of the relatively high level of control required, especially at high loads. It is important to avoid hyperarching cervical or lumbar lordosis. Maintain posterior pelvic tilt and contract the stomach muscles. Make sure that the weights or short bar do not slip at high loads. The erector spinae fixate the anterior deltoids thereby strengthening them as well. This exercise can be performed using free weights in each hand or the lower pulley apparatus.

**Start-/end-position** Grasp the bar in a closed overhand grip on the sides of the body near the thigh area, beside the quadriceps. Arms are straight and at slightly more than shoulder width apart. Elbows and wrists should be straight as well. Legs are spread slightly more than shoulder width apart, and knees are slightly bent. Head is upright with eyes looking straight ahead.

**Range of motion and performance** Raise the bar forward to shoulder height with fully extended elbows; hold for one second and return. The same body position should be maintained throughout the exercise. Assistance from legs or back should be avoided. Lift is performed to a 4-count while inhaling. Lower the bar in a slow, controlled movement to a 6-count while exhaling.

**Movement analysis** From start to mid-position: Sterno-scapular joint – lateral rotation and elevation by cervical trapezius working concentrically. Shoulder – flexion by anterior deltoid and pectoralis major working concentrically. From mid- to end-position: Sterno-scapular joint – medial rotation and depression by cervical trapezius contracting eccentrically. Shoulder – extension by anterior deltoid and pectoralis major contracting eccentrically.

Illustration 10.4. Exercise 10.3. Standing barbell shoulder press.



a.) Start-/end-position

b.) Mid-position

## EXERCISE 10.3. STANDING BARBELL SHOULDER PRESS

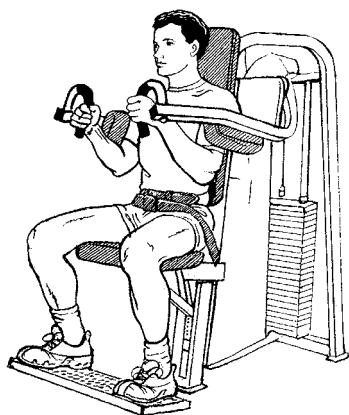
When performing this exercise, it is important to avoid hyperarching the cervical or lumbar lordosis. Maintain posterior pelvic tilt.

**Start-/end-position** Grasp the bar in a closed overhand grip in front of body above anterior deltoids. Hands are at shoulder width apart or slightly more so that the elbows come near the ribs when lowering the bar. Elbows are under the bar and wrists are straight. Legs are spread slightly more than shoulder width apart, and the knees are slightly flexed. Hold the bar and lean it on shoulders and clavicle in front of the body. Head is upright and eyes look forward.

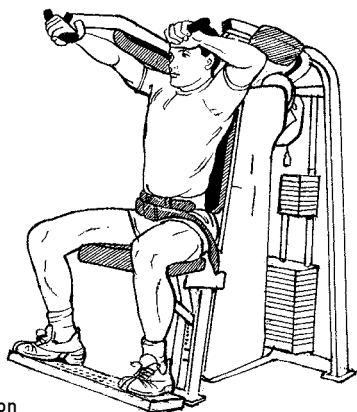
**Range of motion and performance** Push the bar upwards (shoulder press) until elbows are fully extended. Avoid locking elbows forcefully. Avoid using leg power and make sure both hands perform the lift simultaneously. The same body position should be maintained throughout the exercise. Press is performed to a 4-count while exhaling. Lower the bar in a slow, controlled movement to a 6-count while inhaling.

**Movement analysis** From start to mid-position: Sterno-scapular joint – lateral rotation and elevation by cervical trapezius working concentrically. Shoulder – abduction by medial and anterior deltoid working concentrically. Elbow – extension by triceps and alconeus (elbow muscle) working concentrically. From mid- to end-position: Sterno-scapular joint – medial rotation and depression by cervical trapezius contracting eccentrically. Shoulder – adduction by medial and anterior deltoid contracting eccentrically. Elbow – flexion by triceps and elbow contracting eccentrically.

Illustration 10.5. Exercise 10.4. Machine seated lateral raise.



a.) Start-/end-position



b.) Mid-position

#### EXERCISE 10.4. MACHINE SEATED LATERAL RAISE

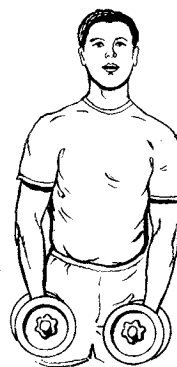
This exercise is recommended primarily for beginners because of its easy body activation and organization. Note the reverse breathing order in this exercise.

**Start-/end-position** Sit on the seat with feet on floor or foot rests (see illustration). Adjust seat height so that shoulder joints (which are the movement axis) are at the height of the axis of the bar which is the action axis on the apparatus. Head is upright and eyes look straight ahead.

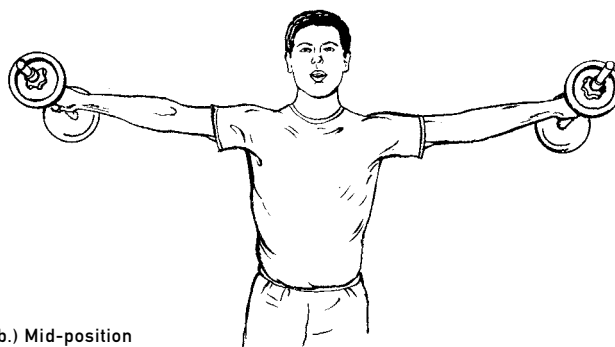
**Range of motion and performance** Grasp the handles and press up on the padded arm cushions. Arms are abducted until elbows reach shoulder height. Make sure the movement comes from the shoulders and not the hands. Maintain the same body position throughout the exercise and be sure to perform the lift with both arms simultaneously. Lift to a 4-count while inhaling. Lower in a slow, controlled movement to a 6-count while exhaling.

**Movement analysis** From start to mid-position: Sterno-scapular joint – lateral rotation and elevation by cervical trapezius working concentrically. Shoulder – abduction by medial and anterior deltoid muscles working concentrically. From mid- to end-position: Sterno-scapular joint – medial rotation and depression by cervical trapezius contracting eccentrically. Shoulder – adduction by medial and anterior deltoid muscles contracting eccentrically.

Illustration 10.6. Exercise 10.5. Standing dumbbell lateral raise.



a.) Start-/end-position



b.) Mid-position

## EXERCISE 10.5. STANDING DUMBBELL LATERAL RAISE

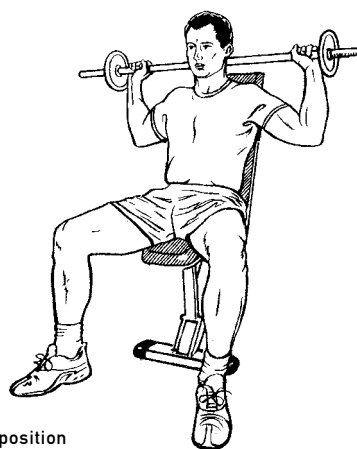
It is important to avoid hyperarching the cervical and lumbar lordoses when performing this exercise. Maintain posterior pelvic tilt and contracted stomach muscles throughout the exercise. For a more comprehensive development of the medial deltoid, the exercise can be performed with free weights from other starting positions: weights behind the buttocks or weights at the sides of the body.

**Start-/end-position** Grasp the weights in a closed overhand grip in front of the body at the thighs, near the quadriceps. Elbows are slightly flexed. Turn the weights so that palms face each other and elbows face outwards. Legs are spread slightly more than shoulder width apart, and the knees are slightly bent. Head is upright and eyes look straight ahead.

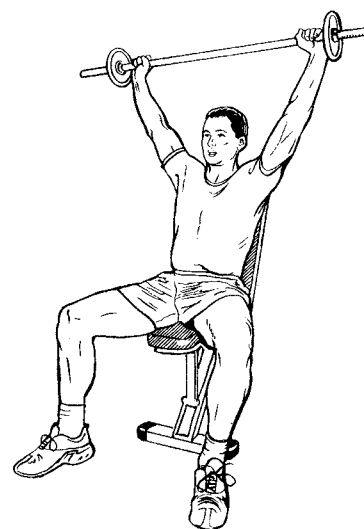
**Range of motion and performance** Abduction is performed by raising the weights until elbows and wrists are parallel to the floor and in line with the shoulders. Make sure the movement is performed by the shoulders and avoid elbow flexion. Avoid using leg power and maintain the same body position throughout the exercise. Abduction should be performed simultaneously by both arms. Abduction is performed to a 4-count while inhaling. Lower the weights in a slow, controlled movement, to a 6-count while exhaling.

**Movement analysis** From start to mid-position: Sterno-scapular joint – lateral rotation and elevation by cervical trapezius working concentrically. Shoulder – abduction by medial and anterior deltoids. From mid- to finish position: Sterno-scapular joint – medial rotation and depression by cervical trapezius contracting eccentrically. Shoulder – adduction by medial and anterior deltoids contracting eccentrically.

Illustration 10.7. Exercise 10.6. Seated barbell behind-the-neck press.



a.) Start-/end-position



b.) Mid-position

## EXERCISE 10.6. SEATED BARBELL BEHIND-THE-NECK PRESS

The heavy load and stress on cervical vertebrae and trapezius in this exercise can cause headaches. Avoid hyperarching the lower back while performing this exercise.

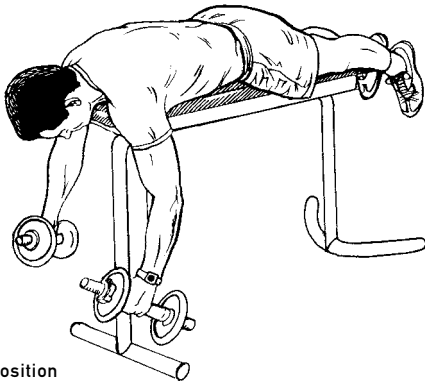
**Start-/end-position** Sit on the bench with feet spread on the floor. Grasp the bar in a closed overhand grip with the bar behind the neck above the deltoid muscle. Hands are slightly more than shoulder width apart so that elbows are close to ribs when lowering the bar. Head is upright, eyes look straight ahead, and back is supported by the backrest

up to the middle of the shoulder blades. Lift the bar from the rack and position it in the air behind the head. Avoid leaning the bar on the C7 vertebra.

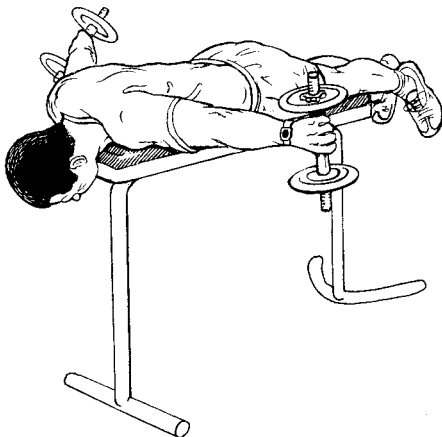
**Range of motion and performance** Push the bar up (shoulder press) above head, until elbows are fully extended. Avoid locking elbows forcefully. During the exercise elbows face outward. Make sure the lift is performed simultaneously by both arms. The same body position should be maintained throughout the exercise. The press is performed to a 4-count while exhaling. The bar is lowered in a slow controlled movement to a 6-count while inhaling.

**Movement analysis** From start to mid-position: Sterno-scapular joint – lateral rotation and elevation by cervical trapezius working concentrically. Shoulder – abduction by medial deltoid and cervical trapezius working concentrically. Elbow – extension by triceps and alconeus (elbow muscle) working concentrically. From mid- to finish position: Sterno-scapular joint – medial rotation and elevation by cervical trapezius contracting eccentrically. Shoulder – adduction by medial and anterior deltoid contracting eccentrically. Elbow – flexion by triceps and alconeus contracting eccentrically.

Illustration 10.8. Exercise 10.7. Prone posterior raise.



a.) Start-/end-position



b.) Mid-position

## EXERCISE 10.7. PRONE POSTERIOR RAISE

**Start-/end-position** Lie prostrate (on stomach) on a narrow bench. The chin rests on the edge of the bench, with face beyond the bench to avoid stress on neck. Maintain posterior pelvic tilt and contracted stomach muscles while performing this exercise. Grasp the weights in an overhand grip with elbows locked and hands almost straight down. Avoid hyperarching lower back.

**Range of motion and performance** Horizontal abduction of arms is performed until elbows reach shoulder height. Be sure the movement is performed by elbows and not by hands. Perform the lift simultaneously with both arms and maintain the same body position throughout the exercise. Lift is performed to a 4-count while inhaling. Weights are lowered in a slow controlled movement to a 6-count while exhaling.

**Movement analysis** From start to mid-position: Sterno-scapular joint – adduction by rhomboids and trapezius working concentrically. Shoulder – horizontal abduction by posterior deltoid working concentrically. From mid- to finish position: Sterno-scapular joint – abduction by rhomboids and trapezius contracting eccentrically. Shoulder – horizontal adduction by posterior deltoid contracting eccentrically.

# 11: EXERCISES FOR THE BACK AND NECK

The back is the posterior part of the trunk. It is the part of the body people are least familiar with because it is, as the expression goes, “out of sight, out of mind.” The back does not get enough attention, even though it works as hard as any other part of the body. There is virtually no daily physical activity whereby the back is not somehow involved. The back is perceived by both genders as erotic as well as a symbol of power and security. The expression “to have a strong back” denotes firmness and a sense of security. The best-known internal part of the back is the spine. A “spineless” person is one who cannot stand up for himself or herself. Such expressions are quite apt, since the back and spine serve as the foundation for the great majority of physical activities.

The spine is composed of thirty-three vertebrae placed on top of each other. There is an aperture at the centre of each vertebra for the passage of the spinal cord (the central nerve conductor in the body). The spinal cord mediates between the central nervous system in the brain and the rest of the body. For this reason, injury to the spinal cord can result in paralysis because the body parts are disconnected from their central activation centre in the brain. The spinal cord is “S-shaped,” with two *lordoses* (concave curves) and two *kyphoses* (convex curves). The neck curve is called the *cervical lordosis* and the hip curve is called the *lumbar lordosis*. One kyphosis is located between the shoulder blades and the other is in the pelvic area. The lordoses and kyphoses turn the spinal cord into a “spring” that plays a vital role in absorbing the shocks assailing the body during daily activities such as walking, running, or jumping. The S-shape makes it possible to distribute loads placed on the back along the entire vertebral column. It is, therefore, important

to maintain proper posture and the normal shape of the spine. The lordoses and kyphoses need to be large enough to act as effective shock absorbers but not so large that they create tension and pressure on the back muscles, and possibly social problems that often develop from concomitant low self-esteem due to postural deficiencies. A correlation exists between proper posture and subjective feelings, moods, and self-esteem, according to research.

As we descend along the spine, the shape of the vertebrae changes, becoming thicker and larger, to carry more weight. Despite its structure, the spine has a number of weak points which are prone to problems. Some contend that this is the result of the evolutionary process whereby humans began to walk erect on two legs. Walking erect does, indeed, save energy since it makes use of gravitational force (with each step, the body “falls” forward); yet the load of the upper body weighs down on a narrower area – the lower part of the spine. This causes one of the most common of medical problems – low back pain. The sciatic nerve passes through this region and to the legs. For this reason, back pain often extends to the legs.

Cartilaginous discs separate each of the vertebrae. Their task, along with the lordoses and kyphoses, is to reduce stress and absorb shocks to the body caused by daily activity. When too much stress is placed on the discs due to overload or deviation from normal range of motion, the result may be a *herniated disc*. When this occurs, the viscous material inside the cartilage bursts out of its casing towards the spinal cord and presses upon it. An inflammation develops at the point of pressure on the spinal cord, which causes pain in those parts of the

body connected to that spot on the spinal cord. A slipped disc is practically incurable and is accompanied by tremendous pain. The best way to lower the risk of this injury is to develop the trunk muscles, especially those of the back. Strong, well-developed trunk muscles help to reduce stress on the discs and allow them to function under the continual stress of daily activities.

More than one joint is located between each two vertebrae. The entire spine consists of more than a hundred joints due to the irregular structure of each individual vertebra. The spinal joints are small and have a limited range of motion. However, their large numbers and interconnections facilitate a wide-range of motion on all three movement axes. Vertebral joint flexibility is essential for maintaining and improving range of movement as well as blood supply to the spine. For this reason, it is advisable to perform trunk movements in all movement planes, and to improve back flexibility through appropriate exercises. However, if a wide array of movement is possible, there are also risks of deviating from the designated range of motion and thereby incurring injuries. It is important to remain within optimal ranges of movement and maintaining symmetry of movement and posture while exercising the back muscles.

The cervical (neck) vertebrae are located in the upper part of the spine. The main function of the neck is to carry the weight of the head and facilitate its movement. This task is mainly carried out by the posterior neck muscles. During daily activities, range of motion in this area is minimal, so that over the years, there is a drastic reduction in the range of neck movement and neck muscle strength. The neck muscles of most people are too weak to perform their job adequately. This leads to posture problems since the centre of gravity of the head is at the front, causing the head to lean forward too much. This places a heavier load on the neck muscles which often results in neck discomfort. This faulty posture is usually characterized by excessive cervical lordosis and causes stress and pressure on the neck. The hand nerves pass through the neck, and pressure in this area, at times, may result in pain in the head or numbness in the hands. Therefore, it is highly important to strengthen neck muscles and to maintain the range of neck movement by means of stretching exercises. Neck muscles should be strengthened with moderation and

great caution. It is advisable to avoid placing heavy loads and stress on the vulnerable cervical vertebrae because its special structure is not suited to carrying heavy loads.

Lack of physical activity to strengthen back muscles can cause muscle pain when muscles are overexerted. Moreover, faulty posture can lead to vertebral malformations. Countless problems can arise in the back and have physical and emotional ramifications. The best and safest way to reduce the risk of back problems is through appropriate physical activity in the weight room. This type of activity includes exercises for the back at different loads, at optimal ranges of movement, at a slow, controlled pace and a balanced distribution of loads for each group of back muscles.

Back and neck pains are a “modern plague.” Such pains limit daily activities and impair quality of life. The best way to cope is to strengthen the back muscles, maintain spinal flexibility, and improve movement capacity of the back and neck. The development of a strong back is especially important, not only for aesthetic reasons but, even more importantly, for health considerations.

## THE BACK AND NECK MUSCLES

The back muscles are arranged in three layers. The first and deepest group includes small, long muscles adjacent to the vertebrae and spine. They perform vertebral extension, flexion, and rotation. This layer of muscles is important for spinal movement and stability. The erector spinae group is the most dominant of these muscles. Erector spinae keep the spine erect and prevent it from falling forward outside the body’s centre of gravity. These muscles constantly work against the force of gravity and carry the bulk of the upper body’s weight (trunk, head, and arms). It is, therefore, very important to strengthen them and improve their flexibility. The second layer includes several muscles associated with breathing activity – expansion and contraction of the thorax. It includes, among others, the *rhomboids* (small and large), which are responsible for scapular adduction (when the thorax is inflated). The third and most external layer includes, among others: *latissimus dorsi*, *teres* (major and minor), and *trapezius*. The latissimus dorsi give the back its “triangular” shape. It is known as the “show

off” muscle or the “peacock” muscle because exercisers like to parade around wearing tight shirts to show off their “lats.” Latissimus dorsi are noticeable from the front as well. Teres muscles are synergists (assistants) to latissimus dorsi. The trapezius takes its name from its shape and consists of three heads: cervical, medial, and inferior. The superior trapezius is the main neck muscle that connects the scapulae to the base of the cranium in the neck. The trapezius (all three parts) is responsible for scapular adduction. All three heads of trapezius work when the muscle is activated. Nevertheless, it is possible to develop each head separately through specific exercises.

“The scapular adduction muscle group” refers to trapezius and the rhomboids. This group does not receive the proper attention compared to the chest muscles. Scapular adduction is not as common in daily activities as are the movements performed by the pectorals, which are the antagonists of the scapular adduction muscles. For some reason, exercisers tend to work vigorously on their chest muscles but neglect the scapular adductors, thus, increasing, instead of decreasing, this imbalance. Exercises to strengthen scapular adductors close any existing muscle tone gap between these muscle groups. Creating a proper balance between anterior and posterior muscles prevents kyphosis, a hunched-over condition characterized by slouched shoulders, inverted chest, and rounded upper back. For this reason, it is important to use exercises specifically for the scapular adductors, since they play an essential role in activating the upper extremities and maintaining proper posture. The terms “upper back” and “lower back” are used to describe areas of the back, although there are no muscle groups with those names. The exercises presented here detail the best way to achieve results without harming the spine. Similarities and differences between the exercises are provided together with exercise descriptions. An additional repertoire of exercises at different levels of difficulty for the upper and lower back is provided.

The exercises are organized in descending order, from the upper to the lower part of the back. The *Standing barbell shrugs* strengthens the superior trapezius and neck area. The following exercises, *Seated lat pulldown* and *Palm-away front chin-up* are designed to strengthen the shoulder girdle and back. The *Bent-over barbell row* and *Standing standard bent-over two-arm long bar row*

strengthen the central part of the back, and *One-arm bent-over dumbbell row* and *Low pulley seated row* increase the level of difficulty. The *Prone roman chair back extension* and *Good Morning* strengthen the lower back (see pp. 266–267 for an additional exercise to develop shoulder muscles under “Common Exercises for Developing Power on Multipurpose Apparatus.”)

Illustration 11.1. The back and neck muscles.

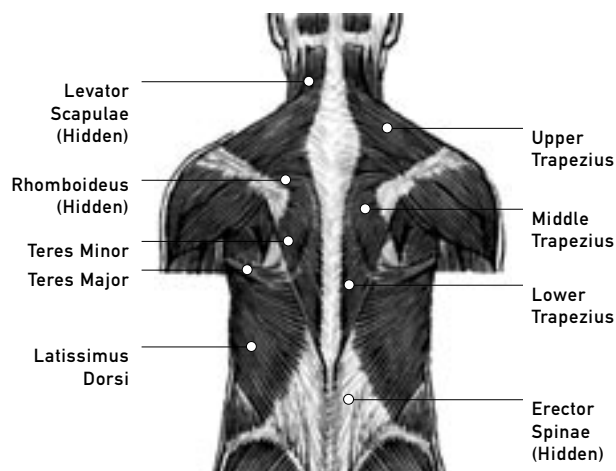
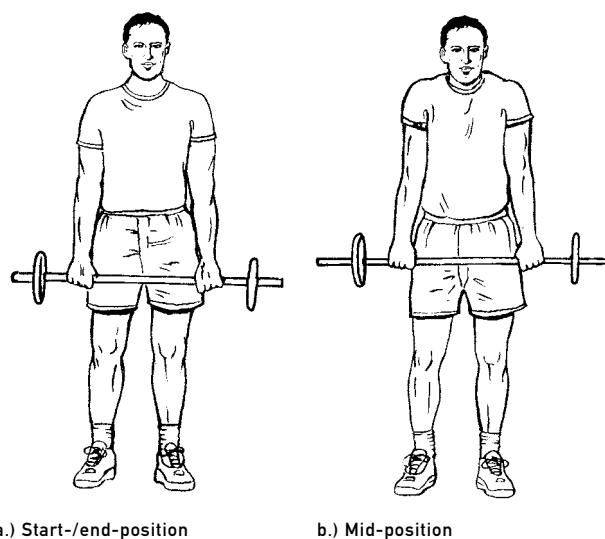


Illustration 11.2. Exercise 11.1. Standing barbell shrugs.



### EXERCISE 11.1. STANDING BARBELL SHRUGS

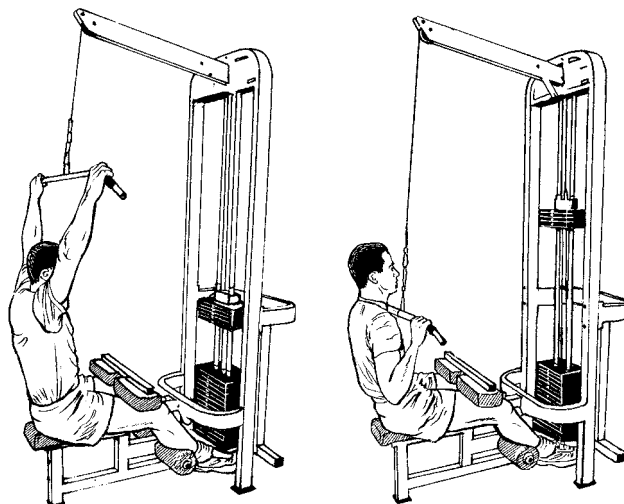
This exercise strengthens the cervical trapezius. Avoid hyperarching the cervical or lumbar lordosis while performing this exercise. Maintain posterior pelvic tilt and contracted abdominal muscles. Be sure that the bar does not slip while using heavy loads. This exercise should be performed only with an underhand grip or a combined grip (one hand grasps the bar underhand and the other overhand). The exercise can be performed with free weights in each hand or with a lower pulley apparatus.

**Start-/end-position** Hold the bar in a closed overhand grip in front of the body near the thighs. Arms are extended and spread at or slightly more than shoulder width. Elbows and wrists are straight. Legs are spread slightly more than shoulder width, and knees are slightly flexed. Head is upright and eyes look straight ahead.

**Range of motion and performance** Raise the bar by pulling the shoulders up (elevation) towards the front of the ears, up to shoulder height with straight elbows. The lift is performed in a 4-count while inhaling. Return by pulling shoulders down (depressions) in a slow, controlled movement while exhaling to a 6-count. Avoiding using leg power and be sure to lift simultaneously with both arms. Maintain the same body position throughout the exercise.

**Movement analysis** From start to mid-position: Sterno-scapular joint – scapular elevation by cervical trapezius and levator scapulae working concentrically. From mid- to end-position: Sterno-scapular joint – scapular depression by cervical trapezius and levator scapulae contracting eccentrically.

Illustration 11.3. Exercise 11.2. Seated lat pulldown.



a.) Start-/end-position

b.) Mid-position

### EXERCISE 11.2. SEATED LAT PULLDOWN

This exercise activates over forty muscles in the back (mainly latissimus dorsi), shoulder girdle, arms, chest, and neck without exerting pressure on the joints. It is a good preparation for exercisers who cannot perform even one chin-up because they can perform the movement with a weight less than their body weight. This exercise is also useful for advanced-level exercisers seeking to improve their maximal capacity by adding resistance beyond their body weight. Even those suffering from slipped discs can perform this exercise because it exerts almost no pressure on the spine, providing that care is taken to maintain the posterior pelvic tilt.

**Start-/end-position** As soon as we raise our arms we create lumbar lordosis, which is why the pelvis needs to be tilted to the rear. The apparatus is not useful because the seat is not inclined and knees are not above navel height. The pelvis can be tilted to the rear by placing legs forward and using a foot rest for support. Knees should be at navel height. Knees can be placed under a padded restraining lever that prevents the body from rising when the exerciser pulls down the bar at high loads. Different ways of holding the bar can be used to vary the training and increase the level of muscle force and volume: In a “wide grip,” most of the load is on back muscles and the upper part of latissimus dorsi; in an “underhand grip,” most of the load is on the back and arm

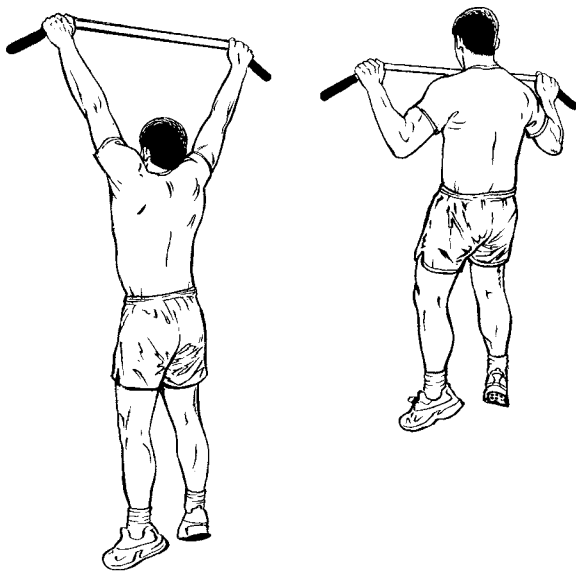
muscles, especially biceps; in an “overhand grip,” the main load is on the back and arm muscles, mainly brachioradialis. Pulling the bar behind the neck works mostly on cervical trapezius, while pulling the bar in front of the neck mainly works on upper pectorals.

Hold the bar in a closed grip, at or slightly wider than shoulder-width apart. Arms are straight and equidistant from the centre of the bar. Sit on the seat maintaining posterior pelvic tilt and a slight curve in the lower back. Knees exert slight pressure on the padded restraining device.

**Range of motion and performance** Pull the bar down in front of the head to chin height or behind the neck to vertebra C7 without touching it (see illustration). Make sure that both arms work equally. The pull is performed in a slow, controlled movement to a 4-count while exhaling. Arms return to extension in a slow, controlled movement to a 6-count while inhaling.

**Movement analysis** From start to mid-position: Sterno-scapular joint – medial rotation by trapezius working concentrically. Shoulder – adduction by latissimus dorsi, working concentrically. Elbow – flexion by biceps, brachialis and brachioradialis working concentrically. From mid- to end-position: Sterno-scapular joint – lateral rotation by trapezius contracting eccentrically. Shoulder – abduction by latissimus dorsi contracting eccentrically. Elbow – extension by biceps, brachialis and brachioradialis contracting eccentrically.

Illustration 11.4. Exercise 11.3. Palm-away front chin-up.



a.) Start-/end-position

b.) Mid-position

### EXERCISE 11.3. PALM-AWAY FRONT CHIN-UP

Chin-ups activate over forty muscles in the back (particularly latissimus dorsi), shoulder girdle, arms, chest, and neck without applying pressure to the joints. Since resistance in this exercise remains constant (body weight), the aim of the exercise is to reach maximal number of repetitions. An exerciser who can perform a maximum of eight chin-ups is working on developing muscle strength. If the maximum number is nine to fourteen, the aim is to develop strength endurance (power). An exerciser who can do fifteen chin-ups on average is working on developing muscle and strength endurance (a combined element of physical fitness).

An exerciser who is unable to perform even one chin-up should first practice with one of the preparatory exercises such as the preceding exercise, or the exercise especially designed for this purpose (see p. 248 under “Common Exercises for Developing Power on Multipurpose Apparatus.”)

Different types of hand grips can be combined in order to vary chin-up training and increase the level of muscle strength and volume: in a wide grip, most of the load is on the back muscles and the upper part of latissimus dorsi; in a narrow grip, load is mostly on the arm muscles, lower chest, and lower part of latissimus dorsi; in a narrow overhand grip, most of the load is on the arm and back muscles, including the brachioradialis; and when the bar is behind the neck, most of the load is carried by the arm and back muscles, including cervical trapezius. This exercise entails tilting the head forward and pressure on the cervical vertebrae is high.

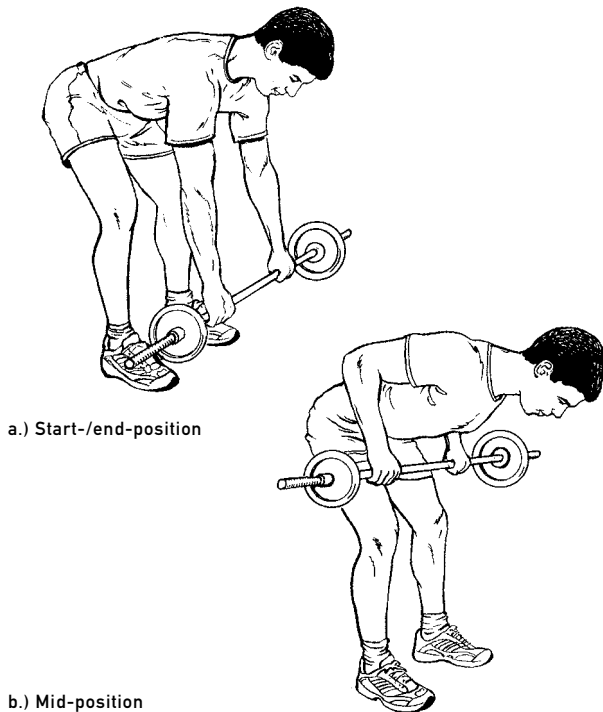
**Start-/end-position** Hang from the high bar, with elbows straight; use a closed overhand wide grip. Body is straight.

**Range of motion and performance** Pull the body up by the arms until the chin is above the bar. Make sure that neither arm dominates during the pull. Avoid using other muscle groups and shaking the body; legs and pelvis should not assist in the lift. Avoid hyperarching lumbar lordosis, especially towards the end of the movement when trying to avoid hitting the head on the bar. Chin-up is performed to a 4-count while exhaling. Extend arms in return in a slow, controlled movement to a 6-count while inhaling.

**Movement analysis** From start to mid-position: Sterno-scapular joint – medial rotation by trapezoid working

concentrically. Shoulder – adduction by latissimus dorsi working concentrically. Elbow – flexion by biceps, brachialis and brachioradialis working concentrically. From mid- to end-position: Sterno-scapular joint – lateral rotation by trapezoid contracting eccentrically. Shoulder – abduction by latissimus dorsi contracting eccentrically. Elbow – extension by biceps, brachialis and brachioradialis contracting eccentrically.

Illustration 11.5. Exercise 11.4. Bent-over barbell row.



#### EXERCISE 11.4. BENT-OVER BARBELL ROW

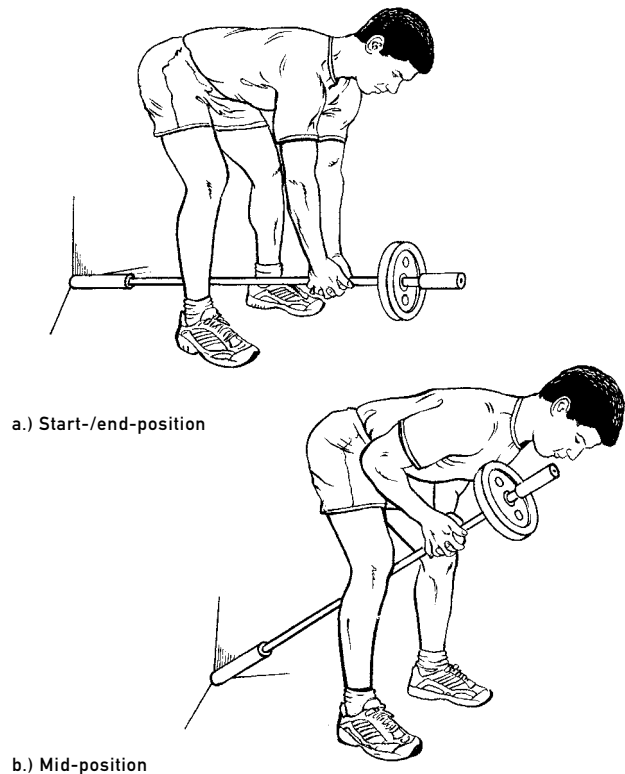
Balancing and carrying the heavy weight in this exercise requires strong leg and back muscles. The exercise is popular among athletes and bodybuilders and is not recommended for beginners because of the load on the lower back.

**Start-/end-position** Stand with legs spread shoulder width apart with knees flexed. Hold the bar in a closed overhand grip, arms and hands about shoulder-width apart. Upper body leans forward to a seventy- to ninety-degree angle at the hip joint. Back is straight and head is tilted upward. Avoid hyperarching cervical lordosis. Elbows are fully extended, but the bar does not touch the floor. Trunk is parallel to the floor.

**Range of motion and performance** Lift the bar until it touches lower chest or upper abdomen. Elbows face upward throughout the exercise. Upper body remains rigid; the back remains straight during each repetition of the exercise, and the abdomen is contracted. Avoid hyperarching cervical and lumbar lordoses when performing the exercise and make sure that neither arm is dominant in lifting. The lift is performed to a 4-count while exhaling. Return extension is in a slow, controlled movement to a 6-count while inhaling.

**Movement analysis** From start to mid-position: Sterno-scapular joint – adduction by trapezoid working concentrically. Shoulder – extension by latissimus dorsi working concentrically. Elbow – flexion by biceps, brachialis and brachioradialis working concentrically. From mid- to end-position: Sterno-scapular joint – abduction by trapezoid contracting eccentrically. Shoulder – flexion by latissimus dorsi contracting eccentrically. Elbow – extension by biceps, brachialis and brachioradialis contracting eccentrically.

Illustration 11.6. Exercise 11.5. Standing standard bent-over two-arm long bar row.



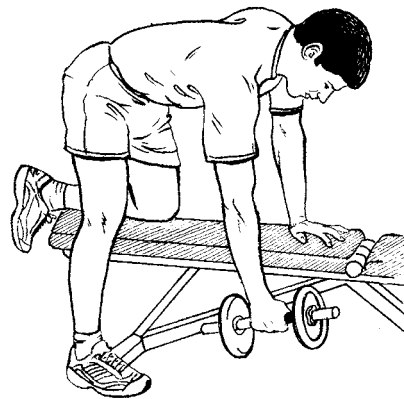
### EXERCISE 11.5. STANDING STANDARD BENT-OVER TWO-ARM LONG BAR ROW

This exercise requires strong legs and technical skill in order to isolate the load on the lower back. It is therefore not recommended for beginners. This exercise can also be performed with a *T-bar* to make the exercise easier technically. The exercise is usually performed using a twenty-kilogram long bar. One end of the bar is empty and the other side holds the weight at the desired resistance. Advanced exercisers can perform the exercise with one arm, alternating each repetition or set.

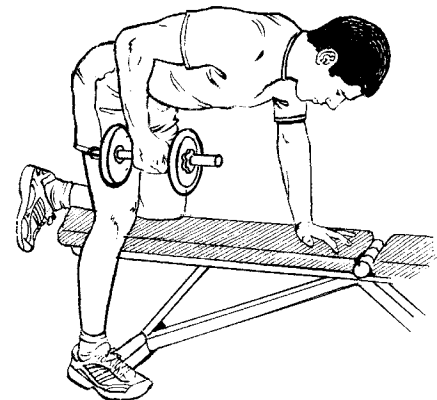
**Start-/end-position** With legs spread at shoulder width and knees flexed, hold the bar from underneath with fingers interlaced. Upper body leans forward at a ninety- to hundred-degree angle at the hip. Back is straight and head is tilted upward. Avoid hyperarching cervical lordosis. Elbows are in full extension, but the bar does not touch the floor.

**Range of motion and performance** Lift the bar and weight in a “rowing” motion until it almost reaches the chest. Avoid banging into the groin area. Elbows face upward throughout the exercise. Upper body remains rigid; back straight and abdomen contracted. Avoid hyperarching cervical and lumbar lordoses and make sure, when lowering the bar, that the weights do not touch the floor. At the end of the set, place the bar gently on the floor. Lift is performed to a 4-count while exhaling. Extend arms from mid- to end-position in a slow, controlled movement to a 6-count while inhaling.

**Movement analysis** From start to mid-position: Sterno-scapular joint – adduction by trapezius working concentrically. Shoulder – extension by latissimus dorsi working concentrically. Elbow – flexion by biceps, brachialis and brachioradialis working concentrically. From mid- to end-position: Sterno-scapular joint – abduction by trapezoid contracting eccentrically. Shoulder – flexion by latissimus dorsi contracting eccentrically. Elbow – extension by biceps, brachialis and brachioradialis contracting eccentrically.



a.) Start-/end-position



b.) Mid-position

Illustration 11.7. Exercise 11.6. One arm bent-over dumbbell row.

### EXERCISE 11.6. ONE ARM BENT-OVER DUMBBELL ROW

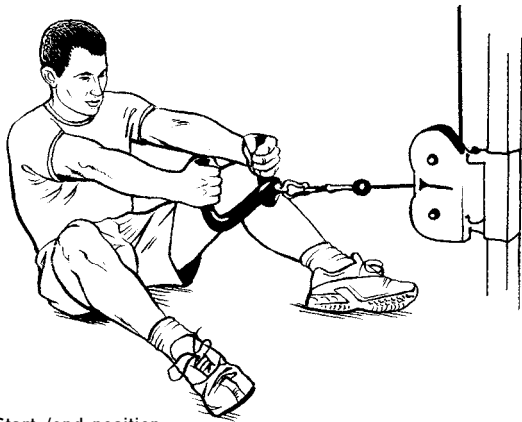
**Start-/end-position** Stand beside the bench with inside leg kneeling on the bench and outside leg standing beside the bench with slightly flexed knee. Lean forward with inside hand leaning on the bench in line with the bent knee. Trunk is parallel to the floor and head is a direct extension of the trunk. Avoid flexing or extending head. Hold the weight with outside hand in a closed middle grip with elbow in full extension. To work more on the posterior deltoid, the start-/end-position can be altered by flexing outside arm to a 90-degree angle at the elbow and a 90-degree angle at the shoulder joint, while the forearm is perpendicular to the trunk on the frontal axis.

**Range of motion and performance** Pull the weight towards the external side of chest while arm and elbow stay close to ribs. The pull is performed to a 4-count while inhaling.

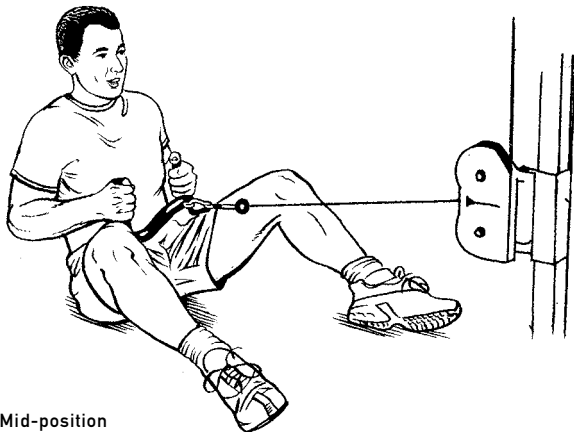
Straighten arm in a slow, controlled movement to a 6-count while exhaling.

**Movement analysis** From start to mid-position: Sterno-scapular joint – adduction by trapezius working concentrically. Shoulder – extension by the latissimus dorsi working concentrically. Elbow – flexion by biceps, brachialis and brachioradialis working concentrically. From mid- to end-position: Sterno-scapular joint – abduction by trapezius contracting eccentrically. Shoulder – flexion by latissimus dorsi contracting eccentrically. Elbow – extension by biceps, brachialis and brachioradialis contracting eccentrically.

Illustration 11.8. Exercise 11.7 Low pulley seated row



a.) Start/end-position



b.) Mid-position

## EXERCISE 11.7 LOW PULLEY SEATED ROW

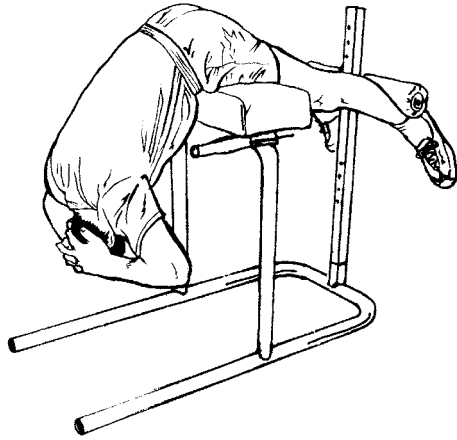
This exercise can be performed with two different grips. When holding a vertical “V” handle in a narrow grip (see illustration) with elbows close to ribs, most of the load is on latissimus dorsi. In a wide grip on a short (horizontal) bar with elbows at shoulder height, the main load is on posterior deltoid.

**Start-/end-position** Sit on apparatus with hands on leg supports.

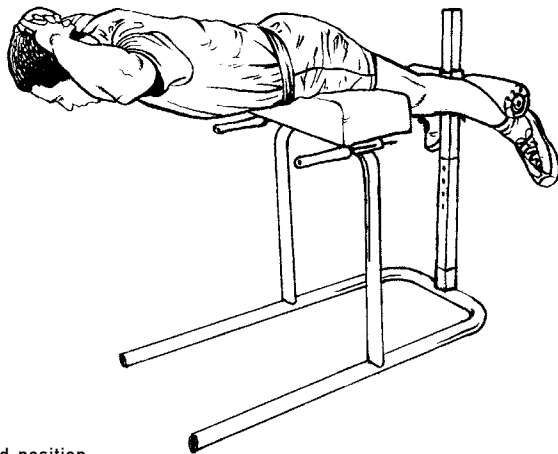
Upper body is perpendicular to the floor; head is upright and eyes look straight ahead, knees are slightly flexed. Hold the bar handles in a middle-closed grip at upper abdomen height, elbows in full extension.

**Range of motion and performance** Pull the bar handles until they touch the lower chest or upper abdomen. Elbows face outward. Trunk remains erect throughout each repetition of the exercise; the abdomen is contracted – avoid posterior extension of the trunk. Avoid hyperarching cervical and lumbar lordoses when performing the exercise and make sure that neither hand is more dominant in the pull. Legs remain in same position throughout the activity (some types of apparatus have room for using feet as counter-resistance). The pull is performed to a 4-count while exhaling (the opposite is also an option since the thorax “opens” and increases volume when pulling). Straighten arms in a slow, controlled return movement to a 6-count while inhaling.

**Movement analysis** From start to mid-position: Sterno-scapular joint – adduction by trapezius working concentrically. Shoulder – extension by latissimus dorsi working concentrically. Elbow – flexion by biceps, brachialis and brachioradialis working concentrically. From mid- to end-position: Sterno-scapular joint – abduction by trapezoid contracting eccentrically. Shoulder – flexion by latissimus dorsi contracting eccentrically. Elbow – extension by biceps, brachialis and brachioradialis contracting eccentrically.



a.) Start-/end-position



b.) Mid-position

## EXERCISE 11.8. PRONE ROMAN CHAIR BACK EXTENSION

This exercise is designed to strengthen the erector spinae. Avoid hyperextension of neck and lumbar lordoses as well as pressure on lumbar lordosis. This exercise is not recommended for beginners. It can be performed on an apparatus that neutralizes pressure on lower back and limits possible hyperextension. The farther away the hands are from the work axis, especially from lumbar spine L1–L5 and the closer they are to the head, the higher the level of difficulty.

**Start-/end-position** Lie face down on the “Roman chair” with hips on padded seat in front. Adjust the height of the rear padded cylinder so that the heels fit below. The lower body is in a fixed horizontal position, face down. Hands are placed behind head. Level of difficulty can be reduced by placing hands at the side of body or on chest.

**Range of motion and performance** Flex trunk until it reaches horizontal position. Avoid hyperarching cervical and lumbar lordoses. Avoid using the arms to push or assist the lift. Extension (straightening the trunk) is performed to a 4-count while exhaling. Flexion (descending) to vertical end-position is performed to a 6-count while inhaling.

**Movement analysis** From start to mid-position: Spine – extension by erector spinae working concentrically. Hip – extension by the gluteus maximus and hamstrings working concentrically. From mid- to end-position: Spine – flexion by erector spinae contracting eccentrically. Hip – extension by gluteus maximus and hamstrings contracting eccentrically.



a.) Start-/end-position



b.) Mid-position

## EXERCISE 11.9. GOOD MORNING

This exercise exerts a heavy load on lower back muscles and therefore is intended for professional exercisers and bodybuilders but not beginners. It can be performed with legs straight (see illustration) or with knees slightly flexed.

**Start-/end-position** Hold the bar in a high grip above C7 vertebra or in a low grip with the bar below C7 vertebra between the shoulder blades. In either case, avoid pressing the bar on neck vertebrae. The bar can be padded with a towel to avoid direct pressure on the vertebrae. In a wide overhand grip, legs are spread at or slightly more than shoulder width. Legs should be parallel with toes turned slightly outwards.

**Range of motion and performance** Flex the spine, avoiding hip flexion as much as possible. Avoid bending beyond the angle afforded by trunk flexibility. During flexion, the head remains raised and heels remain on the floor. To enhance results when straightening the trunk, contract the buttocks. Flexion is performed to a 6-count while inhaling. Straighten trunk in a slow, controlled movement to a 4-count while exhaling.

**Movement analysis** From start to mid-position: Spine – flexion by erector spinae contracting eccentrically. Hip – flexion by gluteus maximus and hamstrings contracting eccentrically. From mid- to end-position: Spine – extension by erector spinae working concentrically. Hip – extension by gluteus maximus and hamstrings working concentrically.

# 12: EXERCISES FOR THE BUTTOCKS

Both men and women have a high regard for the beauty of the buttocks. Women report that they regard male buttocks as a stimulatingly erotic part of the body and they prefer them to be tight, solid, small, and muscular because it is said to reflect male power and potency. Men admit to the sexual signals and influence of the female buttocks, when stationary and, even more so, when in motion. This is one of the reasons models exaggerate their pelvic “wiggle” at fashion shows. The basic function of the buttock muscles in the human body is to maintain hip joint stability and erect posture. Buttock muscles link the lower part of the back to the lower extremities. Most of their activities are, therefore, flexion and extension of the hip (e.g., in abduction exercises, squats, lunges, leg presses, and stair climbing). The buttocks play an active role in stabilizing and fixating the pelvis in activities involving a transition from flexion to standing, and in straightening the lower back, as shown in exercise 6.12 *Bent leg deadlifts* and exercise 11.9 *Good morning*.

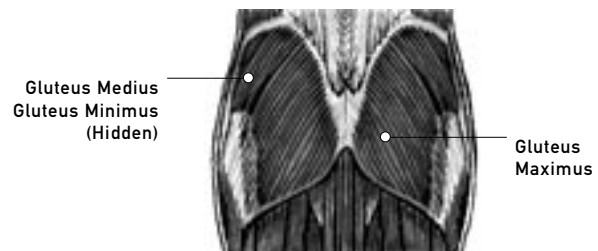
Avoid hyperextending (thereby reducing intravertebral lumbar disc pressure) while performing exercises to develop buttock muscles. In a state of hyperextension, the movement is performed by the lumbar vertebrae.

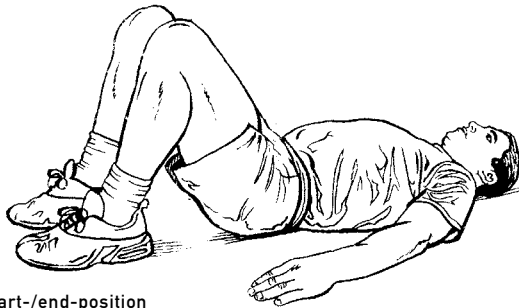
## THE BUTTOCK MUSCLES

The buttocks are comprised of three muscles in two layers: the deep layer of *gluteus minimus* and the upper visible layer of *gluteus medius* and *gluteus maximus*. Gluteus minimus and medius perform abduction and medial rotation of the hip. Gluteus maximus performs extension and lateral rotation of the hip.

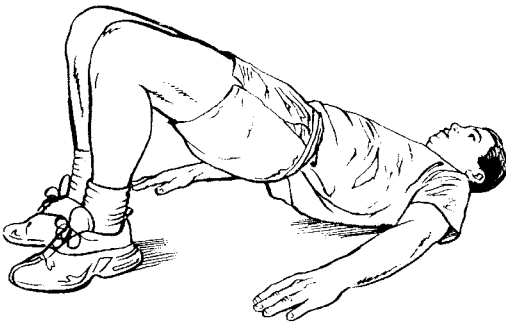
The exercises explain methods of developing the “gluteals” without special apparatus, but with significant results nonetheless. The exercises are organized according to level of difficulty. To strengthen the gluteals, we will perform the *Supine bridge with knees bent (Bridging)* and *Prone 4-point hip extension (Kick backs)* (see pp. 57–61 for additional exercises for the gluteals [6.7 to 6.12], pp. 106 and 107 for the erector spinae [11.8 and 11.9], and pp. for the leg muscles under “Common Exercises for Developing Power on Multipurpose Apparatus”).

Illustration 12.1. Posterior view of the gluteals.





a.) Start-/end-position



b.) Mid-position

### EXERCISE 12.1. SUPINE BRIDGE WITH KNEES BENT (BRIDGING)

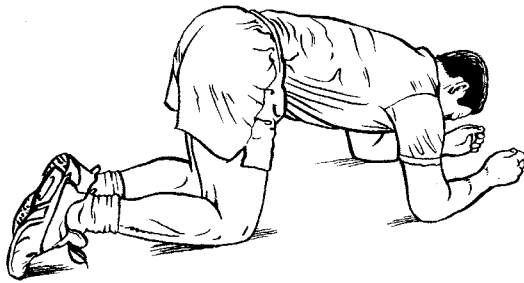
To enhance development of the gluteals and femoral biceps, feet can be placed on a bench. Another option for increasing difficulty level is to perform the exercise on one foot.

**Start-/end-position** Lie supine on a mattress or the floor with knees flexed at a ninety-degree angle, feet on mattress, and hands resting at the sides of the body. Those with a sensitive neck can place a soft pillow (e.g., a folded towel) under the neck.

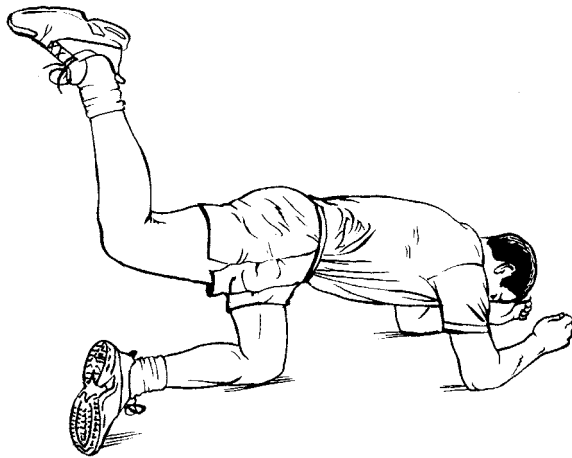
**Range of motion and performance** Raise buttocks by contracting them and pressing feet against the floor. Avoid hyperextension and hyperarching of lumbar lordosis. Avoid stress on the neck and using arm strength to lift the buttocks at the end of the exercise. Stay at peak extension (maximum contraction) about two seconds in order to increase muscle tension. Raise buttocks to a 4-count while exhaling. Lower buttocks to end-position in a slow, controlled movement, to a 6-count while inhaling.

**Movement analysis** From start to mid-position: Spine – flexion by erector spinae contracting eccentrically. Hip – extension by gluteus maximus and hamstrings working concentrically. Knee – extension by quadriceps working concentrically. From mid- to end-position: Spine – extension by erector spinae working concentrically. Hip – flexion with gluteus maximus and hamstrings contracting eccentrically. Knee – flexion by quadriceps contracting eccentrically.

Illustration 12.3. Exercise 12.2. Prone 4-point hip extension (Kick backs).



a.) Start-/end-position



b.) Mid-position

## EXERCISE 12.2. PRONE 4-POINT HIP EXTENSION (KICK BACKS)

It is best to develop the gluteals by working against resistance since they are quite large and strong. To enhance development of gluteus maximus, a weight can be strapped above the heel.

**Start-/end-position** Stand on fours on a mattress; forearms, toes and knees on the mattress. Lean on forearms with abdominal muscles contracted, chin held in, and neck elongated.

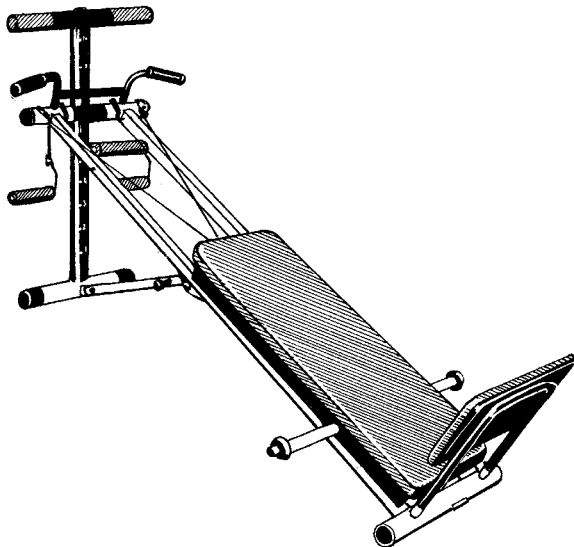
**Range of motion and performance** Extend hip above buttock height. Avoid hyperextension and hyperarching of lumbar spine. Avoid hyperarching cervical and lumbar lordoses throughout the exercise. The exercise can be performed with either straight leg or flexed knee. Hold peak extension (maximum contraction) about two seconds in order to increase muscle tension. Hip extension is to a 4-count while exhaling. Hip flexion back to start-/end-position occurs in a slow, controlled movement should be to a 6-count while inhaling.

**Movement analysis** From start to mid-position: Spine – extension by erector spinae working concentrically. Hip – extension by gluteus maximus and hamstrings working concentrically. From mid- to end-position: Spine – flexion by erector spinae contracting eccentrically. Hip – flexion by gluteus maximus and hamstrings contracting eccentrically.

# 13: COMMON EXERCISES FOR DEVELOPING POWER ON MULTIPURPOSE APPARATUS

Multipurpose apparatus in the fitness room offer a large array of exercises for developing all the muscle groups in the body, but usually at a lower level of safety. They are designed for specific types of exercises but amateurs and professionals can use them for exercises that can be performed on other equipment as well. In this chapter a number of popular exercises for each apparatus are provided. Additionally, practical suggestions for optimal results with maximum safety during training are introduced and analyzed.

Illustration 13.1. The Total Trainer.



## THE TOTAL TRAINER

The “Total Trainer” is an improvement on an apparatus called “Alpha,” the first apparatus to utilize body weight on a mobile track. The Total Trainer is often found in private homes as well as fitness rooms. It usually includes an instructional video and manual with instructions for stretches. It is important to follow safety rules and, most importantly, to maintain good body organization during training, since the apparatus offers a wide range of exercises in different body positions. Certain exercisers, mainly older ones, purchase the apparatus to perform “leg presses” as a way to counter osteoporosis.

**Advantages of the Total Trainer** – Allows exercisers a means of working all muscle groups in the body. It is foldable and portable, relatively inexpensive, requires minimal maintenance, and permits exercisers to control level of difficulty.

**Limitations** – Requires high-level operational skill.

**Levels of difficulty** – The steeper the incline, the higher the resistance level. Weights can be added on the sides of the moving surface to increase resistance.

Illustration 13.2. Exercise 13.1. Total trainer prone shoulder press. (Use overhand grip handles instead of foot press surface.)



a.) Start-/end-position



b.) Mid-position

### EXERCISE 13.1. TOTAL TRAINER PRONE SHOULDER PRESS. (USE OVERHAND GRIP HANDLES INSTEAD OF FOOT PRESS SURFACE.)

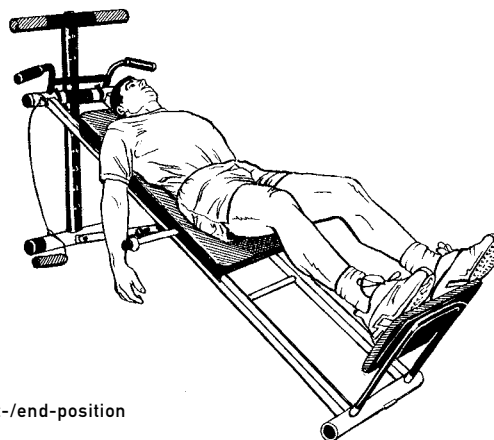
**Start-/end-position** Lie face-down with head tilted down and beyond the mobile surface, knees are slightly bent. Place head so that it does not hit the floor when returning to the end-position. Grasp the handles in a closed overhand grip.

**Range of motion and performance** Straighten arms by elbow extension while pushing the body upwards. Extension is to a 4-count while exhaling. Return elbow flexion is in a slow, controlled movement to a 6-count while inhaling.

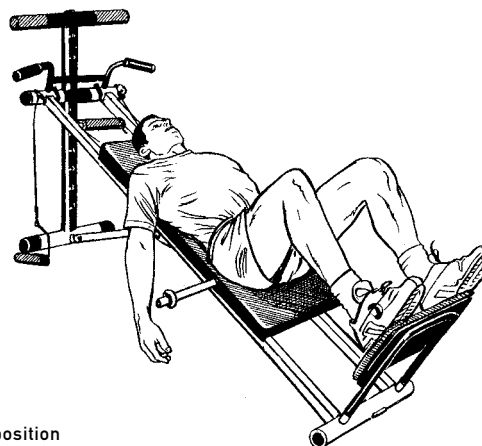
**Movement analysis** From start-to mid-position: Sterno-scapular joint – lateral rotation and elevation by cervical trapezius working concentrically. Shoulder – abduction by medial

deltoid working concentrically. Elbow – extension by triceps and anconeus (elbow muscle) working concentrically. From mid- to end-position: Sterno-scapular joint – medial rotation and depression by cervical trapezius contracting eccentrically. Shoulder – adduction by medial deltoid contracting eccentrically. Elbow – flexion by triceps and anconeus contracting eccentrically.

Illustration 13.3. Exercise 13.2. Total trainer supine leg press.



a.) Start-/end-position



b.) Mid-position

### EXERCISE 13.2. TOTAL TRAINER SUPINE LEG PRESS.

The leg-press is the most frequently performed exercise on the Total Trainer. The surface incline can be adjusted to each exerciser's level. The smaller the hip joint angle is in relation to the trunk, the greater is the load on the gluteals. The exercise can also be performed with only one leg pushing while reclining on the back in order to increase the load on the leg. To augment resistance,

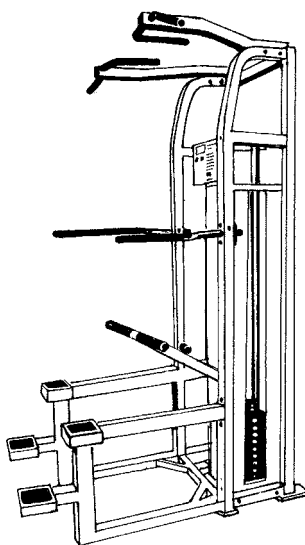
weights can be attached to the bars on the sides of the moving surface.

**Start-/end-position** Lie on back with head resting on the moving surface, preferably with a pillow under the head. Place heels on the edge of the footrest surface so that feet are above knee height, and the front half of the feet is beyond the surface. Hands hang loose at the sides of the body or rest on abdomen.

**Range of motion and performance** Flex knees to a ninety-degree angle to reduce load on knee and wear on the patella. When going up, extend legs by pushing with heels only, so as to avoid pressure and load on knees. Avoid forceful locking of knees during extension. Make sure that when extending the knees on the ascent, work is concentric, when flexing the knees in the descent, the work is eccentric. The rhythm will be a 4-count when ascending, and a 6-count when descending.

**Movement analysis** From start-to mid-position: Hip – flexion by gluteus maximus and hamstrings contracting eccentrically. Knee – flexion by quadriceps contracting eccentrically. Ankle – dorsiflexion by gastrocnemius and soleus contracting eccentrically. From mid- to end-position: Hip – extension by gluteus maximus and hamstrings working concentrically. Knee – extension by quadriceps working concentrically. Ankle – plantar flexion by gastrocnemius and soleus working concentrically.

Illustration 13.4. Graviton chin-up dip.



## THE GRAVITON

The *Graviton* is designed for beginners and exercisers who lack the strength to perform even one chin-up. It can also be used to improve maximum ability by increasing resistance. The steps in front of the apparatus can be used to stretch or develop the gastrocnemius, as in exercises 6.1 and 6.2. The Graviton offers several options for performing chin-ups and parallel bar work.

**Advantages of the Graviton** – Chin-ups on this apparatus are performed without having to arch the back because the opening in the bar allows the body to be raised without banging one's head on the high bar. As a result, intravertebral lumbar disc pressure is significantly lower in all chin-up variations. Since the apparatus simulates the normal kinesthetics and movement of chin-ups, it enhances exercisers' motivation and belief in their ability to lift the body weight.

**Limitations of the Graviton** – it is very expensive and its height requires a high ceiling.

**Resistance** – while regular apparatus overcome the resistances specified on each apparatus, resistance on the Graviton is calculated differently. The load on the exerciser is determined by the *differential* between body weight and the weight loaded on the apparatus. If more weights are added, more “assistance” is provided, thus, reducing the differential (i.e., exercisers lift less and so the work-load is lighter). If less weight is added, less assistance is given, the differential is greater and exercisers lift more.

**Form of calculation** – since the load on the exerciser is the differential between body weight and weight resistance, the calculation is as follows:

First calculate the exerciser's RM<sub>1</sub>. For example, an exerciser weighs 70 kg, and performs a single chin-up with the addition of 50 kg. The differential is 20 kg, so the RM<sub>1</sub> to be overcome is 20 kg. Added resistance is calculated in the form of a pyramid of 25, 20, 15, and 10 per cent of RM<sub>1</sub> (in this case, the differential is 20 kg). The number of repetitions is calculated using the repetitions/strength relationship table (see Table 17.3). In this case, we refer to the supplementary percentage of the pyramid. For example, according to the table, 10 per cent has a supplementary percentage of 90 per cent of RM<sub>1</sub> which equals three repetitions.

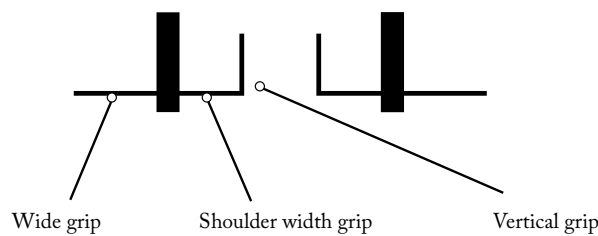
Table 13.1. Calculations of RM1 for chin-up dip machine

| % of RM <sub>1</sub><br>ACCORDING<br>TO PYRAMID | CALCULATING<br>SUPPLEMENTARY<br>RESISTANCE<br>WHEN 20 KG = RM <sub>1</sub> | CALCULATING THE<br>WEIGHT TO BE LOADED<br>ON THE GRAVITON<br>(SUPPLEMENTARY<br>RESISTANCE WEIGHT) | SUPPLEMENTARY %<br>FOR CALCULATING<br>NUMBER OF<br>REPETITIONS | NUMBER OF<br>REPETITIONS<br>ACCORDING TO<br>REPETITIONS-TO-<br>POWER TABLE |
|-------------------------------------------------|----------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|----------------------------------------------------------------|----------------------------------------------------------------------------|
| 25%                                             | 5 kg = 20 kg x 25%                                                         | 55 kg = 5 kg +50 kg                                                                               | 75%                                                            | 8                                                                          |
| 20%                                             | 4 kg = 20 kg x 20%                                                         | 54 kg = 4 kg +50 kg                                                                               | 80%                                                            | 6                                                                          |
| 15%                                             | 3 kg = 20 kg x 15%                                                         | 53 kg = 3 kg +50 kg                                                                               | 85%                                                            | 4                                                                          |
| 10%                                             | 2 kg = 20 kg x 10%                                                         | 52 kg = 2 kg +50 kg                                                                               | 90%                                                            | 3                                                                          |

*Types of grips for chin-ups*

Chin-ups on the Graviton can be executed with three types of grips:

Illustration 13.5. View from the top of the grip bar for practising chin-ups on the Graviton.



All three types of grips activate the latissimus dorsi, and arm, shoulder, and chest muscles. Development emphasis varies according to the grip type used.

**Vertical grip (“hammer” grip)** – The bar handle is held like a hammer, that is, with thumbs facing us. This grip works more on developing forearm muscles.

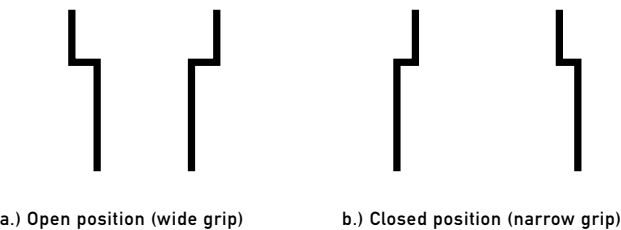
**Shoulder-width grip** – Emphasis is on developing arm and shoulder muscles. In the overhand grip, there’s more work on the forearm extensors; in the underhand grip, the work is more on the forearm flexors.

**Wide grip** – Emphasis is on developing latissimus dorsi. This grip is usually overhand.

*Types of parallel bar grips*

In addition to chin-ups, Graviton users can perform parallel bar exercises using the two additional grip bars in the middle section. The parallel grip bars can be rotated inward to a “closed position” or outward in an “open position.”

Illustration 13.6. View from above of the grip bars for practising parallel bar exercises on the Graviton.

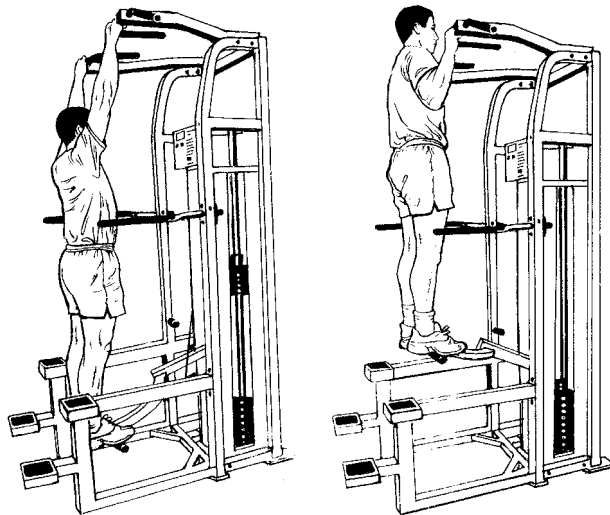


The handles can be gripped in a closed or open position. In an open position the grip is wide, and in a closed position, the grip is narrow. In both variations, work occurs on the pectorals and the posterior arm muscles. Emphasis varies according to the grip position.

**Wide grip** – Emphasis is on developing the pectorals.

**Narrow grip** – Emphasis is on developing the posterior arm muscles.

Illustration 13.7. Exercise 13.3. Hanging assisted chin-up.



a.) Start-/end-position

b.) Mid-position

### EXERCISE 13.3. HANGING ASSISTED CHIN-UP

This is the most highly recommended preparatory exercise for chin-ups. The exercise activates more than forty muscles in the back (mainly latissimus dorsi), shoulder girdle, arms, chest, and neck without pressing on the joints. Although, quantitatively, the difference between doing zero and one chin-up is 100 per cent (the same as between one and two chin-ups), there is a qualitative difference in terms of physical ability and, therefore, the improvement is non-linear. Exercisers, who can perform a single chin-up, can improve to fifteen chin-ups and relatively more quickly, depending on their perseverance and fitness level. However, advancing from

zero to one chin-up is the most difficult task and requires a lot of patience and dedication. For those who might despair, it helps to remember that over time, water can wear away stone!

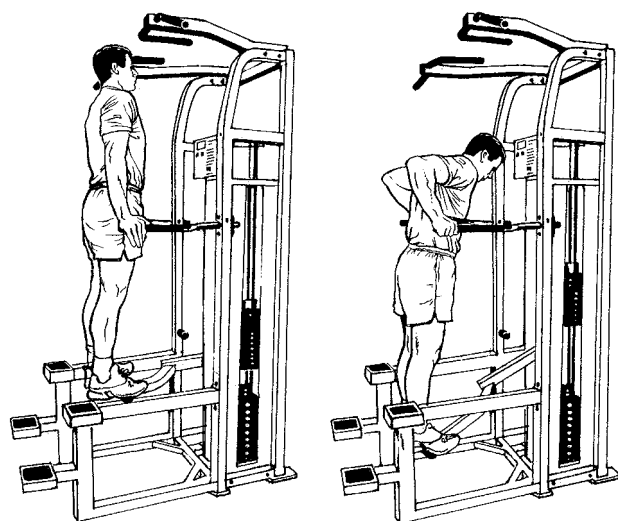
While performing chin-ups, be sure the parallel bar handles are in an open position. Choose the desired grip and resistance. It is possible to use different hand grips in order to vary the exercise and increase strength levels. A wide grip places most of the load on latissimus dorsi and arm muscles. A narrow grip works on the same muscles but with most of the load on the arm muscles. In the vertical (hammer) grip, most of the load is on the shoulder and brachioradialis.

**Start-/end-position** Grasp the handles in a closed overhand grip, with elbows straight. Place legs on the auxiliary foot rest. Head is upright, looking straight ahead. Body is erect.

**Range of motion and performance** Pull the body up using arms until elbows are closed or until chin reaches slightly above handle height. Make sure both arms share in the work and avoid shaking the body or using pelvis or leg movements to gain momentum and assist in elevation. It is important to perform the exercise without assistance from other muscle groups. The body elevates as one unit. Assistance can be provided only by the apparatus foot rest. Pull up to a 4-count while exhaling. Straighten arms in a slow, controlled return movement to a 6-count while inhaling.

**Movement analysis with an overhand grip** From start- to mid-position: Sterno-scapular joint – medial rotation by trapezoid working concentrically. Shoulder – adduction by latissimus dorsi working concentrically. Elbow – flexion by biceps, brachialis and brachioradialis working concentrically. From mid- to end-position: Sterno-scapular joint – lateral rotation by trapezoid contracting eccentrically. Shoulder – abduction by latissimus dorsi contracting eccentrically. Elbow – extension by biceps, brachialis and brachioradialis contracting eccentrically.

Illustration 13.8. Exercise 13.4. Standing assisted dips.



a.) Start-/end-position

b.) Mid-position

This exercise can be performed with two types of grips:

**Wide grip** – During the activity elbows are turned outwards and force is mainly exerted on the pectorals.

**Range of motion** – Lower body so that elbow joint is at seventy to eighty degrees between arm and forearm, and return.

**Narrow grip** – During the activity elbows are close to ribs and force is exerted mainly on posterior arm muscles.

**Range of motion** – Lower the body to seventy- to eighty-degree-angle in elbow joint between arm and forearm and return.

#### EXERCISE 13.4. STANDING ASSISTED DIPS

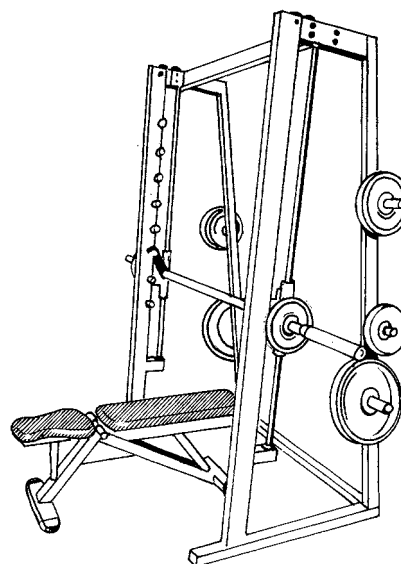
**Start-/end-position** Grasp parallel handles in a narrow overhand grip. Body is vertical, head raised and looking straight ahead, neck is long and not sunken into shoulders, and elbows are straight.

**Range of motion and performance** Flex elbow to a ninety-degree angle between arm and forearm. Exceeding this angle creates a heavy load on the shoulder joint. Avoid swinging the body or turning elbows to the sides. Keep them close to the ribs throughout the movement. Maintain the same body position throughout the exercise. Flexion is performed to a

6-count while inhaling. Elbow extension is performed in a slow, controlled movement to a 4-count while exhaling.

**Movement analysis** From start- to mid-position: Sterno-scapular joint – Elevation by trapezius and pectoralis minor contracting eccentrically. Shoulder – abduction and extension by pectoralis major and anterior deltoid contracting eccentrically. Elbow – flexion by triceps and anconeus (elbow muscle) contracting eccentrically. From mid- to end-position: Sterno-scapular joint – Depression by trapezius and pectoralis minor working concentrically. Shoulder – adduction and flexion by pectoralis major and anterior deltoid working concentrically. Elbow – extension by triceps and anconeus working concentrically.

Illustration 13.9. The Smith machine.

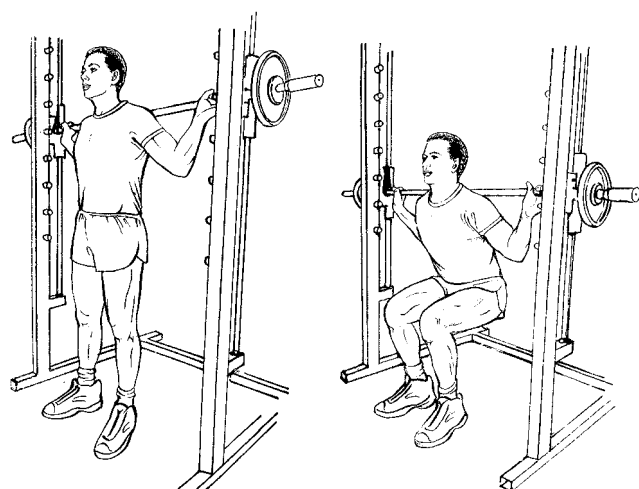


#### THE SMITH MACHINE

The *Smith machine* was designed to assist the stabilizing muscles in complex exercises such as squats or chest presses. The apparatus is named after its inventor, the famous 1970s fitness professional Randy Smith. Beginners can learn skills with it, and advanced exercisers can enhance their achievements. Activity on the machine helps to strengthen skeletal bones since all exercises are converted to vertical movement. When the load is perpendicular to the ground, most of the energy

is expressed in compression that reduces the role of the stabilizing muscles in the movement. The apparatus can be used for many exercises other than squats; notably, incline chest presses and lunges. The Smith machine is extremely safe and, because it has a mechanism to prevent the bar from falling, assistance from another person is not necessary when performing exercises. Since internal weights are built into the Smith machine to balance the bar in the straps, bar weight is not included in resistance calculations.

Illustration 13.10. Exercise 13.5. Smith machine Squat.



a.) Start-/end-position

b.) Mid-position

### EXERCISE 13.5. SMITH MACHINE SQUAT

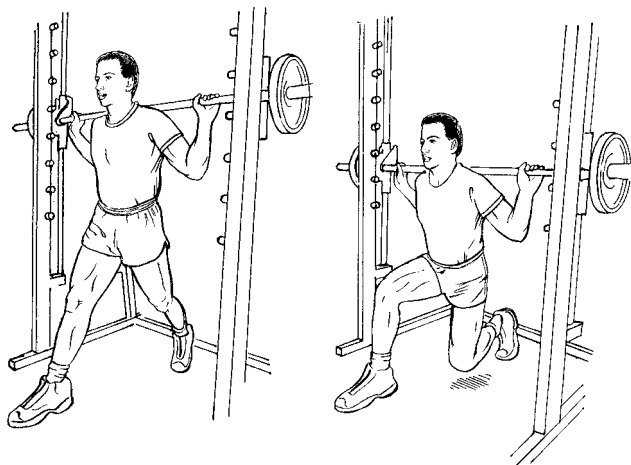
The squat is a basic, important exercise for developing leg strength. Exercisers who cannot keep their heels on the ground during flexion because of a short Achilles' heel, or any other reason, are advised to elevate the heels and squat until the knees reach the toe line. Exercisers can squat to less than toe line or move slightly away from the apparatus according to individual ability.

**Start-/end-position** Raise the bar after releasing the two brakes at the sides of the bar with a quarter-turn. Stand erect and symmetrically, legs parallel, back straight, and tilted slightly back. Grasp the bar in a closed overhand grip. Hold the bar above the seventh vertebra (C7) using a high grip. Using a low grip, hold the bar below C7 and between the shoulder blades. In both variations, keep the bar from pressing on the cervical vertebrae. The head is placed in front of the middle of the bar. Work facing a mirror (if there is one) and move slightly forward so that the load in the knees is reduced. Avoid leaning on the bar; just hold it. Spread legs at or slightly more than shoulder width apart and turn the toes slightly outwards. The load is on the erector spinae, hip joint, and heels, with toes working only to maintain body stability.

**Range of motion and performance** Flex knees to a ninety-degree angle between thigh and lower leg. Body remains erect and heels do not leave the ground. Be sure not to bend forward or backward. Maintain balance by pushing buttocks out as necessary. Knees should not exceed the foot line to avoid overloading the knees. Keep head raised throughout the activity. When finished, stand on whole foot, return the bar, and use the brakes to hold it. Make sure that muscle work is eccentric in the descent and concentric when rising. Flexion is performed to a 6-count while inhaling and extension to a 4-count while exhaling.

**Movement analysis** From start- to mid-position: Spine – flexion by erector spinae contracting eccentrically. Hip – flexion by gluteus maximus and hamstrings contracting eccentrically. Knee – flexion by quadriceps contracting eccentrically. Ankle – dorsiflexion by gastrocnemius and soleus contracting eccentrically. From mid- to end-position: Spine – extension by erector spinae working concentrically. Hip – extension by gluteus maximus and hamstrings working concentrically. Knee – extension by quadriceps working concentrically. Ankle – plantar flexion by gastrocnemius and soleus working concentrically.

Illustration 13.11. Exercise 13.6. Smith machine front lunges.



a.) Start-/end-position

b.) Mid-position

### EXERCISE 13.6. SMITH MACHINE FRONT LUNGES

This exercise is very difficult and is intended for advanced exercisers. Emphasis is on quadriceps and gluteus. The exercise described here is the *static lunge*. For learning and practice, perform the exercise against body weight only, without additional weights.

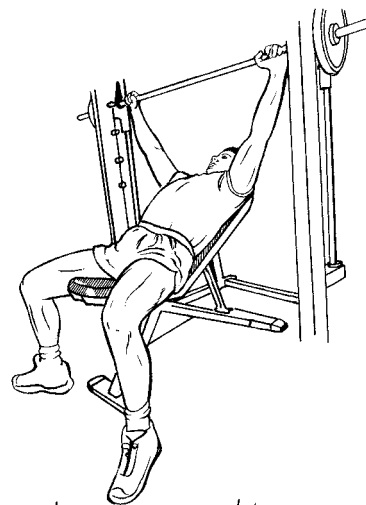
**Start-/end-position** Stand erect with right leg forward. Using an underhand grip, hold the bar balanced on the shoulders, over the deltoids.

**Range of motion and performance** Flex right knee to a ninety-degree angle. The flexed knee should not exceed the foot line so as not to wear on the patella and overload the cruciate ligaments. Movement is slow and controlled. Inhale to a 6-count in flexion, and exhale to a 4-count when rising. Several repetitions can be performed on the same leg (static lunge) or legs can be alternated after each lunge (dynamic lunge). The thigh and knee of the front leg are both at a ninety-degree angle when performing the exercise.

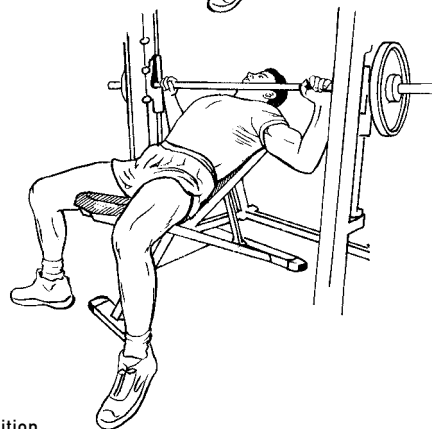
**Another variation** Place rear foot on a padded chair or bench. Place front leg slightly forward to a lunge position. The knee does not exceed the foot line. The rear leg is static and used for balance. Perform lunges with front foot only. In both variations the knee should not move. In both static variations, inhale to a 6-count during the lunge, and exhale to a 4-count when returning.

**Movement analysis** From start- to mid-position: Hip – flexion by gluteus maximus and hamstrings contracting eccentrically. Knee – flexion by quadriceps contracting eccentrically. Ankle – dorsiflexion by gastrocnemius and soleus contracting eccentrically. From mid- to end-position: Hip – extension by gluteus maximus and thigh extensors working concentrically. Knee – extension by quadriceps working concentrically. Ankle – plantar flexion by gastrocnemius and soleus working concentrically.

Illustration 13.12. Exercise 13.7. Smith machine incline chest press.



a.) Start-/end-position



b.) Mid-position

### EXERCISE 13.7. SMITH MACHINE INCLINE CHEST PRESS

This exercise can encompass all parts of the pectoral muscle by adjusting the back rest to the desired angle (decline/incline). Performing a chest press at an incline or decline involves the same muscle groups, and movement analyses are similar. The difference lies in the load distribution on the various motor units (nerve and muscle fibres) in each muscle group. A chest-press at a positive (upwards) angle concentrates on the superior pectoral fibres. A chest-press at a negative (downwards) angle emphasizes the inferior pectoral fibres. Placing the legs on the leg-rest is controversial, and a number of different inappropriate placements have proven harmful. Placing the legs on the floor causes the back to arch and overexerts and pressures lumbar lordosis. When working with high loads, crossing the legs in the air during the press reduces balance and creates pelvic instability which can cause the lumbar vertebrae to rotate and press on the nerve roots. Therefore, it is advisable to perform the exercise with knees on the seat for a greater feeling of stability. In any case, avoid moving one or both legs during the press, and make sure they are symmetrically placed.

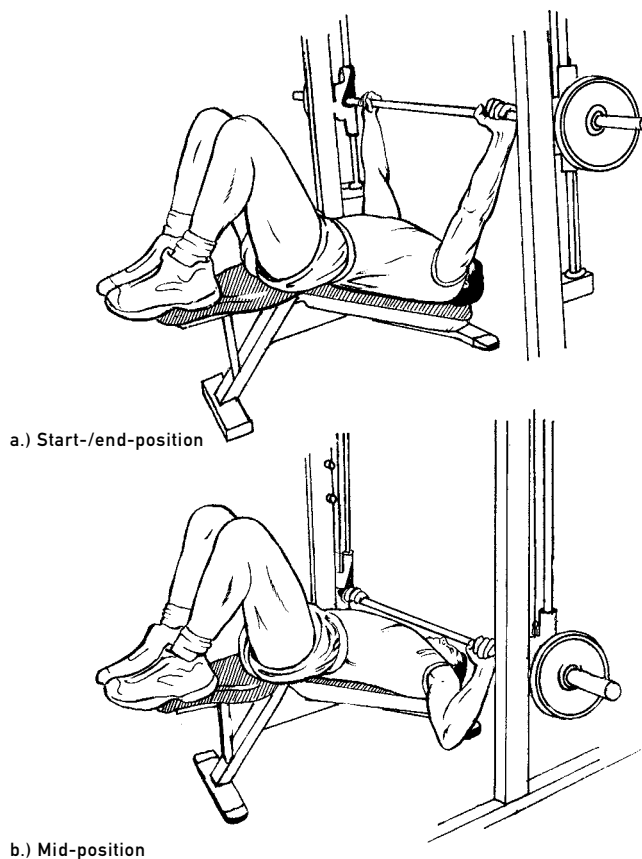
**Start-/end-position** Lie back on the bench at a thirty-five- to forty-five-degree angle. The whole head is resting on the bench. The feet are also on the bench (to improve the feeling of stability at high loads) or the knees are flexed in the air above the navel. Perform posterior pelvic tilt when legs are on the floor. Hold the bar in a closed overhand grip at slightly more than shoulder width, preferably with ninety-degree angle at both the shoulder and the elbow. A wide grip works more on the pectorals, while a narrow grip focuses work more on the triceps because the dominant joint is the elbow and not the shoulder.

**Range of motion and performance** Flex elbows while lowering the bar in a slow, controlled movement. Body position does not change throughout the exercise. Avoid hyperarching lumbar lordosis. Lower bar to about a centimetre above upper thorax. The bar should not touch the thorax. Lower the bar to a 6-count while inhaling and lift it to a 4-count while exhaling, until arms are straight.

**Movement analysis** From start- to mid-position: Sterno-scapular joint – adduction by serratus anterior contracting eccentrically. Shoulder – horizontal and sagittal abduction by pectoralis major and anterior deltoid contracting

eccentrically. Elbow – flexion by triceps contracting eccentrically. From mid- to end-position: Sterno-scapular joint – abduction by serratus anterior working concentrically. Shoulder – horizontal and sagittal adduction by pectoralis major and anterior deltoid working concentrically. Elbow – extension by triceps working concentrically.

Illustration 13.13. Exercise 13.8. Smith machine decline chest-press.



### EXERCISE 13.8. SMITH MACHINE DECLINE CHEST-PRESS

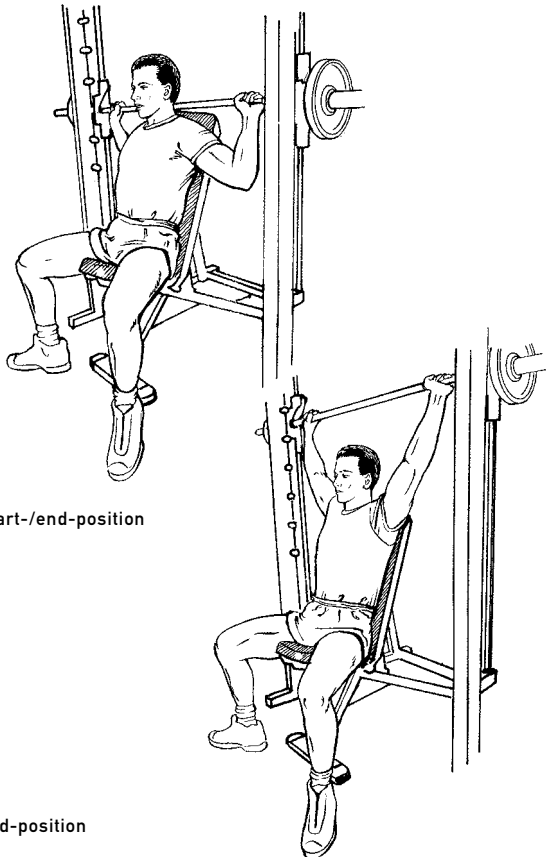
**Start-/end-position** Lie back on bench with head at a thirty-degree decline. Avoid increasing the angle (or the tilt) to prevent overloading the shoulder joint. The head lies on the bench. Avoid letting the body slide down. Place the feet on the bench for a greater feeling of stability at high loads, or flex the knees in the air above the navel. Hold the bar in a wide closed overhand grip at slightly more than shoulder width. A wide grip works more on the chest muscles, while

a narrow grip focuses work more on the triceps because the dominant joint is the elbow and not the shoulder.

**Range of motion and performance** Extend elbows and lower the bar in a slow, controlled movement. Avoid hyperarching lumbar lordosis. Body position does not change while performing the exercise. Lower the bar to about a centimetre above the upper part of the thorax without letting the bar touch the chest. Lower the bar to a 6-count while inhaling, and raise it back up to a 4-count while exhaling, until arms are straight.

**Movement analysis** From start- to mid-position: Sterno-scapular joint – adduction by serratus anterior contracting eccentrically. Shoulder – horizontal abduction by pectoralis major and anterior deltoid contracting eccentrically. Elbow – flexion by triceps contracting eccentrically. From mid- to end-position: Sterno-scapular joint – abduction by serratus anterior working concentrically. Shoulder – horizontal adduction by pectoralis major and anterior deltoid working concentrically. Elbow – extension by triceps working concentrically.

Illustration 13.14. Exercise 13.9. Smith machine seated shoulder press.



a.) Start-/end-position

b.) Mid-position

### EXERCISE 13.9. SMITH MACHINE SEATED SHOULDER PRESS

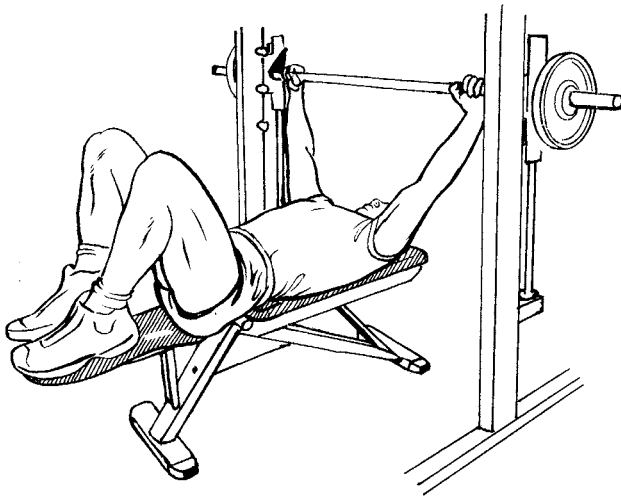
Shoulder presses can be performed on the Smith machine in front or behind the neck. The exercise is not intended for beginners due to the load it exerts on all the vertebrae. The body has to be relatively strong and prepared to perform this exercise. During this exercise, there is a tendency towards an anterior pelvic tilt; therefore, it is important to avoid hyperarching the lumbar and cervical lordoses. It is advisable to maintain a position of posterior pelvic tilt when performing the exercise.

**Start-/end-position** Make sure the bench is centred. Raise the back rest to an eighty-degree angle so that the shoulder joint can perform the optimal movement. Grasp the bar in a closed overhand grip above the posterior deltoid muscle with hands at more than shoulder width apart, or in a wide grip, so that the elbows can move towards ribs when lowering the bar. The elbows are under the bar and the wrists are straight. Place the bar about a centimetre above the seventh vertebra. Spread legs to slightly more than shoulder width apart, with knees slightly flexed. The head is upright and eyes look straight ahead.

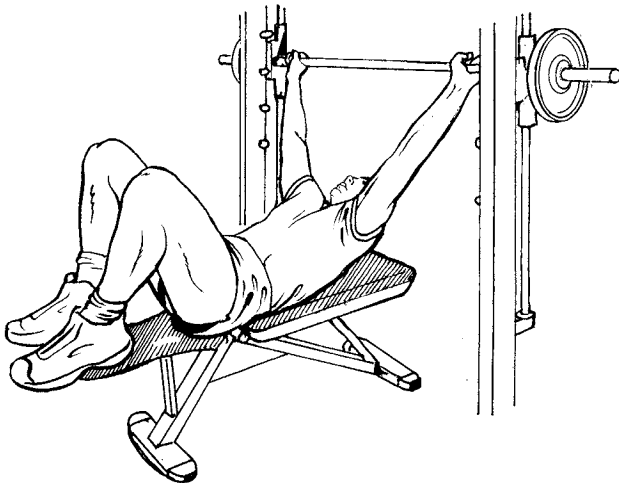
**Range of motion and performance** Extend elbows while pushing the bar upwards until they are straight but not locked. Avoid locking elbows forcefully. Maintain the same body position throughout the entire exercise and avoid banging the bar on neck. Extension is performed to a 4-count while exhaling. Lower the bar in a slow, controlled movement to a 6-count while inhaling.

**Movement analysis** From start- to mid-position: Sterno-scapular joint – lateral rotation and elevation by cervical trapezius working concentrically. Shoulder – abduction by medial deltoid working concentrically. Elbow – extension by triceps and anconeus (elbow muscle) working concentrically. From mid- to end-position: Sterno-scapular joint – medial rotation and depression by cervical trapezius contracting eccentrically. Shoulder – adduction by medial deltoid contracting eccentrically. Elbow – flexion by triceps and elbow contracting eccentrically.

Illustration 13.15. Exercise 13.10. Supine bent-knee flat bench Smith machine crunch.



a.) Start-/end-position



b.) Mid-position

### EXERCISE 13.10. SUPINE BENT-KNEE FLAT BENCH SMITH MACHINE CRUNCH

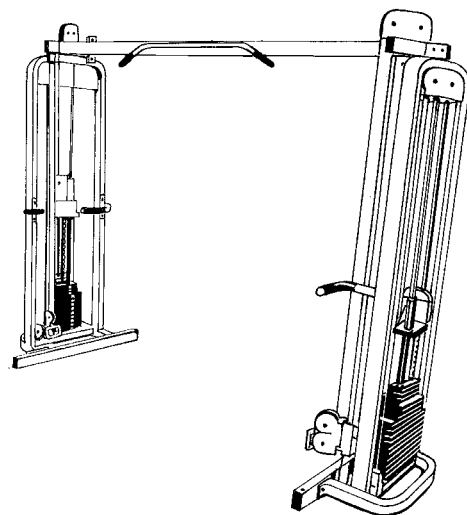
This version of the crunch is used mostly by professional exercisers and is not intended for beginners. In addition to developing the abdominals, the exercise works on shoulder and arm muscles isometrically. The exercise can also be performed lying down on a chest-press machine. The Smith machine assists by adding resistance that enhances abdominal muscle power.

**Start-/end-position** Lie on back with feet on bench. Flatten lower back to the bench by flexing legs in the air or by placing them on the bench at a forty-five-degree angle in order to prevent lower back intravertebral disc pressure. Place the bar above the sternum (chest bone) and grasp it in a closed overhand grip with arms straight. Try to keep a constant distance of an imaginary orange between chin and chest and keep the neck straight throughout the exercise.

**Range of motion and performance** Flex the spine while rising (crunch) to a thirty-degree angle or until shoulder blades are in the air. Maintain the “orange-distance” (i.e., the circumference of an orange) between chin and chest and keep the neck elongated. Elevation is performed only by the abdominals without swinging or assistance from other muscle groups that do not help to develop the abdominals. Rise only by flexing the spine without assistance from the head. Avoid nodding the head (in a “yes” movement) which results in pain and cumulative damage to neck. The arms remain straight when elevating and descending. Rise to a 4-count while exhaling, and descend to a 6-count while inhaling.

**Movement analysis** From start- to mid-position: Spine – flexion by rectus abdominis and obliques working concentrically. From mid- to end-position: Spine – extension using rectus abdominis and obliques contracting eccentrically.

Illustration 13.16. Crossover apparatus.



## CROSSOVER

The name of this apparatus is derived from the unique exercise that can be performed on it. It offers a large number of exercises for all muscle groups. The apparatus is equipped with grip straps for arms or legs, and grip handles and bars for performing activities with both hands. Some contend that the *Crossover* offers as much exercise as most other main pieces of gym apparatus together. Users should have a high level of skill due to the large array of options it offers which precludes user safety. During work with the Crossover, it is important to maintain symmetry of movement and posture, especially when the activity is performed while standing and/or using only one arm or leg. The height of most Crossover machines can be adjusted, allowing exercisers to activate different muscle groups and different motor units within the same muscle. It is important that both sides of the apparatus be at the same height when working with both hands at the same time. The equipment has no resistance bar; therefore, the apparatus is the axis of action. If at all possible, the Crossover should be placed in front of a mirror for visual feedback.

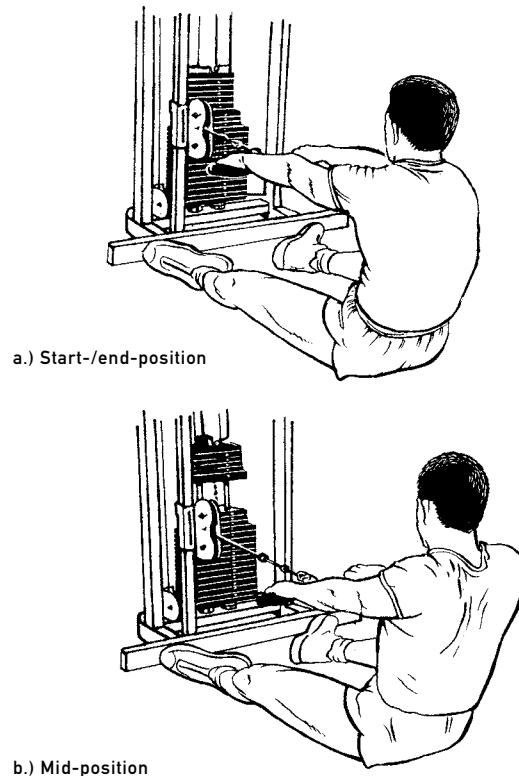
**Advantages of the Crossover** – It offers a variety of exercises for training all muscle groups in the body. In most models, the apparatus (axis of operation) is adjustable for both height and direction of activity, thus allowing three or even four exercisers to work on it at the same time. Its safety level is relatively high for a multipurpose machine.

**Limitations** – Relatively expensive and takes up a lot of space.

Some of the following exercises are quite common, but they are mainly unique to the Crossover machine.

## SCAPULAR ADDUCTORS

Illustration 13.17. Exercise 13.11. Seated low pulley cable crossover scapular retraction.



### EXERCISE 13.11. SEATED LOW PULLEY CABLE CROSSOVER SCAPULAR RETRACTION

This exercise works on the scapular adductors. It is important to execute it with arms straight throughout the movement in order to isolate the scapular adductors. If the elbow is inadvertently flexed during the movement, the load moves away, towards the biceps brachii. The exercise requires high-level coordination and isolation of muscles. Those who find it difficult to perform the exercise should practice it first without resistance in order to learn the movement. To demonstrate the correct movement, the instructor should stand behind the exerciser with a pencil and have the exerciser “grasp” it between his or her shoulder blades. This “grasping” attempt entails scapular adduction, and this drill will help exercisers to feel and master the correct movement.

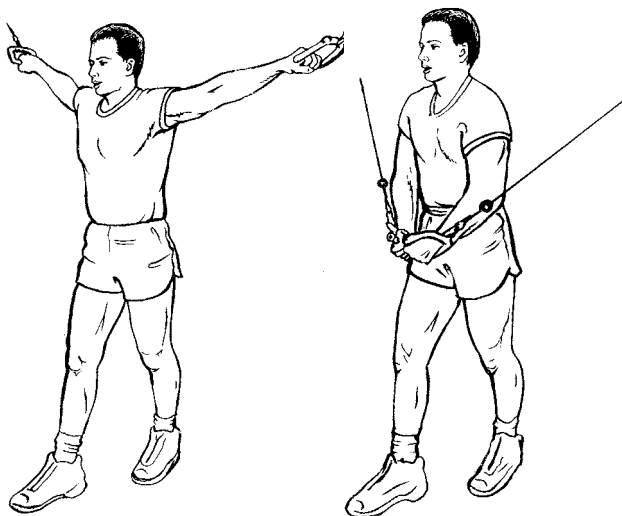
Once exercisers can perform the movement without help from irrelevant muscle groups, they should perform it with resistance.

**Start-/end-position** Before settling in, make sure the cable is taut. Sit on the floor with legs spread apart, feet are on the floor and knees are flexed towards the ceiling, or flexed on the floor. It is also possible to position the legs straight with slightly flex the knees (see illustration). The back is straight, the shoulders are rotated forward, and the pelvis is tilted to the posterior. Grasp the lower handle at chest-height opposite the movement axis in the scapulae.

**Range of motion and performance** Adduct the scapulae only. The arms are straight without elbow flexion. The lower part of the trunk remains erect, and adduction is performed between the scapulae and spine. Avoid hyperarching lumbar lordosis or elevation movements. When abducting the scapulae, carefully control the weights to avoid banging them down heavily. Breathing in this exercise is the reverse of that in others. Inhale during exertion while adducting the scapulae to a 4-count, being sure to inflate the chest during inhalation. When abducting the scapulae, exhale and deflate the chest to a 6-count.

**Movement analysis** From the start- to mid-position: Thoraco-scapular joint – adduction by rhomboids and trapezius working concentrically. From mid- to end-position: Thoraco-scapular joint – abduction by rhomboids and trapezius contracting eccentrically.

Illustration 13.18. Exercise 13.12. Standing cable crossover fly.



a.) Start-/end-position

b.) Mid-position

## EXERCISE 13.12. STANDING CABLE CROSSOVER FLY

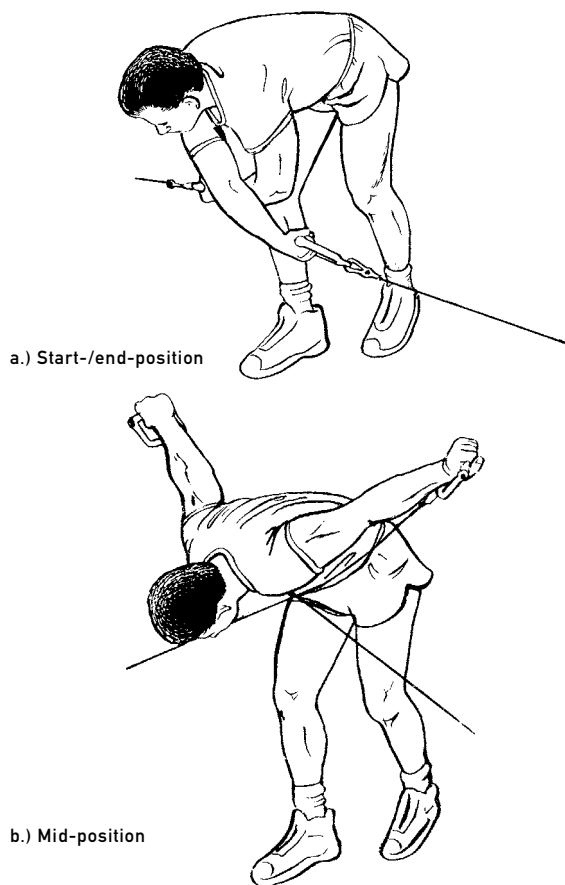
This is the “classic” exercise on this machine, the one that gave the machine its name. The exercise develops mainly the pectoral muscles and gives a feeling of “filling out the chest muscles.” When the high cable is used, emphasis is on developing the inferior part of the pectorals. When the lower cable is used, emphasis is on developing the superior pectorals. The Crossover has many other popular variations: The adduction movement can conclude with hands crossing the midline of the body. In this variation, alternate the upper hand in each crossover set to maintain movement symmetry. The exercise can also be executed using one arm and a high cable: adduction is performed by the one arm towards the opposite leg. Another variation, using the lower pulley, has exercisers move (adduct) from below towards the centre. In this case as well, exercisers can either use both arms (with or without crossover), or one arm.

**Start-/end-position** Stand erect and take one step forward with knees slightly flexed and trunk leaning slightly forward. Grasp high pulley cable handles, one per hand, wrists straight. Slightly flex the wrists (to reduce pressure on elbow). The head is upright and eyes look forward. Be sure that the weights attached to both cables are equal.

**Range of motion and performance** Adduct the arms from a position of arms open and above shoulder height at the start of the movement, a position whereby the arms almost meet (or even cross over) in front of the pelvis. The body position remains the same throughout the exercise. Avoid arching the lumbar lordosis during the exercise. During adduction, exhale to a 4-count. In opening the arms in the return to the end-position, exhale to a 6-count.

**Movement analysis** From start- to mid-position: Thoraco-scapular joint – medial rotation by trapezius and pectoralis minor working concentrically. Shoulder – horizontal and frontal adduction by pectoralis major and anterior deltoid working concentrically. From mid- to end-position: Thoraco-scapular joint – lateral rotation by trapezius and pectoralis minor contracting eccentrically. Shoulder – horizontal and frontal abduction by pectoralis major and anterior deltoid contracting eccentrically.

Illustration 13.19. Exercise 13.13. Cable crossover bent-over posterior raise.



### EXERCISE 13.13. CABLE CROSSOVER BENT-OVER POSTERIOR RAISE

This exercise, which is unique to the Crossover, develops mainly the shoulder muscles including the posterior head. Towards the end of the movement when the scapulae are adducted, the exercise develops the medial trapezius and rhomboids (scapular adductors).

**Start-/end-position** Stand between the two sides of the apparatus, legs apart, trunk leaning forward about ninety degrees. The legs should be slightly more than shoulder width apart, and the knees slightly flexed. Pull the lower pulley cable handles, grasping them in crossover, each hand holding the cable from the other side. Wrists are straight; elbows are slightly flexed. Neck is relaxed and eyes look at the floor. Be sure that both sides are attached to equal weights.

**Range of motion and performance** Begin from a position with arms crossed below shoulder height, horizontally abduct arms until they are extended laterally above shoulder height. During the exercise, body position remains constant, and care should be taken to avoid arching the lumbar lordosis. Switch the upper hand crossing the midline of the body after each set. During horizontal abduction, inhale to a 4-count. In returning the arms to the end-position, exhale to a 6-count.

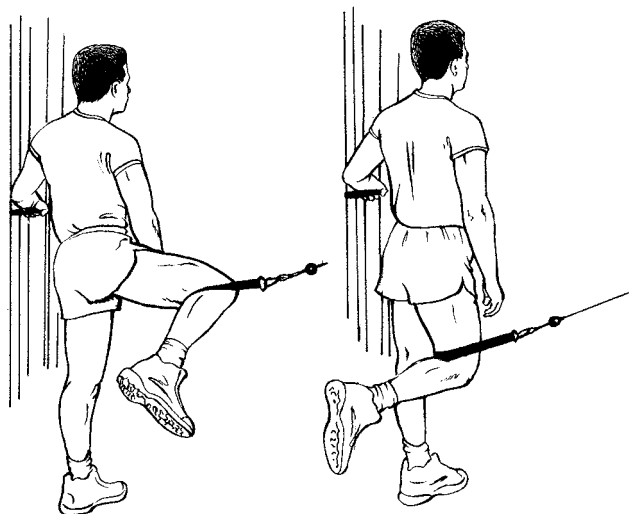
**Movement analysis** From start- to mid-position: Thoraco-scapular joint – adduction by trapezius and rhomboids working concentrically. Shoulder – adduction by posterior deltoid working concentrically. Elbow – extension by triceps and anconeus (elbow muscle) working concentrically. From mid- to end-position: Thoraco-scapular joint – abduction by trapezius and rhomboids contracting eccentrically. Shoulder – abduction by posterior deltoid contracting eccentrically. Elbow – flexion by triceps and anconeus contracting eccentrically.

### WORKING ON LEGS AND BUTTOCKS ON THE CROSSOVER

Due to the structure of the apparatus and its adjustable height as well as exerciser placement in relation to the equipment, the Crossover also offers exercises for the lower extremities and buttocks. When doing exercises to strengthen leg and buttock muscles, the support handles on the sides of the apparatus have to be used. When working with the cable from the right side of the apparatus, one usually holds onto the balance handle from the left side, and vice versa. In performing the following exercises, place special emphasis on body organization in the apparatus; especially, strap placement on the leg, which determines resistance moment and, thus, the intensity and effect of the loads on lumbar lordosis. In thigh adduction and abduction exercises, the best place for the strap is above the knee rather than above the ankle, in order to avoid excessive loads on the knee menisci. Since the activity entails standing on one foot, ensure that the work is symmetrical, that is, repeat the same loads and repetitions for both legs. Balance is maintained by the *fixator* muscles (those that prevent movement) and not by “movement compensation” or by creating excessive load on the vertebrae.

## ADDUCTION – ABDUCTION

Illustration 13.20. Exercise 13.14. Standing low pulley cable thigh adductions.



a.) Start-/end-position

b.) Mid-position

In this exercise, the fixator muscles on the stationary leg (the left leg shown in the illustration) work as much as the contracting muscles on the moving leg (the right leg shown in the illustration); therefore, many exercisers report feeling more strain and fatigue in the stationary than in the moving leg. If possible, perform the exercise in front of a mirror for feedback.

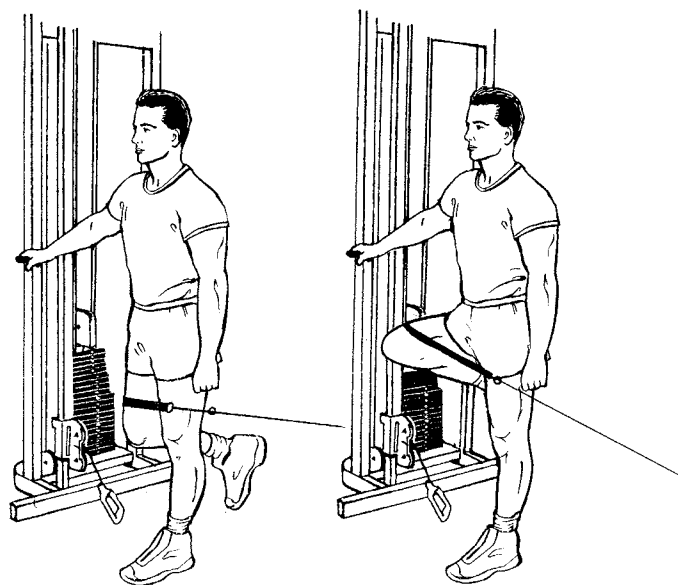
### EXERCISE 13.14. STANDING LOW PULLEY CABLE THIGH ADDUCTIONS.

**Start-/end-position** Stand in front of a mirror (if there is one) beside the apparatus, left leg slightly flexed. Left hand holds the left handle for balance (opposite the apparatus pulley on the right, which is at pelvic height). Flex the right knee to about ninety degrees (to shorten the lever and to concentrate work only on the adductors). In addition, placing the strap near the ankle increases the risk of injury or cumulative damage to the medial meniscus of the right knee. Attaching the strap above the knee neutralizes the knee joint and work occurs mainly on the right thigh adductors. Therefore, the strap should be attached above the right knee from the apparatus on the right side. The right hand is free, trunk is erect, head is raised, and eyes are forward.

**Range of motion and performance** Adduct the right thigh from a horizontal to a vertical position (i.e., movement towards centre). Avoid crossing the midline of the body as this creates hyperadduction and rotational forces on the lumbar spine as well as excessive strain and loads on the lateral ligament of the hip joint of the leg performing the movement (the right leg in this case). Avoid shaking the pelvis or making unnecessary swinging movements. Maintain a fixed body position throughout the exercise. After completing the set for the right leg, transfer the strap to the left thigh, switch apparatus side, and follow the same rules for developing left thigh adductor muscles. It is possible to turn around on the spot and switch legs but then the feedback from the mirror is lost. During thigh adduction, exhale to a 4-count. During return thigh abduction to end-position, inhale to a 6-count.

**Movement analysis** From start-/end- to mid-position: Thigh – adduction by thigh adductors working concentrically. From mid- to start-/end-position: Thigh – abduction by thigh adductors contracting eccentrically.

Illustration 13.21. Exercise 13.15. Standing low pulley cable thigh abductions.



a.) Start-/end-position

b.) Mid-position

In this exercise, the muscles fixating the stationary leg work as much as the contracting muscles on the active leg; therefore, many exercisers report feeling more strain and fatigue in the stationary leg than in the moving leg. After completing the set for the right leg, transfer the strap to the left thigh, switch pulleys, and follow the same rules for developing the left thigh abductor muscles. If possible, perform the exercise in front of a mirror for feedback.

### EXERCISE 13.15. STANDING LOW PULLEY CABLE THIGH ABDUCTIONS

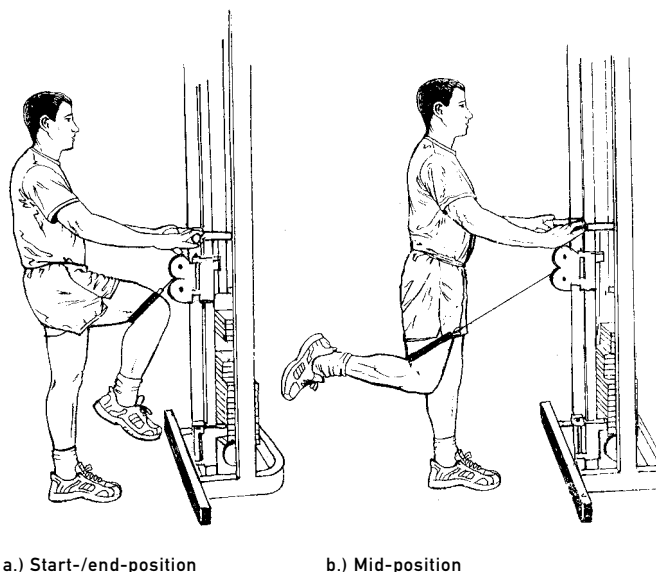
**Start-/end-position** Standing facing the mirror (if there is one), parallel to the apparatus, with left foot slightly flexed at the knee. The right hand holds the left handle (on the right half of the apparatus) for balance; the left apparatus is at knee height. Flex the right knee to ninety degrees (to minimize the lever and to focus work on the abductors only). When the strap is in the ankle area, there is a risk of injury or cumulative damage to the lateral meniscus of the knee. When the strap is above the knee, the knee joint is neutralized and the work is done mainly by the right knee abductors. The strap above the right knee passes in front of the left thigh. The left arm is free, trunk is straight, head is raised, and eyes look forward.

**Range of motion and performance** Abduction of right knee from a position vertical to the horizontal state (lateral movement). Avoid crossing the thigh-height line in abduction so the hip joint is not stressed. In adduction (return movement), avoid crossing the midline so that rotational forces on lumbar spine are not activated. Avoid shaking the pelvis or making other swinging motions. Maintain the same body position throughout the exercise. While abducting the right thigh, exhale to a 4-count. While adducting the thigh to the end-position, inhale to a 6-count.

**Movement analysis** From the start- to mid-position: Thigh – abduction by gluteus medius, gluteus minimus, and thigh tensor fascia working concentrically. From mid- to end-position: Thigh – adduction by gluteus medius, gluteus minimus, and thigh tensor fascia contracting eccentrically.

## BUTTOCKS

Illustration 13.22. Exercise 13.16. Standing low pulley cable thigh extension.



In this exercise, the fixating muscles in the stationary leg (left leg shown in the illustration) work just as hard as the contracting muscles (the hip extensors) in the moving leg (right leg shown in the illustration). Therefore, many exercisers report feelings of strain and fatigue in the stationary leg. Avoid banging the weight down, and ensure that muscle tension is maintained throughout the extension and flexion in the exercise. After completing the set using the right leg, transfer the strap to the left thigh, and follow the same instructions to develop the left gluteals. Stand facing the weights. If there is a mirror, observe your activity on the sagittal plane for feedback.

### EXERCISE 13.16. STANDING LOW PULLEY CABLE THIGH EXTENSION

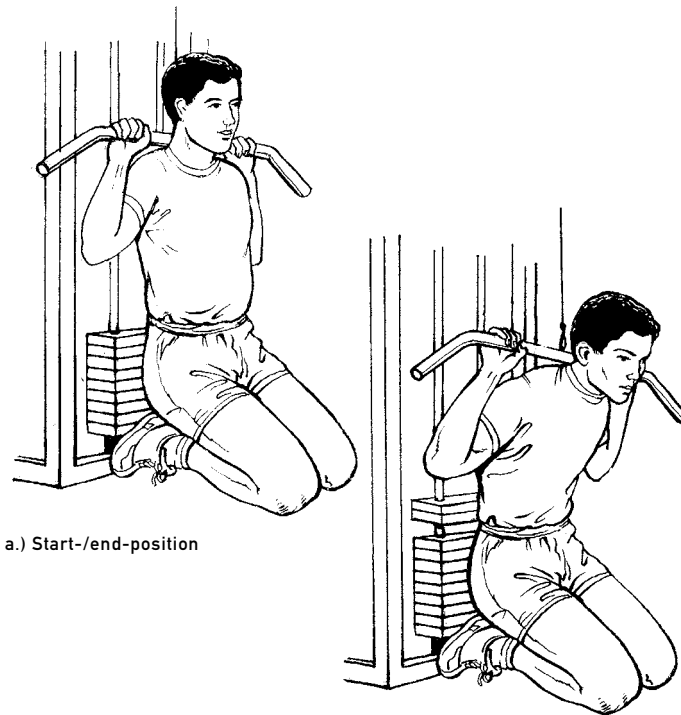
**Start-/end-position** Hold the handle above the right side of the apparatus with both hands. The right apparatus should be at thigh height. The body is erect and a slight forward incline is possible. Right knee should be flexed to ninety degrees. Place the strap behind the right knee to neutralize the knee

joint and concentrate the work mainly on the right thigh extensors (the gluteals). When the strap is placed in the ankle area, there is a risk of injury or cumulative damage to the right knee in the area of the posterior ligaments. The trunk is erect, the head is raised, and the eyes look forward.

**Range of motion and performance** Extend thigh to the rear from a state of flexion of about ninety degrees to hyperextension of about fifteen to twenty degrees. Going beyond this range raises intradisc pressure in the lower back. Avoid shaking the pelvis or making other unnecessary swinging movements. Arms and hands are for balance only. Maintain a constant body position throughout the exercise. During thigh extension, exhale to a 4-count. During return flexion to the end-position, inhale to a 6-count.

**Movement analysis** From start- to mid-position: Thigh – extension by gluteus maximus and hamstrings working concentrically. From mid- to end-position: Thigh – flexion by gluteus maximus and hamstrings contracting eccentrically.

Illustration 13.23. Exercise 13.17. Kneeling forward crunch with pulley bar behind head.



a.) Start-/end-position

b.) Mid-position

## ABDOMINALS

### EXERCISE 13.17. KNEELING FORWARD CRUNCH WITH PULLEY BAR BEHIND HEAD

The high pulley apparatus is usually used to strengthen muscles in the shoulder girdle and arms by pulling the bar down while flexing elbows and sitting (Exercise 11.2) or extending elbows while standing (Exercise 9.8). The high pulley also offers the option of performing sit-ups and crunches. This version of crunches is used mainly by professional exercisers. The sitting position for performing this exercise is not suitable for people with sensitive knees or backs. The apparatus assists by adding resistance to the range of motion in order to improve abdominal muscle power.

**Start-/end-position** Sit on knees (a mat for padding is an option) under the high pulley on the apparatus, with back to the machine. Using a closed overhand grip, grasp the straight bar (or a “V” bar), which is connected to the apparatus cable directly behind the exerciser’s back. Hold in the chin and keep neck long.

**Range of motion and performance** Crunch using abdominal muscles only, with elbows constantly facing down towards the hip joint. Avoid using hip flexors or inclining the trunk forward so that shoulders exceed the knee line. Avoid making nodding movements with the head, which cause neck pain and damage. During flexion, exhale to a 4-count. Returning to end-position, inhale to a 6-count.

**Movement analysis** From start- to mid-position: Spine – flexion by abdominus rectus and obliques working concentrically. From mid- to end-position: Spine – extension by abdominus rectus and obliques contracting eccentrically.

# 14: AEROBIC APPARATUS IN THE FITNESS ROOM

Aerobic activity in the weight room differs from most of the exercises presented thus far. While most of the apparatus and exercises focused on up to this point develop mainly muscle mass and power, aerobic apparatus develop cardiovascular capacity and strength. This is in contrast to most weight room activity, which is anaerobic, meaning that its sources of energy are drawn from the muscles themselves. In order to achieve an aerobic effect, the larger muscle groups of the body are activated (especially those of the legs and buttocks) for a sustained period of time. Aerobic activity, whether in the weight room or elsewhere, has significant health benefits. It is one of the most effective ways of dealing with the classic health problems of a “society of abundance”: overweight; emotional stress; and high cholesterol, as well as high levels of other fats in the blood, all of which raise the risk of cardiovascular disease. For example, the heart attack (a “silent killer” of the modern age) is a result of our typical lifestyle. For these reasons, many health-conscious exercisers, especially among the elderly, choose to concentrate specifically on aerobic activity in the weight room. Aerobic physical activity is the most effective way to prevent and reduce the risk of developing these diseases.

Aerobic activities (usually associated with outdoor activities such as running, bike riding, and mountain climbing) have become common in the weight room due to the incorporation of computers, electronics, and mechanics of present-day aerobic apparatus. This integration makes it possible to train using apparatus that are programmed to simulate different aerobic training methods such as Fartlek and interval training. Aerobic apparatus can be used as one element of a

training session or as an entire unit of a training session in itself. The warm-up is part of a program designed for independent aerobic activity. The aerobic warm-up on an apparatus is relatively short and at low exertion levels in preparation for the coming exertion. Be sure to return to normal heart beat gradually at the end of the chosen program. While working on aerobic apparatus, inhale and exhale according to the pace of activity. The faster the activity is performed, the faster is the rate of respiration.

The main exertion factor for enhancing cardiovascular capacity is duration, which is an integral part of common activities such as walking, running, swimming, and cycling. These activities entail vigorous exertion by the lower extremities. This means that, in addition to improving cardiovascular capacity, leg and buttock muscles are developed. Running, or any other activity on aerobic apparatus, is relatively easier than in the outdoors because exercisers do not have to compensate for indirect exertion factors such as temperature, humidity, and headwinds. Nevertheless, it is important to become familiar with the apparatus, training program potential, and ways of utilizing the apparatus in a manner that avoids injury.

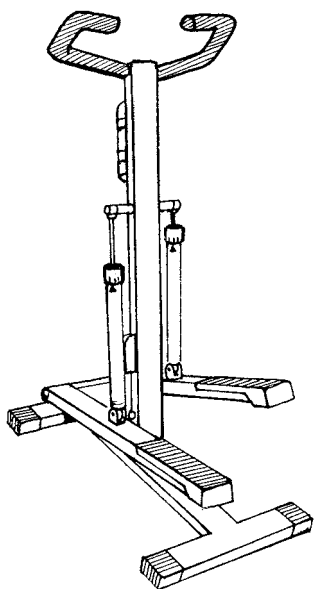
Aerobic apparatus in the fitness room (e.g., bicycle, stepper, treadmill, and elliptical fitness crosstrainer [E.F.X.]) activate three basic exertion factors: duration, pace, and resistance. An additional exertion factor on the treadmill is the incline. Intelligent use of these exertion factors produces desired effects and enables exercisers to develop cardiovascular capacity as well as strength endurance. Pulse is not a direct exertion factor but, rather, a reaction to the above exertion factors like

perspiration and other physiological reactions. For this reason, pulse is a convenient measure for determining exertion level. Certain aerobic apparatus make it possible to measure pulse during the activity by means of telemetry – either a strapped-on transmitter or special handles that permit heart rate calculation when held for ten seconds. These heart rate numbers then appear on the exercise monitor.

In pedalling apparatus, such as the stepper, stationary bike, recumbent cycle, or E.F.X., the pedals do not function independently because they work on the same axis of activity. A dominant leg compensates for the other leg and, thus, unequal development may occur. Therefore, exercisers should concentrate on making the same effort with both legs.

A sample of popular aerobic apparatus in the fitness room is presented here. Each apparatus is described in terms of activity, main advantages and disadvantages, safety aspects, and characteristic programs. Familiarity with these elements will enable exercisers to compare and combine apparatus for maximal benefits from fitness training programs. The results go far beyond visible desired effects of weight loss and body development and include unseen health benefits such as improved cardiovascular capacity and reduced blood cholesterol.

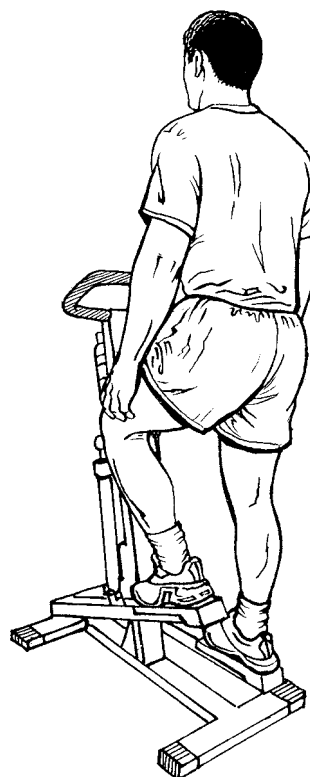
Illustration 14.1. The Mechanical stepper apparatus.



## MECHANICAL STEPPER

Stepper machines primarily develop the thigh and buttock muscles, which are large muscles and, therefore, consume more oxygen. The handles on the sides of the machine are for balance only and should be resorted to only when dynamic balance is lost. Freeing the hands helps improve dynamic balance, which is the reason the handles should not be grasped during exercise on the stepper. Holding the handles too long actually impairs dynamic balance and, at high resistance, can create pressure and load on the cervical vertebrae. When pedalling, the entire foot should rest on the pedal surface so that the heels, not the balls of the feet, perform the pushing. This minimizes wear and tear on the knees. Only in special cases (when the *gastrocnemius* are the target muscles) should the balls of the feet do the pushing, and even then, exercisers should be careful to avoid knee injury.

Illustration 14.2. Exercise 14.1. Pedalling on the mechanical stepper.



Start-/end-position

## EXERCISE 14.1. PEDALLING ON THE MECHANICAL STEPPER

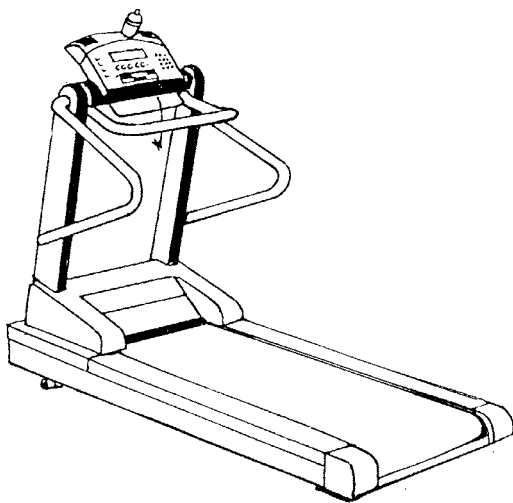
**Start-/end-position** Stand with back straight, hands at the sides of the body (remember – use them only for balance). Resistance is controlled by adjusting the knobs. Maintain equal resistance on both pedals.

**Range of motion and performance** The range of motion should be short and fast. During activity, knees do not exceed the foot line. Be sure that the load falls on thigh and buttock muscles rather than on the knees or lower back. Avoid swinging the pelvis. Use the mirror to check posture. Maintain foot symmetry in terms of distance from the action axis on the apparatus and to equalize pressure by both legs. Try to keep a constant pace throughout the activity. Avoid lifting the heels from the pedals while pedalling. Exhale with one pedal depression (knee extension) and inhale when the same pedal is elevated (knee flexion). Breathing should be adjusted to the movement pace.

**Movement analysis in extension** Hip – Extension by gluteus maximus and hamstrings working concentrically. Knee – extension by quadriceps working concentrically. Ankle – plantar flexion by gastrocnemius and soleus working concentrically.

**Movement analysis in flexion** Due to the mechanical structure of the apparatus, flexion is activated by extension of the second leg.

Illustration 14.3. The Treadmill apparatus.



## TREADMILL

The treadmill is extremely popular because it is suitable for a broad array of populations: young and old, amateur and professional athletes, and for rehabilitation. Most treadmills have a safety clip on a string which is attached to the exerciser's pants. If the runner tires and is unable to keep up, the string goes taut, flipping the switch and stopping the apparatus. When descending from the treadmill for the first few times, exercisers may experience dizziness caused by confusion in the ear's vestibular system which is responsible for balance. After several attempts, the vestibular system adjusts to these changes. Some treadmills are equipped with telemetry equipment that is strapped around the chest for real-time readouts of heart rate during exercise.

**Advantages of the treadmill** – The apparatus is safe and contains a complete system of shock absorbers to reduce load on the joints. The surface is always even and “bump free,” minimizing the risk of sprains, which is in contrast to the relatively high risk of running outdoors. Adjusting the incline makes it possible to simulate common outdoor activities. Exercisers can stop the apparatus at any time without having to worry about getting back to the starting point. One can work out on the machine without worrying about the weather. The greatest advantage of the treadmill is the information and feedback it provides about pace, time, distance, incline, and calories burned during the activity.

**Limitations of the treadmill** – The treadmill does not fully simulate walking or running. In fact, it is the treadmill doing the “running” and exercisers merely adapt themselves to its movement. Resistance is different than in regular walking. Also, in terms of coordination, exercisers push themselves forward when running outdoors, whereas on the treadmill, they run “in place” and simply raise their legs. It is important not to become dependent on the apparatus since it does not replace the internal motivation required for aerobic activity. In some extreme cases of negative incline (downhill) or positive incline (uphill), the knees suffer from overload. Also, sophisticated treadmills are relatively expensive.

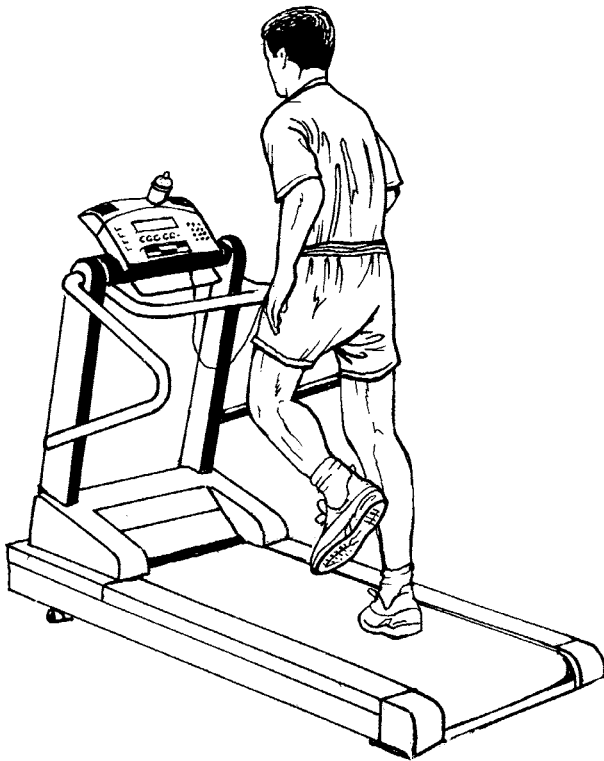
### Direct exertion factors on the treadmill

1. **Pace** – Most treadmills can reach a speed of twenty kilometres per hour, which is three minutes per kilometre.

2. *Incline* – It is possible to reach an incline of fifteen to twenty per cent on most high quality treadmills.
3. *Duration* – Most programs are up to sixty minutes.

Exertion factor levels vary according to the training program.

Illustration 14.4. Exercise 14.2 Activity on the treadmill.



#### EXERCISE 14.2 ACTIVITY ON THE TREADMILL.

**Start-/end-position** Stand upright on the treadmill, attach safety clip, connect the heart telemetry transmitter, and select the desired program.

**Operating the treadmill** These instructions are suitable for most treadmills. Others have similar modes of operation.

1. Start/enter
2. Enter body weight (using the arrows)  $\boxtimes$  Enter

3. Operating time (maximum sixty minutes, minimum ten minutes)  $\boxtimes$  Enter
4. Enter age  $\boxtimes$  Enter
5. Select program  $\boxtimes$  Start/enter
6. Begin training

### *Treadmill programs*

Exercisers can select one of six popular programs offered on most treadmills, with slight variations:

**Manual** – Exercisers control speed and incline with this program.

The manual program is recommended for beginners who need duration as the main exertion factor. Only after a period of adaptation (when exercisers reach at least the thirty-minute stage of aerobic activity) can additional exertion factors be introduced such as speed and changes in pace. After a period of adaptation, it is advised to try the *Hills* program. Advanced exercisers and athletes can try the *Random* program, which is similar in profile to Fartlek training.

**Hills** – Various incline profiles simulate activity on smaller and larger hills. Incline and speed can be modified, but a hill cannot become a plateau. The training profile appears on the screen throughout the activity.



**Random** – The apparatus program randomly modifies effort, incline, and speed factors. The program is similar to Fartlek training.



**Interval** – The program offers fixed exertion and rest intervals, which also appear on the screen. The variations in exertion are reflected in the pulse response. Exercisers can control exertion duration, rest duration, speed, or incline. It is also possible to set the intervals according to upper and lower threshold pulse rates. This requires use of telemetry and a transmitter. Interval programs are most suitable for improving beat volume of the cardiovascular system. The recommended number of intervals for average exercisers is seven.



**Heart rate control** – This program requires use of the transmitter. It is similar to the interval program but with modifications in the exertion factors. The computer is fed information about maximum and minimum pulse rate; for example, a range of activity between a maximum pulse of 180 beats per minute and a minimum of 120 beats per minute. When exercisers go above or below this range the digital display flashes or beeps.

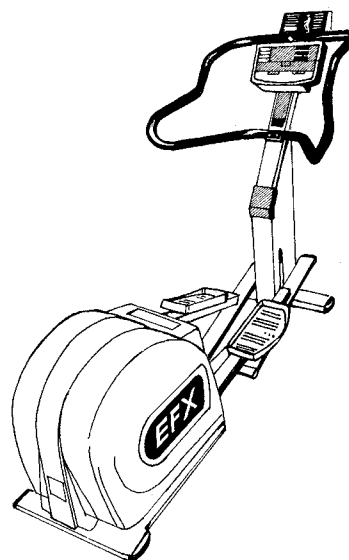
**Weight loss** – Intended for weight reduction and requires use of a transmitter. Recommended activity duration is thirty minutes or more. Shorter training spans are not sufficiently effective. Some apparatus are equipped with a preparatory program prior to beginning the actual program. In any case, it is important to remember that the more we run, and the more exertion factors we include, the more calories we burn.

**Range of motion and performance** – Determined according to the selected program and the exerciser's goals. Inhale and exhale to the rhythm of the activity.

**Movement analysis in extension** – Hip – extension by gluteus maximus and hamstrings working concentrically. Knee – extension by quadriceps working concentrically. Ankle – plantar flexion by gastrocnemius and soleus working concentrically.

**Range of motion in flexion** – Hip – flexion by gluteus maximus and hamstrings contracting eccentrically. Knee – flexion by quadriceps contracting eccentrically. Ankle – dorsiflexion by gastrocnemius and soleus contracting eccentrically.

Illustration 14.5. The E.F.X. (Elliptical Fitness Crosstrainer) apparatus



## E.F.X. – ELLIPTICAL FITNESS CROSSTRAINER

This apparatus represents a new generation of equipment, combining walking, stair-stepping, and running movements. The movement produced by the three activities is elliptical, hence the name. The E.F.X. came onto the market in 1995 and sold 3.8 million units in its first three years. Between 1998 and 2001 4.5 million additional units were sold – a total of 8.3 million units in the first six years of marketing. According to a survey by the IHRSA, an international health and fitness club association, the E.F.X. reached a penetration rate of 92 per cent (meaning the rate of exercisers who tried the apparatus when doing aerobic activity in the fitness club). The main advantage of the E.F.X. is the range of motion it offers. In regular walking, the range of motion is between fifty and sixty degrees in the knee and hip joints. The range of motion on the E.F.X. in these joints is sixty to seventy degrees. This difference enhances work on the muscles and raises energy output. In addition to its regular elliptical training movement programs, the apparatus can also work on developing the buttock muscles.

## *Advantages of the E.FX.*

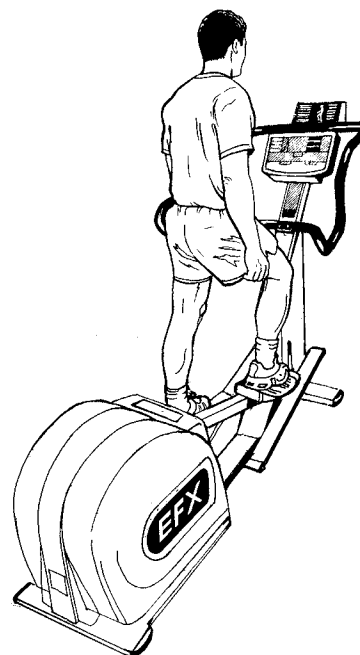
1. There are no shocks. Feet rest on the pedals and the ankle can perform plantar flexion or dorsiflexion without removing the feet from the pedals.
2. The unique combination of movements, which simulate running and stair stepping, allows exercisers to activate more motor units and muscle groups in greater ranges of motion.
3. The option exists of varying the resistance, duration, speed, and incline exertion factors. Exercisers set the values and enjoy a greater selection of program options.
4. Unlike the treadmill, the E.FX. allows exercisers to control duration, as well as speed and resistance levels throughout, which can help to raise motivation to maintain these levels. Exertion factors are determined directly and in real time only by the exercisers. The moment they stop, the activity stops.
5. The apparatus contains an automatic self-lubrication mechanism, which reduces maintenance to a minimum.
6. The apparatus allows backward pedalling so that these muscle fibres which usually receive less activation can also be worked. Backward pedalling also develops special types of coordination, including balance.

## *Limitations*

1. The apparatus tends to be very expensive.
2. If the friction level of the pedal wheels is different, one foot will work more than the other. It is important to clean the moving surfaces before activity to prevent asymmetry in friction.
3. It is relatively difficult for beginners to use because it requires dynamic balance and relatively high motivation level.
4. Mechanically, the pedals lie on the same axis of activity and are interdependent. Thus, if one foot is more dominant, its effect on the other

pedal cannot be neutralized. This is in contrast to activity on the treadmill, for example, where each foot works independently.

Illustration 14.6. Exercise 14.3. Pedalling on the E.FX.



Start-/end-position

## **EXERCISE 14.3. PEDALLING ON THE E.FX.**

**Start-/end-position** Stand upright on the apparatus with hands at sides of body. The handles are for support and should not be held during activity. Try to work (exercise) without using the handles. Be sure the feet on the pedals are equidistant from the axis of activity so that both legs work equally and the resistance moment is the same. Try to maintain foot symmetry of placement on both pedals (throughout the activity).

## *Operating the E.FX.*

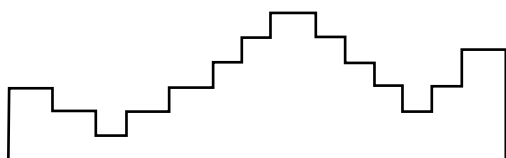
1. Start/enter
2. Enter body weight (using arrows) ☐ Enter
3. Operating time (maximum sixty minutes, minimum ten minutes) ☐ Enter
4. Enter age ☐ Enter
5. Enter resistance

## *E.FX. programs*

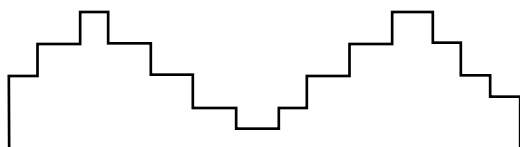
Exercisers can select one of six programs. *Range of motion and performance* is determined according to the exerciser's goals and the program selected. Inhale and exhale to the rhythm of the activity during performance. It is important to warm up at the beginning of the selected program (some programs include warm-up). Make sure pulse returns to normal gradually at the end of the selected program. The following is a short explanation of each program.

**Manual** – Exerciser controls speed and incline.

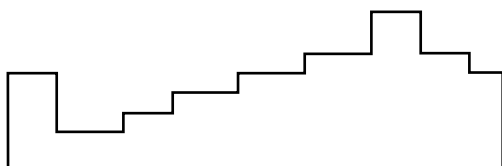
**Cross country** – Ski-walking, one incline



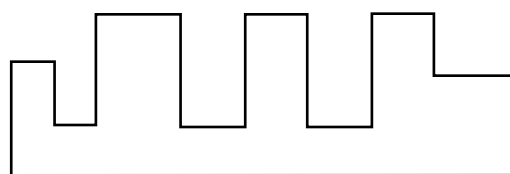
**Cross country** – skiing-walking, higher speed, two inclines.



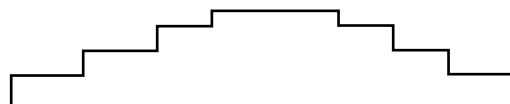
**Hill climb x2** – Mountain climbing, option of one or two peaks.



## **Intervals**



**Up and down** – Declines and inclines, primarily for developing gluteals.



**Valley** – Decline from plateau to “valley” and climb back up to plateau.



**Movement analysis in extension** – Hip – extension by gluteus maximus and hamstrings working concentrically. Knee – extension by quadriceps working concentrically. Ankle – plantar flexion by gastrocnemius and soleus working concentrically.

**Movement analysis in flexion** – Hip – flexion by gluteus maximus and hamstrings contracting eccentrically. Knee – flexion by quadriceps contracting eccentrically. Ankle – dorsiflexion by gastrocnemius and soleus contracting eccentrically.

## RECUMBENT CYCLE (FITNESS BIKES)

Illustration 14.7. Recumbent cycle (fitness bike).



The recumbent cycle (fitness bike) is the “classic” aerobic apparatus for beginners. The main muscles activated are: gluteals, quadriceps, femoral biceps, gastrocnemius, and soleus. The digital display on the apparatus provides feedback on calories burnt, duration of activity, and distance. Exercisers can choose from a number of programs that offer variety and personal tailoring. If the computerized feedback provided by the apparatus is reliable, work has to be maintained at sixty to eighty revolutions per minute (rpm). If the exerciser deviates from the recommended speed range, the rpm light flashes. Due to load on the quadriceps, beginning exercisers may experience local fatigue in the thigh area, causing them to end the activity before the cardiovascular system becomes the limiting factor. It is therefore advisable to reduce speed and resistance, if necessary, but to continue with the activity.

**Advantages of the apparatus** – The back rest provides lower back support and significant reduction of load on the stabilizing muscles in contrast to a stationary cycle.

**Disadvantages of the apparatus** – More expensive than stationary bikes.

Illustration 14.8. Exercise 14.4. Pedalling on recumbent cycle.



Start-/end-position

It is important to warm up before or during the selected program. Make sure pulse returns gradually to normal at the end of the selected program.

### EXERCISE 14.4. PEDALLING ON RECUMBENT CYCLE.

**Start-/end-position** Sit on the bike. Adjust the range of motion: Legs should extend to two to three degrees before locking (completely extension) of the knee joint. Avoid locking the knees so that the knee cartilage is not “worn out.” Make sure the seat is close enough to the pedals to prevent the pelvis rolling during the movement.

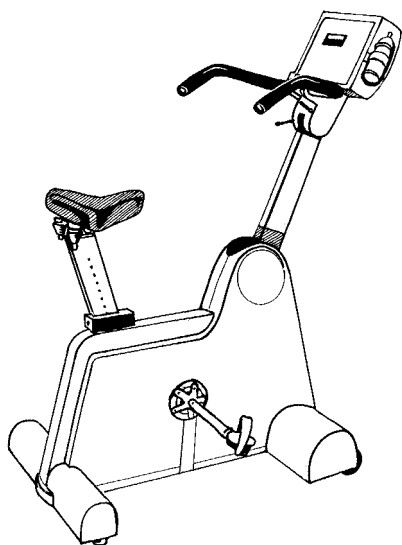
**Range of motion and performance** Is set according to the exerciser's goals and the program selected. Inhale and exhale to the rhythm of the activity during exercise.

**Movement analysis in extension** Hip – extension by gluteus maximus and hamstrings working concentrically. Knee – extension by quadriceps working concentrically. Ankle – plantar flexion by gastrocnemius and soleus working concentrically.

**Movement analysis in flexion** Hip – flexion by gluteus maximus and hamstrings contracting eccentrically. Knee – flexion by quadriceps contracting eccentrically. Ankle – dorsiflexion by gastrocnemius and soleus contracting eccentrically. In flexion there is almost no resistance in the eccentric activity because the other leg is activating the movement.

Movement analysis refers to each leg working alternately.

Illustration 14.9. Stationary cycle (fitness bike).



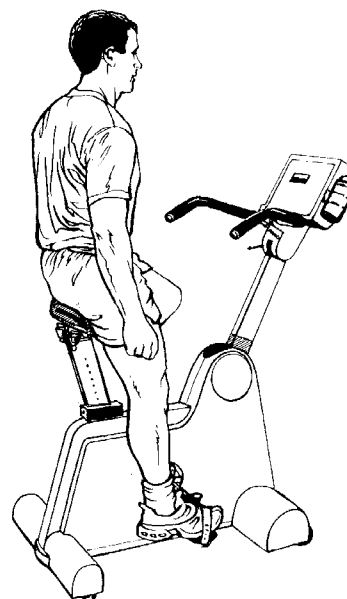
## STATIONARY CYCLE (FITNESS BIKE)

This is another “classic” aerobic apparatus for beginners. The activity is relatively easy, compared to that on other equipment in the fitness room. The main muscles at work are the quadriceps, femoral biceps, and soleus. The digital display provides feedback on calories burnt, duration, and distance covered. The apparatus offers a number of programs (similar to those of the treadmill) for variety and for suitability to riders’ personal levels and needs. For the apparatus feedback to be reliable, work has to be maintained at sixty to eighty revolutions per minute (rpm). If an exerciser deviates from the recommended speed range, the rpm light flashes. Due to the load on the quadriceps, beginning exercisers may experience local fatigue in the thigh area, which may cause them to cease activity before the cardiovascular system can become the limiting factor. It is, therefore, advisable to reduce speed and resistance and to continue with the activity.

**Advantages of the apparatus** – Less expensive than the recumbent bike.

**Disadvantages of the apparatus** – Lack of back support puts more intravertebral stress on lumbar vertebrae.

Illustration 14.10. Exercise 14.5. Pedalling on a stationary cycle (fitness bike).



Start-/end-position

It is important to warm up either before or during the program by gaining gradual mastery over exertion factors. Be sure pulse returns to normal at the end of the program.

## EXERCISE 14.5. PEDALLING ON A STATIONARY CYCLE (FITNESS BIKE)

**Start-/end-position** Sit on the bike. Adjust the range of motion: Extend legs up to two to three degrees before locking (completely extending) the knee joint to avoid wearing away knee cartilage. Make sure the seat is close enough to the pedals to prevent the pelvis from rolling during the movement.

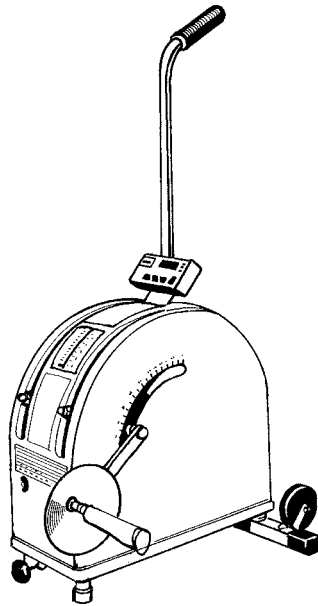
**Range of motion and performance** Is determined by the exerciser’s goals and the program selected. Inhale and exhale to the rhythm of the activity.

**Movement analysis in extension** Hip – extension by gluteus maximus and hamstrings working concentrically. Knee

- extension by quadriceps working concentrically. Ankle
- plantar flexion by gastrocnemius and soleus working concentrically.

**Movement analysis in flexion** Hip – flexion by gluteus maximus and hamstrings contracting eccentrically. Knee – flexion by quadriceps contracting eccentrically. Ankle – dorsiflexion by gastrocnemius and soleus contracting eccentrically. In flexion there is almost no resistance in the eccentric activity because the other leg is activating the movement.

Illustration 14.11. Hand ergometer.



## HAND ERGOMETER

The device was originally intended for populations with special needs; that is, exercisers who wish to improve their cardiovascular endurance but, for whatever reason, are not able to pedal with their feet. The manual pedalling device makes it possible to pedal with the hands while sitting. The apparatus is used by competitive tricyclists (tricycles especially adapted for paraplegics) who wish to improve their achievements. It is possible to pedal backwards and to develop the scapular adductors in addition to the arm muscles. The scapular adductor

muscle group usually suffers from lack of activity. This activity strengthens this group of muscles considerably.

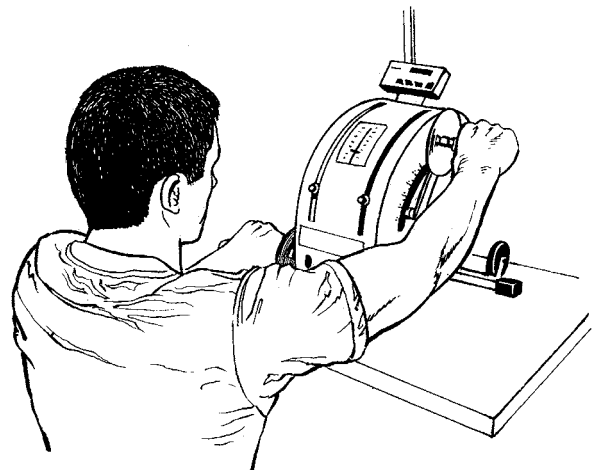
**Advantages of the hand ergometer** – The device provides a variety in training, strengthens the scapular adductor, and maintains aerobic fitness despite temporary or permanent injury to the lower extremities. Manual pedalling develops significantly more power endurance in the upper extremities (arms) than any other apparatus.

**Disadvantages of the hand ergometer** – Exercisers need to have a lot of persistence and determination to adhere to the pedalling activity, especially during the beginning stages when they are not able to do more than a minute or two. Beginning exercisers tend to quit after only a few attempts because of difficulty and boredom, and, as a result, they miss the advantages of this device.

Operating the apparatus:

1. Press the FUNCTION key on the screen until the arrow stands on TIME.
2. Press the SET key for calibration.
3. Press the MIN key to set the duration in minutes of the activity.
4. Choose the resistance to the activity by turning the screw at the bottom of the apparatus. Turning to the right raises the resistance. Turning to the left lowers the resistance. The resistance level also applies to turning the hand pedals backwards.
5. Begin activity.

Illustration 14.12. Exercise 14.6. Activity on hand ergometer.



### EXERCISE 14.6. ACTIVITY ON HAND ERGOMETER.

**Start-/end-position** Sit on the seat with feet on the floor and legs slightly spread apart. Hands grasp the pedalling handles. Seat distance from the apparatus should allow arms to extend without locking the elbow (complete extension) or tilting the trunk forward.

**Movement analysis in pulling hand** Sterno-scapular joint – scapular adduction by trapezius and rhomboids contracting eccentrically. Shoulder – extension by latissimus dorsi and posterior deltoids working concentrically. Elbow – flexion by elbow flexors (e.g., biceps, brachialis, brachioradialis) working concentrically. Wrist – isometric work of flexors and extensors. There is almost no eccentric work.

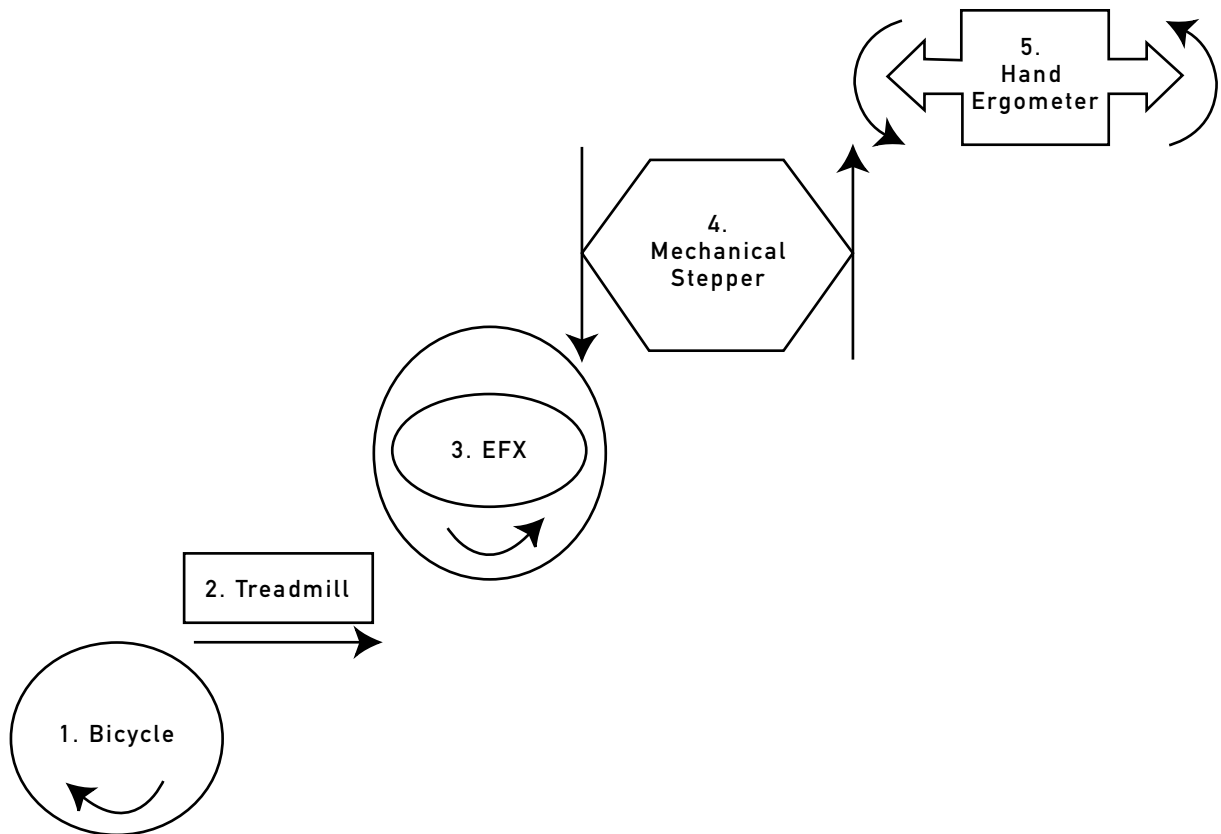
**Movement analysis in pushing hand** Sterno-scapular joint – scapular abduction by serratus anterior working concentrically. Shoulder – flexion and slight adduction by pectorals and anterior deltoids working concentrically.

Elbow – extension using triceps working concentrically.  
Wrist – isometric work in flexors and extensors. There is almost no eccentric work.

**Aerobic apparatus in ascending order of difficulty –**  
This order of difficulty is presented as a general summary and is not binding. A specific program on a particular apparatus may be more difficult than activity on another one. Level of difficulty depends on the exerciser in terms of fitness level and genetic make-up.

1. Bicycle
2. Treadmill
3. E.FX.
4. Stair stepper
5. Hand ergometer

Illustration 14.13. Aerobic apparatus in ascending order of difficulty.



# 15: ORGANIZATION AND SAFETY IN THE GYM

From an economical perspective, the gym should provide the highest level of service. This entails two principal aspects: 1.) customer service (including the professional approach); and 2.) management of the gym space (including the facility level and related services). The gym or fitness club has to have the necessary skills to explain its professional approach; it should post a “Club Credo” with the objectives beyond those of physical activity. Together with the instructors, managers need to identify customers’ needs and expectations in order to offer appropriate solutions.

## 15.1. ADMINISTRATIVE CONSTRAINTS IN THE GYM

Exercisers and instructors need to take into account a number of administrative considerations that directly and indirectly influence training programs and exercisers’ motivation.

### *Equipment availability*

It is essential to suit training programs to the equipment available in the gym. The types of apparatus available and the selection options among the apparatus need to be taken into consideration as an integral part of building a training program. A possible solution is to improvise alternative exercises that do not require special apparatus or an adaptation if the apparatus is unavailable. Unquestionably, equipment costs money and takes up space, but it is usually suited to the exercising population

and their economic status. It is certainly possible to build as effective a training program in a small gym with less equipment as in a larger, better-equipped facility.

### *Number of exercisers*

The “rush hour” in gyms, when more exercisers than usual arrive, may interfere with exercisers’ ability to carry out their training programs since a large crowd at the apparatus prevents exercisers from completing their training program on time. During long waits, body temperature and motivation decline. It is, therefore, important to know when the club is busy, or to change the order of exercises in order to avoid long breaks between sets, thereby “speeding up” the training sequence.

### *Location*

Gyms are located in different and sometimes unexpected places. While one may be on the rooftop of an exclusive building overlooking an incredible view, another is buried in a basement with insufficient ventilation or lighting. Location affects exercisers’ motivation as well as the type of population frequenting the club. Most exercisers choose their fitness club because of convenience (e.g., proximity to home or workplace) and/or social status. A club of greater travel distance or one that makes the exerciser feel “out-of-place” may affect training frequency or may even lead to the cessation of activity.

### *Space availability*

No two gyms are alike. There are the small, “homey” ones and there are the huge ones. Some are so over-equipped that exercisers do not have enough room to move around. This is unsafe and creates the feeling of training in a fitness apparatus “warehouse.” The amount of space available for moving around freely without bumping into other exercisers or apparatus directly affects enjoyment and motivation.

### *Time available to the exerciser*

Time constraints may make it difficult to complete a training program. It is important to take this into consideration when planning a training program by prioritizing needs. Identify the exerciser’s priorities in terms of aims and needs, fitness elements, and relevant exercises. For example, main exercises are preferable to supplementary exercises. In some cases, rest periods can be shortened or set combinations can be changed in order to facilitate the exerciser’s recovery between sets. When training time is limited, multi-joint exercises should be performed in order to include a larger number of muscle groups (in apparatus such as the upper pulley, leg-presses and chest-presses on special apparatus, etc.).

### *Gym Hours*

Some gyms are open twenty-four hours a day, seven days a week, but they are not in the majority. Certain fitness clubs cope with overcrowded facilities and the need for flexible hours by regulating and extending club hours. To avoid rush-hour crowds, some clubs offer lower rates for certain hours or days.

### *Parking Facilities*

Parking problems may affect decisions to register or renew membership. Parking can directly or indirectly affect the amount of time allocated for training; in some cases, the time wasted searching for parking may result in cancellation of a training session. It is advisable

to make sure that there is enough parking or find an alternative solution such as carpooling or using a bicycle. In any case, this issue should be taken into account when selecting a gym.

### *Dressing Room Services*

Many exercisers try to fit training into work hours during their lunch break. Shower rooms that enable these exercisers to return to their normal activities feeling fresh and clean are essential. This issue, although not directly included as a training factor, is a decisive consideration when applying for membership.

## **15.2. INSTRUCTORS’ RESPONSIBILITIES**

The main role of instructors is to build exercisers’ training programs (see Chapter 17). In addition, instructors are also responsible for other aspects of activity taking place.

On the *technical* side, they have to be actively involved to ensure the smooth operation of the gym, including ensuring that equipment is in good working order. Instructors should alert the owners and exercisers about faulty equipment, not repair it – that’s a technician’s job!

Checkpoints for instructors:

1. Correct pins are being used for the weights and the apparatus.
2. Cables are taut and not torn or cut.
3. Weight collars are locked.
4. Arm/leg/back rests are locked in place.
5. Padding on the apparatus is intact.
6. Wheel bearings do not creak.
7. Electrical connections and cables meet safety regulations.
8. Lighting works properly.
9. Air-conditioning works properly.
10. The gym is in order and free weights are in place.

Instructors are advised to review each checkpoint before their shift to ensure that activity during the shift is sufficiently safe.

For *ergonomic* purposes, instructors have to adapt the apparatus as much as possible to the nature of activity and to the exercisers’ needs and physique. For example, instructors should make sure that exercisers

use apparatus with a backrest only for the lower back because leaning the shoulders on the backrest may cause hyperarching of the back. Instructors can and should teach exercisers ways to achieve the most from each apparatus. They should make exercisers aware of the ergonomic aspects of exercises on the apparatus in order to minimize risk of injury.

*Socially*, instructors should work to create a positive social environment that enables exercisers of all levels to feel comfortable. Since the environment is a locale of social and emotional interactions, instructors should monitor activities so that a pleasant atmosphere is maintained for all exercisers. Friendly relations between exercisers should be encouraged and opportunities for cooperation should be created according to exercisers' needs and levels. Part of the instructor's job is to maintain clients' loyalty and to answer their questions about training programs (of course) and nutrition, maintaining a healthy lifestyle, and other related issues. Instructors should always display a positive attitude towards all exercisers.

From an *educational aspect*, instructors should encourage a learning environment during training sessions by being "open-minded." Training alone is not enough. It is also very important to explain reasons for certain exercises and ways to exercise. Instructors should arouse curiosity so that exercisers feel free to ask about the significance of specific activities or programs. These insights help exercisers to understand the importance of physical activity in their lives and significantly increase their devotion to personal training programs.

*Professionally*, instructors should be able to design personal training programs based on scientific principles and suited to specific needs. They should attend lectures and read the professional literature to keep up to date on research about developing fitness elements and behavioural patterns for a healthy lifestyle.

From the *ethical viewpoint*, instructors have to be prepared to monitor exercisers' training programs on a daily basis. This includes recording and observing training sessions, offering advice, and demonstrating caution and sensibility in making judgments. Instructors need to be considerate in their decisions and sensitive in giving feedback in order to be positive and not to insult the exercisers!

In terms of *safety*, instructors have to be familiar

with emergency procedures in case of injury, including keeping records of accidents and filling out injury reports. They should set a personal example during physical activity by adhering to safety regulations when demonstrating exercises and by leading a healthy lifestyle (such as not smoking).

### 15.3. APPARATUS PLACEMENT

To ensure proper supervision and increase exercisers' safety, apparatus should be placed properly in the gym. The layout plan should be in consonance with the managers' conceptions and goals. Equipment should be set up in such a way that gym space is used most effectively without compromising safety or the potential to supervise all of the apparatus. It should be remembered that proper supervision is possible only if the entire gym is visible at any given moment. Equipment should be organized so that exercisers can move easily and freely from one to another anywhere in the gym. Safety should be the highest priority.

All high-risk exercises, such as squats, platform lifts, or lifting weights above the head, should be done away from mirrors, windows, exits, or entrances in order to avoid damage or distractions. The tallest equipment should be placed along the walls. Lower equipment items should be placed in the centre of the room, so as to provide a better view. The possibility of attaching tall apparatus, such as power racks or squats to the floor should be considered in order to increase their stability. Weight racks should be placed at a safe distance so that exercisers' movements and instructors' work are not disturbed.

The following are a few guiding principles for safe and efficient use of apparatus as formulated by safety experts from the American National Union for Strength and Fitness, the body that supervises fitness and strength training professionals in the U.S. (Armitage-Johnson, 1994; Armitage-Johnson, 2001).

1. The minimum distance between apparatus is at least 60 cm, and the optimal distance is 90 cm.
2. The space above the work surface should be sufficiently high, at least 3.7 m. This space must be free of items hanging from the ceiling, such as light fixtures, pipes, signs, etc.

3. Appropriate distance between Olympic bars is 90 cm from each side.
4. The recommended working surface area for free weights is 3.7 m by 2.4 m per exerciser.
5. A 90 cm wide passage should be kept free across the entire gym. No machines, apparatus, or equipment should block this passageway or interfere with free movement on it.
6. All equipment should be placed at least 15 cm from mirrors. Mirrors should be at least a half metre off the floor.
7. Work corners should be formed in the gym according to type of equipment: apparatus should be in one part of the room, and free weights and their work surfaces at another. Other areas should be allocated for aerobics (e.g., fitness bikes, steppers) and for stretches and muscle relaxation.
8. Each exerciser in the gym should have a minimum area of 2.8 sqm; the ideal area is 5.6 sqm. For example, if the gym has 100 sqm, the maximum number of exercisers that can train safely at one time is thirty-five.
9. The ratios is 1:10–30 (instructor:exercisers). The exact ratio of instructors to exercisers is determined by the exercisers' level of experience. A 100 sqm at full capacity (35 exercisers) needs to have at least two instructors.

## 15.4. EQUIPMENT MAINTENANCE

Maintenance and cleanliness prolongs the facility as well as equipment longevity and ensures training safety. All instructors have to have knowledge on the proper use of the equipment and its maintenance. A regular equipment maintenance plan helps to ensure long and safe use of the apparatus. A regular time is set aside for upkeep and cleaning, which all instructors have to follow. The following is a list of guidelines for proper gym maintenance provided by the National Union for Strength and Fitness in the United States (Armitage-Johnson, 1994; Armitage-Johnson, 2001):

### *Gym Floor*

1. Wood floors: The work surface must be free of splinters, holes, nails or projecting bolts.
2. Brick floors: Be sure that moisture does not build up, so as to prevent slipping.

3. PVC (linoleum) floors: The work surface should be free of cuts, slits or large spaces between strips.
4. Mattresses banded together must be secured and organized so that they do not separate.
5. Floors must be swept and washed regularly.
6. Proper anchoring of all equipment attached to the floor must be checked regularly.

### *Walls (including mirrors, windows and shelves)*

1. Walls next to work surfaces must be free of all projecting apparatus.
2. Mirrors and shelves have to be attached to the wall properly.
3. Mirrors and windows should be cleaned regularly, about twice a week.
4. The distance between mirrors and floor should be at least half a metre.
5. Cracked or distorted mirrors should be replaced immediately.

### *Environmental Factors*

1. Music in the gym should be at a volume that does not interfere with communication between exerciser and instructor. Only instructors are permitted to adjust the volume of the music.
2. Room temperature should always be kept between 22 and 26°C.
3. The ventilation system should work properly and replace all the air at least eight to ten times an hour (preferably, 12–15 times/hour). Penetrating odours should be avoided.
4. Equipment should not be slippery due to high humidity.
5. The gym should be properly lit with no dark corners.
6. All electrical wires need to be secured under the floor or inside the walls.
7. All safety regulations and instructions have to be posted in prominent places.

### *Free Weights Area*

1. The area should include reclined press benches and squat racks, for weights and hand weights. Sufficient space should be maintained between the various racks in order to allow free access.

2. At the end of each practice, each equipment item should be returned to its place in order to keep the passage free for movement.
3. Protective mats on the floor must not be cracked or torn.
4. Surfaces which come into contact with exercisers' skin must be cleaned and disinfected on a daily basis.
5. Weight collars have to be locked properly.
6. Surfaces for squats have to be covered with slip-proof material.
7. Make sure the Olympic bars turn properly, are well oiled, and locked tightly.
8. Benches and weight racks have to be well anchored to the floor or wall.
9. Faulty or broken equipment has to be removed from the gym or locked in a storage room, so that no exercisers have access to it.

### *Apparatus Area*

1. There should be easy access to every work station (at least 60 cm between apparatus with the optimal distance being 90 cm).
2. Only appropriate collars and pins should be used. Do not improvise!
3. The apparatus area needs to be free of projecting screws, strings or loose chains. Projecting parts of equipment should be removed or screwed in so they do not protrude.
4. Make sure that all straps, chains and cables are well attached to the apparatus.
5. Safety straps must be usable.
6. All moving parts should be lubricated regularly and move smoothly. Telescoping bars (on which machine parts move) must be lubricated two to three times a week.
7. Surfaces which come into contact with exercisers' skin must be cleaned and disinfected on a daily basis.
8. Worn-out parts, such as cables, loose chains, old straps, cracked screws, etc., have to be tended to immediately or the apparatus should be put off limits until the repair has been made.

### *Aerobics Area (e.g., Spinning Room)*

1. Maintain easy access to each work station. Minimum distance between apparatus is 60 cm; optimum distance is 90 cm.
2. Make sure all screws are tight.
3. Make sure that all ergonomic adjustments, such as chair height, bar distance, etc., can be adjusted easily by the exerciser.
4. All parts and surfaces of the aerobic apparatus should be lubricated and clean.
5. Leg and body straps need to be secured and not torn.
6. All measuring instruments (for resistance, time, number of rpm's, etc.) have to function properly.
7. Surfaces that come in contact with exercisers' skin have to be cleaned and disinfected on a daily basis.

### *Stretching and Relaxation Area*

1. Mattress areas need to be free of weight benches and weights.
2. Mattresses need to be free of tears.
3. Stretching mattresses should be adjacent, with no large spaces between them.
4. The area need to be swept and cleaned every day.
5. Elastic straps need to be anchored at their base by safety knots to a stationary surface. They should be checked regularly for signs of wear and tear.

### *Free Weightlifting Area*

1. Proper distance between the ends of Olympic bars is 90 cm. The area that must be available to each weightlifter is 3,7 m by 2,4 m.
2. At the end of work, each weight has to be returned to its place in order to prevent the work area from being strewn with obstacles.
3. Make sure the Olympic bars turn properly, are well lubricated, and closed tightly.
4. Bent Olympic bars have to be replaced. The rough grip surfaces have to be dirt-free.
5. Weight collars have to be functional.
6. Belts, bandages, and rosin have to be available in the gym.
7. Mattresses should not have tears, cracks, or splinters in them.
8. The area should be swept and cleaned properly.
9. The ceiling should be high enough to allow safe lifting of the weights above the head – a minimum of 3,7 m.

# 16: NUTRITION AND PHYSICAL ACTIVITY

Wise nutrition plays a vital role in our physical and emotional wellbeing, which is the reason it is included in this book. A familiarity with the principles of nutrition is an integral part of the holistic concept of human health. Focusing on developing muscle mass, power, speed, or flexibility without proper attention to the food our bodies consume is a form of neglect. It detracts from our investment of time and effort and reduces the advantages we can obtain from physical training and from developing our bodies in the gym. Controlling our food intake can further improve the outcomes of training and physical exertion in general.

Nutrition is the process of eating and converting food into body tissue. The nutritional intake among many individuals of Western society – including many who engage in sport – is disproportionate to body size. In the United States, for example, two-thirds of the population suffers from being overweight (Demory-Luce, 2005; Crossly, 2004). Most Americans eat too many fats, monosaccharides (simple sugars), and salt in the typical “fast-food”-type diet. They also consume too little of the “good” components such as complex carbohydrates found in whole wheat flour or granola, dietary fibre available in vegetables and fresh fruits, or whole proteins that can be found in low-fat meats and cheeses. Obesity usually stems from over-consumption of calories (units of energy).

In order to attain maximal control over our bodies, nutrition has to be selected carefully, in proper proportions, and with our full consideration. Awareness of body needs is a part of overall discipline with an underlying principle of moderation and balance. Maimonedes, the eleventh-century physician-

philosopher, summarized the proper approach as follows: “Let your food be your medicine and your medicine be your food” (Maimonedes, 70:5). Food is the physical fuel of life. While we eat in order to live, eating is only one of the pleasures of life, and what is certain is that we do not live in order to eat. We are all aware of the growing obsession with food in the Western world: multitudes of cooking programs on television, various diets, and the rising frequency of eating in restaurants, whether fast food or “haute cuisine.” Humans have eaten in company since prehistoric times, but the emphasis in our society of abundance seems to be on quantity and not quality, and even less on the companionship of fellow diners. Food and its social and hedonistic associations have a place in our daily routine but should not be “inflated” out of proportion. To quote Maimonedes again: “A person should always eat less than he has, wear what he has, and honour his wife and children more than he has to” (Maimonedes, No. 25).

Respect and appreciation for other human beings should be the centre of our lives, not food.

Most serious exercisers offer living proof that we can develop an awareness of nutrition, not necessarily due to the fact that they live by prescribed diets that are almost impossible to adhere to over time. At the same time, when special diagnosis or treatment is required, we need to refer to a certified clinical dietician to advise us on sports nutrition. By expanding their knowledge and understanding of nutrition, exercisers are able to select proper foods for their life style and, at the same time, help to improve their performance results. Physical activity and wise nutrition, in tandem, mean a healthy life style.

The covert aim of every professional athlete is to be “numero uno”: to run the fastest, to jump the highest or the farthest, to lift the heaviest weight, or to score the highest number of points possible. Even as they employ various training methods, professional athletes are aware that their bodies are actually fuel-consuming engines, and, like sports cars, must receive the type and quality of “fuel” that powers them to the best performance. When this choice is based on principles derived from scientific study, the difference may determine whether the athlete takes first or second place.

As far as we know, the ancient Greeks were the first to try to improve their athletes’ performances by means of special diets. It is related that, in about 450 BCE, Dromaeus would eat large quantities of meat for greater strength. While this practice contained a certain element of truth, today’s knowledge about the effect of nutrition on athletic performance is much greater. Modern scientific research indicates that optimal fuel for the body includes proper quantities and proportions of all nutrients such as carbohydrates, fats, vitamins, minerals, and water, and not only protein for proper body function.

## 16.1. CARBOHYDRATES

Carbohydrates provide the body and muscles with energy and, in essence, constitute the main fuel for body functioning. There are different types of carbohydrates (or “sugars” in the common parlance), some of them preferable to others in terms of quality. The various types of carbohydrates belong to three main categories: *monosaccharides* that contain only one molecule of sugar; *disaccharides* that contain two molecules of sugar; and *polysaccharides* that contain three or more molecules of sugar. Mono- and di-saccharides are usually called *simple sugars* and polysaccharides are called *complex sugars*. The greater the number of molecules, the slower is decomposition in the digestive system and the lower the substance’s caloric value (Silver-Rosenberg, 1996).

Simple sugars are found in many foods and their caloric value is estimated at about four calories per gram. Of the monosaccharides, glucose is found in fruits, corn, and honey, and fructose is contained in honey and fruit. “Foodstuffs” that contain the monosaccharides (e.g., *sorbitol*, *galactose*, *manitol*, *menose*) are often classified

by food producers as dietetic, for no justifiable reason. Among the disaccharides, *sucrose* (white sugar) is composed of one molecule each of *glucose* and *fructose*. *Maltose* is composed of two glucose molecules, while *lactose* (milk sugar) is composed of one glucose and one galactose molecule.

Simple sugars provide so-called “empty calories” because they offer no nutritional benefits aside from the immediate available energy. These sugars are absorbed rapidly into the digestive system and enter the bloodstream, causing a rapid rise in blood sugar. When our bodies consume excess calories, the sugar turns to fat, a process that takes place in the liver. Undue, indiscriminate consumption of sugars causes obesity. Sucrose is usually used as a food sweetener. In Western countries, sucrose consumption accounts for twenty to thirty per cent of total carbohydrate intake. Since our body is equipped to absorb only fructose and glucose directly, the sucrose has to be broken down in the digestive system before it is absorbed into the bloodstream. The process of breaking down sucrose actually exhausts our energies instead of increasing it, especially when we consume the sucrose just before physical activity. Heightened consumption of sugar causes a rise in the prevalence of diabetes and heart diseases and harms our teeth as well.

*Polysaccharides* are chains of simple sugar molecules composed of anywhere from three to 26,000 (!) sugar molecules. They are also called *complex carbohydrates* and are divided into two types: those deriving from vegetable and those from animal sources.

The most common vegetable polysaccharides are *starch* and *cellulose*. We find starch mainly in seeds, rice, grains used for making bread, corn, breakfast cereals, pasta, and baked goods. Large quantities of starch can be found in potatoes, peas, beans, and root vegetables, where plants store starch for future energetic needs. Although starch is the main source of carbohydrates in Western diets, the last century has been marked by a decrease in the intake of complex carbohydrates in daily diets. At the same time, there has been a significant rise in the consumption of simple sugars, mainly disaccharides. This change in food consumption patterns has taken a toll on health, including a reduction in the energy supplies needed for physical activity; the result is weight gain. Complex carbohydrates are more healthful for humans than simple

sugars because of slower rates of breakdown in the intestines and subsequent absorption in the bloodstream.

*Cellulose* and other substances that are our bodies cannot digest because they lack the proper enzymes are also complex carbohydrates. The better-known name for them is *dietary fibres*, and they can be found only in plant sources. Dietary fibres comprise the structural part of leaves, stems, seeds, roots, and also the peels of vegetables and fruits. Dietary fibres differ from each other in their structure and in their physiological activity and can be found on the cell walls as *cellulose*, *micellulose*, *pectin* and *lignin* (not a carbohydrate). Other types of fibres are gums found in plant cells (e.g., *guar gum*, which can be purchased at health food stores).

Dietary fibres can be divided into two types: water-soluble and non-water-soluble. Non-soluble fibres are found mainly in the hull of wheat germ (wheat bran) but also in the peels of vegetables and fruits. Since they do not dissolve in water, they speed up the time it takes for food to move through the digestive system, thus, reducing the amount of time that unhealthy waste products (including carcinogens like metals or toxic pesticides) remain in our digestive system. Water-soluble fibres are found mainly in oat bran (the hull), legumes, and fruits. They retain water and increase fecal volume (by 40–100%) and in this way “trap” various molecules including sugars and fats. In this manner, they contribute to the reduction of blood sugar and cholesterol levels, and thereby prevent heart diseases and diabetes.

Although fibres are not nutrients in the technical sense of the word, they have attracted much attention in recent decades. Studies indicate a connection between increased fibre consumption and lowered frequency of obesity, digestive problems such as diverticulosis and constipation, coronary artery diseases, and certain types of cancer, including cancer of the large intestine. Today, it is known that consumption of thirty grams of fibre a day is an integral and recommended part of the daily diet for maintaining long-term good health.

*Glycogen* is a polysaccharide synthesized in our body from glucose stored in muscle and liver tissue. Among people who eat a balanced diet, 375–475 grams of glycogen is stored in the body, whereby about 325 grams are in the muscle and 10–110 grams in the liver. Stored glycogen is broken down for energy when needed. A number of factors affect this process and the speed of

breakdown. During physical activity, carbohydrates in the glycogen stored in the active muscle serve as a source of energy for muscles in use. Glycogen in the liver, however, is broken down into its original glucose form and is transferred through the blood to the muscles for energy. In the process of *glycogenolysis* during physical activity (in the glycolytic system whereby glucose is transformed into energy), glycogen rapidly turns into an available energy component for active, contracting muscles. When our body's supply of glycogen is exhausted because of nutritional limitations or vigorous activity that depleted the glycogen stores in the muscle, a speeded-up process of creating glucose from other nutrients begins, mainly from protein. In this process, called *gluconeogenesis*, a number of hormones play an important role, especially insulin which is secreted by the pancreas and mediates the transfer of glucose from the bloodstream into the body cells. Hormones regulate the depleted glycogen reserves in the muscle and liver by maintaining glucose levels in the blood. While the amount of glycogen our body can store is relatively small, it can also be affected by nutritional manipulation. For example, not consuming carbohydrates for twenty-four hours leads to a significant decline in glycogen stores in the muscle and liver. On the other hand, maintaining a carbohydrate-rich diet for a few days may double glycogen levels stored in the body in comparison to a low-carbohydrate diet.

The *glycemic index* indicates the rate of carbohydrate penetration into the blood, and it is usually preferable that the glycemic index be low (Sears, 1999). The glycemic index is affected by three main factors: the structure of the carbohydrate molecule, the content of dissoluble fibres, and the amount of fat within. The larger the carbohydrate molecule, the slower is the rate of breakdown in the digestive system and entry into the bloodstream. The fibres act to prevent too high a rate of carbohydrate absorption. Therefore, the higher the proportion of fibres in carbohydrate, the slower is the rate of entry into the bloodstream. If the molecule also contains fat (such as in ice cream), the digestive process and the rate of glucose absorption in the blood is slower. This is an important fact to keep in mind when considering the amount of carbohydrate we should consume. Athletes who need easily available energy in competition should consume food with a high glycemic index. At the same time, it is important to remember

that carbohydrates with high glycemic index “force” the pancreas to react fast by secreting large quantities of insulin. Insulin reduces the blood sugar level, but at the same time, it stops the process of breaking down fats and urges the body to save and store its fat reserves. This is the reason that, during non-competition periods, athletes should replenish their carbohydrate (and glycogen) stores and ingest quantities that do not make the pancreas overexert itself, thereby secreting excessive amounts of insulin into the bloodstream leading to weight gain.

According to research, the average American consumes between forty and fifty per cent of their energy as carbohydrates, of which only twenty per cent are derived from fruits and vegetables and eighty per cent come from grains, baked products, and sweets. This means that about half of the carbohydrates consumed by Americans are monosaccharides. Translated into measurable terms, this means about thirty teaspoons of sugar a day, in comparison to sugar consumption of only about one teaspoon per day a hundred years ago.

The *role of carbohydrates* is to serve as fuel for the body. After each meal, our body uses part of the glucose for energy and stores the rest in the body as glycogen. If insufficient carbohydrate is consumed, the body resorts to using glycogen stored in the muscles and liver for energy. After the cells’ glycogen storage threshold has been exceeded, the sugars are turned to fat.

Carbohydrates have other functions. They prevent protein in the tissues from being broken down unnecessarily to create energy. The most vital function of protein is building, maintaining, and repairing body tissue. A secondary function of proteins is to provide energy. When glycogen reserves are exhausted and the body has no source of additional sugar, the gluconeogenesis mechanism turns protein into glucose, and protein becomes the main supplier of energy. Since reducing protein content is especially harmful to the muscles, our body pays a price for this activity. The breakdown of protein releases nitrogen in the body (high levels becomes toxic for the body) and, under extreme conditions, the kidneys (the “filters of the body”) are overwhelmed with excreting the excess nitrogen. A sufficient supply of carbohydrates in our daily nutrition will prevent gluconeogenesis and help to maintain tissue protein.

Another important function of carbohydrates is to assist the body in metabolizing stored fat. In order for fat to undergo oxidation and become available for producing energy, a regular supply of glucose is essential to the body. Fat is burned in the body in part with the support of carbohydrate combustion. Without sufficient carbohydrates during aerobic activity, the process of using fat for energy cannot be carried out effectively, which may also detract from athletic performance.

Carbohydrates are also essential for the normal functioning of the central nervous system. If, for any reason, not enough carbohydrates are supplied through nutrition or glycogen reserves, the brain (usually nourished by glucose) begins to use fat as a source of energy. In this process, by-products called “ketonic bodies” are produced, which raise the acidity of body fluids and may cause a condition called “ketosis” (a multiplication of ketones in the blood). The result of this process may be acidosis, an overly acidic state in the blood that is dangerous to health and may lead to death.

## 16.2. PROTEINS

Proteins are the most commonly found substance in the human body after water, constituting from twelve to fifteen per cent of body weight. In essence, they are the *building blocks* of the body, which explains their tremendous varied importance and their effect on biochemical processes in the cells. Proteins not only promote growth, maintenance, and rehabilitation of body tissues (including, of course, muscle tissue), but also create enzymes, hormones, and genetic material. One gram of protein provides four calories.

Proteins differ from carbohydrates and from fats in terms of chemical activity, mainly due to their nitrogen content. It is possible to monitor the breakdown of protein in the body by the amount of nitrogen lost through urine and perspiration. All proteins are built as a chain of amino acids (of which there are twenty). Eight are essential acids (nine among children), which have to be supplied from food: *isoleucine, leucine, valine, lysine, threonine, methionine, phenylalanine, tryptophan* (and *histidine* among children). Five of the amino acids (*cysteine, arginine, tyrosin, serine, and glycine*) are not

essential nutritionally but may be essential under certain conditions. The other six acids – *alanine*, *aspartic acid*, *asparagine*, *glutamic acid*, *glutamine*, and *proline* – are produced in sufficient quantities.

Amino acids are produced by the breakdown of proteins in food and other metabolic products. They are connected to one another in so-called *peptide ties* – chains of peptides of varying lengths. In order to maintain the correct level of protein in the body, it is important to remember that not all foods containing proteins always contain all amino acids. Such foods are classified as “missing protein.” Only when the protein contains most of the essential amino acids in the right proportion to keep nitrogen in balance and to build and repair tissues can it be called “full protein.” This is an important element of “biological value.” High biological value is attained when food comes close to the amino acid composition required by the body. Egg protein has the highest biological value – 100. Other examples of full protein include milk, beef, fish, and fowl (e.g., chicken). Incomplete proteins can be found in vegetables, bread, seeds, sprouts, brewers yeast, and legumes (including soy). For the most part, a menu built on vegetable protein alone is not sufficiently nutritious unless it is planned carefully by a professional in order to complement and supplement all the essential amino acids. Legumes, such as lentils, complement the amino acids in grains such as rice. It is also important to know that body proteins are in a constant state of catabolism (breakdown) and anabolism (rebuilding), but these processes occur at different rates in different tissues, in different people, at different ages, and under different metabolic conditions.

Although the prime function of protein is not to act as a source of energy, muscles are able to turn protein into energy as well. In this process, some of the amino acids in the muscle turn into the amino acid alanine. Alanine is released from the active muscle and moves to the liver. There, in a process of gluconeogenesis, some of it is turned into glucose that is secreted into the blood and, in this form, returns to nourish the active cell for producing energy. After four hours of constant athletic activity, this production line is capable of providing us with up to forty-five per cent of the glucose secreted by the liver. The importance of this process is great since the energy produced by means of alanine-glucose can provide ten to fifteen per cent of the entire amount of

energy we consume during physical activity. Properly filled carbohydrate stores in the body protect the muscle from protein breakdown and thus allow protein in the muscle to serve the function for which they are intended – building and repairing tissues.

For the average person, the daily consumption of protein is about 0.8 grams of protein per kilogram of body weight. Athletes need at most 1.5 grams of protein for each kilogram of body weight. Most gym frequenters need less than this. For example, an athlete weighing 70 kilograms needs, at most, 105 grams of protein in the daily diet. At this rate, daily consumption of protein enables athletes to reach optimal results in muscle building and muscle recovery. Beyond this level, protein is not stored in the body as protein but instead is turned into fat. It is important to remember that when protein converts into fat, it never reconverts into protein. Thus, despite the importance of providing the body with protein, protein consumption beyond need may actually have negative effects on the body. Obtaining the required daily protein intake is easy (e.g., 200 grams of chicken breast provides 52 grams of protein, 250 grams of cottage cheese provides 22 grams of protein), and this is without taking into account protein contained in the bread, rice, legumes, or vegetables also eaten. Exercisers who chose to consume protein powders instead of food “lose out” on the added value that protein-rich foods provide (calcium, zinc, and other vitamins and minerals) and, in the long run, their nutrition will not be balanced.

### 16.3. FATS (LIPIDS)

Fats are a varied group of substances that are not water-soluble but are soluble in organic substances. The caloric value of one gram of fat is nine calories. It is usual to divide fats into three main groups: simple fats, complex fats, and fats that are the product of the first two groups (e.g., cholesterol).

*Simple fats* are mainly triglycerides and these constitute ninety-five per cent of our body fat. Triglycerides are composed of glycerol molecules with a chain of three carbons, each connected to a molecule of fatty acid. When one glycerol and three fatty acids combine to form one triglyceride, three molecules of water are released at the same time. In contrast to the process of

creating fat, in the process of creating glycogen, each gram of glycogen created in the body contains 2.7 grams of water (that is, its production consumes water from the body). This explains the relative advantage of producing energy from fat. The concentration of energy in simple fats is higher since they have less water, unlike the heavy glycogen that is saturated with water in the liver, relative to its inherent energy potential. When a triglyceride molecule breaks down into its basic components in the process of hydrolysis, three molecules of water join the broken-down materials.

The fatty acids (of which triglycerides are composed) belong to two main groups according to the number of hydrogen molecules: saturated fats and unsaturated fats. Hydrogen molecules in fat play a central part in the processes of providing energy to the body during aerobic activity. Saturated fatty acids (with hydrogen in the molecules) are found in food from animal sources (beef, egg yolk, fatty cheeses, and cream) but also in coconut oil and palm oil. Triglycerides composed of these acids are solid at room temperature. It is possible to turn liquid vegetable fat into solid fat, like margarine, in an industrial process called *hydrogenation*. These fats are called “trans-fats” or solid fats (Lipovetsky, 2000). Unsaturated fatty acids are usually found in liquid fats. These fats are found in vegetable foods and are divided into two main groups. The first is called monounsaturated fatty acid; that is, it lacks one hydrogen atom in the molecule (olive oil, avocado, and almonds). The second is called polyunsaturated fatty acid, which means that it lacks more than one atom of hydrogen in each molecule (soy oil, corn oil, canola oil, or fish oil) (Sears, 2003). In recent years, long-overdue efforts have been made to convince Western societies to consume more unsaturated fats (especially monounsaturated) and to reduce, as much as possible, consumption of saturated and trans-fats (Lipovetsky and Ayelet, 1997). Unsaturated fats help to lower cholesterol levels in the blood and also to reduce heart disease morbidity caused by blockage of the coronary arteries. In contrast, saturated and trans-fats increase the risk of contracting these diseases.

Due to health considerations, many producers indicate the proportion of polyunsaturated and saturated fatty acids on the label of their products. This proportion is called the “P:S” or “P/S.” The higher the P/S ratio, the larger is the proportion of polyunsaturated fatty acids,

and the lower the proportion of saturated fatty acids. For example, it is better to consume oil with a high P:S ratio (assuming that 1:1 is good, 2:1 is excellent, and 0.5:1 is bad). Since this ratio does not take into account the monounsaturated fatty acids, it is common practice today to note the ratio among the three kinds of fats on food products.

*Complex fats* are fats with an additional component: phosphate in phospholipids, glucose in glycolipids, and protein in lipoproteins.

The third group of fats is produced from simple or complex fats: *cholesterol* is the most widespread of this group. Cholesterol actually does not contain fatty acids but its physical and chemical qualities are characteristic of fats and so, nutritionally, it can be considered a fat. Cholesterol is found in each cell in the body and is produced as a result of eating animal food. In essence, our body produces cholesterol because it needs it for creating hormones and bile acids. High levels of cholesterol in the bloodstream increase the risk of blockages (arteriosclerosis). As a result, especially high levels of cholesterol in the bloodstream may cause an infarction (blockage) of the heart muscle. The cholesterol in the bloodstream is found in “bubbles” called lipoproteins. When cholesterol in the lipoproteins is of low density (LDL), the result may be blockage of blood vessels. When cholesterol in the lipoproteins is of high density (HDL), it is removed from the bloodstream through the liver. This is why HDL is often called “good cholesterol.”

Fat in our body has several functions: it serves as a reservoir and source of energy; it prevents friction between internal organs and protects them from blows and bangs (when the body receives a blow, the force is dissipated among fat and muscle); it allows us to float in water (higher body fat ratio makes floating easier); it helps to insulate the body from cold; and it is of great importance in absorbing fat-soluble vitamins A, D, E, and K in the intestines. In addition to these functions, any meal containing fat remains longer in the stomach, giving us a feeling of satiety. In terms of health, the ratio between fat and overall body weight is of great importance. The ratio of body fat for men who engage in physical activity ranges from eight to fifteen per cent, while among women who engage in physical activity, it ranges from twelve to twenty per cent. It is known that

women who try to reduce fat levels in their body (for example, those who engage in bodybuilding) to seven per cent in relation to their overall weight experience a reduction in breast tissue, a cessation of monthly menstruation, and, in extreme cases, a heightened risk of death from the loss of fat. In any case, among men and women who do not engage in physical activity, fat ratios reach twenty-five per cent and, among the especially obese, they are even higher. High body fat ratios increase the risk of contracting cardiovascular diseases, high blood pressure, and diabetes.

According to recent scientific findings, the recommended overall consumption of fats for a healthy person is up to thirty per cent of his or her daily energy needs: about seven per cent from saturated and trans-fats, about ten per cent from polyunsaturated fat, and about thirteen per cent from monounsaturated fat. It is important to remember that this is about thirty per cent of the *caloric intake* and not thirty per cent of all the food consumed, as one gram of fat contains more than double the calories of a gram of either protein or carbohydrates. It is also recommended to limit daily cholesterol intake to 300 milligrams or less per day because of the risk of arteriosclerosis. Physical activity carried out at the proper intensity and duration to improve endurance may lower triglyceride levels and, at the same time, raise the level of HDL in the blood.

Fat stored in fatty-tissue, together with triglycerides stored in muscle cells, serves to meet energy needs. During physical activity, these fats break down and are released as free fatty acids, which reach the muscle tissue by way of the bloodstream. For activity requiring only moderate effort, the energy the body needs can be produced from similar levels of carbohydrates and fats. Only when the effort continues beyond one hour and the carbohydrate reserves begin to be depleted does this process go into action and the contribution of fat to the energy supply increases. In especially long periods of activity, fats can provide almost eighty per cent of all the energy needed by the body.

Aerobic activity in the proper amount reduces the fat ratio in the body, lowers blood pressure, and raises the effectiveness of cardiac activity (see p. 171 under training programs). These positive phenomena are reflected, among other positive results, in a lower “resting pulse.” Low resting pulse indicates stronger heart muscles that

enable the body to cope with higher loads and thereby reduce the risk of heart disease.

## 16.4. WATER

Water is the elixir of life. Between fifty and sixty per cent of a normal human body is composed of water, and sixty-six per cent of an athlete's body weight. The muscles of athletes who drink as much as they should contain seventy-five per cent fluids; and their blood is composed of ninety-three per cent fluids. Water plays a central role in regulating body heat by excreting fluids that release body heat. In this process, known as perspiration, water mixed with salts leaves the body through the skin pores and evaporates in the air. Athletes who do not consume adequate liquids are not able to cool themselves optimally and, as a result, their athletic performance will suffer. Water has other functions: it lubricates joints, carries food components in the blood vessels, creates an appropriate environment for body acids and enzymes, and helps to store glycogen in the muscle. Water does not reach the body only from outside, through drink and food. The body itself produces it as a metabolic by-product. It is excreted from the body in urine, feces, sweat, and through the respiratory system. Water is a transparent, colourless, tasteless liquid of which there are several types. *Tap water* is usually the main source of the water in our food, and it usually contains chlorine (as a disinfectant) and fluoride (for preventing tooth decay). In some areas tap water is hard. *Hard water* contains large concentrations of calcium and magnesium salts. *Distilled water* has had all “foreign” substances removed and so it can be used in medical and research laboratories or to fill batteries and appliances that need “pure” water. *Spring* or *mineral water* comes from springs that contain minerals, are free of chlorine and pollutants, and are considered better tasting than chlorinated tap water (see p. 153 under minerals).

It is important that athletes drink sufficient water before, during, and after all activity in order to maintain a high level of fluids in the body at all stages of activity. Training decreases the amount of fluids in the body, which can lead to dehydration. It is appropriate to mention so-called *isotonic drinks* here. They have a concentration of dissolved substances (sugars, flavours,

and other additives) that is identical to the concentration level in the blood. Therefore, they are absorbed into the bloodstream through the walls of the stomach in up to seven minutes without having to be broken down in the digestive system. Regular soft drinks are not usually isotonic and require much more time to be absorbed by the bloodstream. The process steals energy from the body because of the composition of the dissolved substances and the breakdown processes they have to undergo. Isotonic drinks improve carbohydrate stores in the body because they contain sugars and sodium, and the combination of sodium with carbohydrates speeds up the absorption of the drinks even more. Isotonic drinks help muscles to recover speedily during and after exertion. In general, the ideal drink for physical and athletic activity should have the following characteristics: not too sweet (not causing drastic changes in blood sugar levels), not carbonated (carbonation bloats the stomach and “fools” the body as to the amount of water received), be immediately thirst-quenching (does not contain substances that may keep the drink in the stomach for a long time), and not so cold or so hot that exercisers cannot drink the required amount. Some athletes dilute fresh squeezed orange juice with water in a ratio of 1:2, creating an inexpensive isotonic drink that is quite beneficial.

The recommended intake of water under regular conditions (not necessarily in the context of athletic activity) is about two litres (quarts) of fluids per day, or one cubic centimetre per kilocalorie (thousand calories) of food. During strenuous physical activity, under hot and/or dry conditions, and when suffering from diarrhea or vomiting, it is recommended to drink more water. Water consumption among infants and the elderly is especially important. A negative fluid balance in the body is a state whereby people do not drink enough to replenish lost body fluids. The results can be headaches (because of disrupted blood flow to the brain) and extra work for the kidneys. A positive fluid balance is a state in which we drink enough to replenish the fluids lost. A positive balance helps to ensure normal functioning of various metabolic processes in the body such as skin softness and flexibility. It is essential to maintain a positive fluid balance to avoid dehydration. Physical activity causes intensified sweating; therefore, those who engage in physical activity, especially professional

athletes, should drink more than usual in order to maintain their positive fluid balance.

## 16.5. VITAMINS

Vitamins are a group of organic compounds in animals and vegetables essential for living bodies to function, develop, and remain healthy. Our bodies receive most vitamins in daily food, but some are supplied by exposure to the sun (e.g., synthesized vitamin D), and others (e.g., vitamin K) are produced in the body by intestinal bacteria. Most of our food contains a number of vitamins but no one food contains all of the essential vitamins in the quantities the body needs. This underlines the importance of varying diets to encompass foods containing all of the vitamin groups. The scientific term for vitamin deficiency is *avitaminosis*, while overconsumption of vitamins is called *hypervitaminosis*. Both conditions can cause physical disturbances – deficiency syndromes in the case of avitaminosis, and excess syndromes from hypervitaminosis.

Vitamins do not contain calories and, therefore, cannot be considered suppliers of energy. They are divided into two groups according to solubility: fat soluble (A, D, E, and K) and water soluble (mainly C and B complex) When foods containing water-soluble vitamins are cooked, it is recommended that the cooking liquids (with the leached vitamins) be used to prepare other foods, for both better health and taste.

The following survey of vitamins notes their sources and the effects of each vitamin on body systems (*Carta Encyclopaedia for Family Wellness*, 1999). This is not meant as a prescription. Only a doctor or qualified dietician can determine whether a person is suffering from vitamin deficiency and prescribe the exact supplementary dosage (if required).

**Vitamin A (retinol)** – Effective for growth and development, body immunity to infections (mainly in the respiratory system), healthy skin and membranes, and good vision. Symptoms of vitamin A deficiency are: reduced secretion of the sweat, mammary, and tear glands; dry, rough skin; dry eyes; and dimmed vision (including night blindness). Symptoms of vitamin A excess are: headaches, drowsiness, and peeling skin. Main sources are: liver, fish oil, egg-whites, milk,

cream, cheese, and butter. It is also found in the form of carotene in spinach, carrots, and cabbage. Since vitamin A is oil dissoluble, it can be created in the body from carotenes (mainly beta-carotene) found in many foods. Recommended daily intake is: 900 mcg for men; 700 mcg for women.

**Vitamins B (all kinds)** – Essential for normal metabolism in the body. They are all water soluble. These vitamins are essential coenzymes, as they are actively involved in metabolism-related processes.

**Vitamin B<sub>1</sub> (Thiamin)** – Essential for oxidizing glucose and producing carbon dioxide and water. This process helps to distribute energy to body tissues and to maintain normal functioning of the nervous and digestive systems and of the brain and muscles. Symptoms of deficiency are: beriberi (a very rare disease today), cardiac paralysis, swelling of legs (because of cardiac insufficiency), weakening of the muscles, and emotional confusion. Prolonged deficiency may cause death. Sources are: all animal and vegetable tissues, but especially high concentrations occur in grain hulls and yeast. The vitamin is water soluble and is destroyed by heat, alkaline solutions, preservatives, and sunlight. Daily recommended consumption is: 1.2 mg for men; 1.1 mg for women.

**Vitamin B<sub>2</sub> (Riboflavin)** – Helps in digestion and in creating energy. It is necessary for normal growth and for blood composition. Deficiency symptoms are: lesions in skin, tongue, lips and mouth membranes, and pellagra (thick skin). Main sources are: liver, kidneys, fish, yeast, legumes, milk and dairy products, and green vegetables. The vitamin is water soluble and stable in heat and in contact with the air, as well as after freezing or drying. It is destroyed by sunlight and alkaline substances. Recommended daily intake is: 1.3 mg for men; 1.1 mg for women.

**Vitamin B<sub>6</sub> (Pyridoxine)** – Regulates the metabolism of amino acids and nervous system activity. Deficiency symptoms are: lack of appetite, nausea, vomiting, skin, lip, and mouth membrane lesions. In children, may also incur nervous tics. Main sources are: yeast, grain germ, nuts, legumes, meat, liver, and fish. The vitamin is water soluble and destroyed by heat and light (especially ultraviolet rays). Daily recommended intake is: 1.3 mg for men and women.

**Vitamin B<sub>12</sub> (Cyanocobalamin, Cobalamin)** – Helps to metabolize amino acids including the transformation of *tryptophan* to niacin, produce red blood cells, nucleic acids and nucleic proteins, synthesize *choline*, and promote body growth. Symptoms of deficiency are: pernicious anemia,

tongue lesions, deviations in the spinal column and peripheral nerves. Sources are: animal products only such as liver, beef, fish, and milk products. Recommended daily intake is: 2.4 mcg for men and women.

**Niacin (Nicotinic acid)** – Helps to produce energy from carbohydrates, fats, and proteins. Symptoms of deficiency are: pellagra, diarrhea, skin lesions, and emotional disorders. Main sources are: liver, kidneys, beef, and whole grains. It is also produced in the body from the amino acid, tryptophan. Recommended daily consumption is: 16 mg for men; 14 mg for women.

**Folic acid** – Is active in cell function and produces red blood cells and activates essential enzymes. Symptoms of deficiency are: pernicious anemia. Sources are: liver, kidneys, and green vegetables. The elderly, pregnant women and alcoholics (whose diet is not balanced) are most likely to display these symptoms. Recommended daily intake is: 0.4 mg for men and women.

**Vitamin C (Ascorbic acid)** – Promotes tissue growth and recovery from disease. Deficiency symptoms are: scurvy, bleeding of skin and gums, skin changes, and exhaustion. Prolonged deficiency can lead to death. Main sources are: fresh fruits and vegetables. The vitamin is water-soluble and is destroyed by heat, alkaline environments, and prolonged cooking. Recommended daily intake is: 90 mg for men; 75 mg for women.

**Vitamin D (Cholecalciferol)** – Helps in the absorption of phosphorus and calcium in the intestines as well as their transfer to the cells to produce bone and tooth tissue. Deficiency symptoms are: among children – rickets, bone problems and deformities; among adults – brittle bones. Symptoms of excess are: lack of appetite, diarrhea, nausea, calcification of soft tissues, and kidney impairment. Main source: fish oil. Most of the vitamin is produced by substances absorbed by the body that enter the fatty tissue under the skin and are converted to vitamin D when exposed to sunlight. In a number of states in the U.S., the law requires producers of milk and cereals to add vitamin D to their products and, as a result, vitamin D deficiency has practically disappeared from the population. The vitamin is fat soluble and stable when processed in foods and cooking. It is essential for pregnant and lactating women and for children. Recommended daily intake is: 5 mcg for men and women up to age fifty.

**Vitamin E (tocopherol)** – Strengthens cell membranes, helps fat metabolism and acts as an antioxidant. Deficiency

symptoms are: anemia, skin rashes, and swelling. Main sources are: milk, vegetable oils, whole grains, leafy green vegetables, nuts, and legumes. This vitamin is fat soluble. Recommended daily intake is: 15 mg for men and women.

**Vitamin K (phytonadione)** – Essential for blood clotting.

Deficiency symptoms are: internal and external hemorrhaging, problems of clotting. Doses exceeding the recommended daily allowance may be toxic. Main sources are: liver, sea kelp, milk, yoghurt, egg-whites, molasses, and leafy vegetables. It is also produced by intestinal bacteria. Vitamin K is oil-soluble and is destroyed by light and oxidants. Recommended daily intake is: 120 mcg for men; 90 mcg for women.

## 16.6. MINERALS

Minerals are non-organic substances. Their primary source is not animal or vegetable, but rather, inorganic substances on the earth's surface. Minerals are essential for building and maintaining normal body functions. Factors that determine a regular supply of minerals are the amounts available in food and their absorption through the intestines. Absorption depends on the type of mineral, its quantity in the body, and the relative quantities of various minerals in the daily diet (some minerals compete with others in terms of absorption). Various substances are found in foods (such as peptides from the hulls of seeds) that bind with minerals and subsequently delay absorption. Minerals are classified into three main groups: 1.) minerals – required in quantities greater than 100 mg per day (potassium, sulphur, phosphorus, chlorine, magnesium, sodium, and calcium), 2.) trace elements – required in quantities of less than 100 mg per day (zinc, iron, manganese, copper, and fluorine), and 3.) ultra-trace elements – required in quantities of a few micrograms per day (arsenic, stannum, boron, vanadium, iodine, chromium, lithium, molybdenum, nickel, selenium, and silicon). Trace elements take their name from the fact that they are required in only minuscule quantities essential for various physical functions.

The minerals from the first group – calcium, phosphorus, and magnesium – build body tissues and maintain a balance of fluids and electrolytes. Sodium, potassium, chlorine, phosphorus, and sulphur maintain

the body's acidity. Sodium, potassium, calcium, and magnesium are also essential for normal activity of nerve and muscle cells. Potassium, phosphorus, magnesium, and sulphur are needed for various enzymatic processes such as producing available energy. Most of the trace and ultra-trace elements are required for enzymatic or hormonal activity related to the metabolic systems: iron, manganese, iodine, and chromium are needed for energy producing metabolism. Zinc, molybdenum, and chlorine are needed for nucleic acid metabolism. Copper, manganese, and selenium are required for protection from oxidation. Silicon and boron are needed for bone metabolism. Chromium and vanadium are needed for glucose metabolism. The functions of some of the ultra-trace elements are still not completely clear. Natural sources of minerals are various unroasted seeds from sunflowers and pumpkins, all types of nuts, sprouts, cold-pressed wheat germ oil, brewer's yeast, sea kelp, and pollen.

**Cooking salt** – Is nothing more than sodium chloride which the body breaks down into its two components: it is a source of the minerals sodium and chlorine. The amount of salt required in the daily diet does not exceed six grams (about 2.5 g of sodium), which is much smaller than the quantities we usually consume. Consuming too much salt increases the risk of high blood pressure, cerebral strokes, and coronary heart disease (arteriosclerosis), which may result in shutting down the heart muscle. For athletes, over-consumption of salt will cause over-retention of fluids, reflected in increased body weight. Consumption of large quantities of minerals in the form of tablets, liquids, or capsules, which supplement regular food, may be harmful unless medical tests indicate that a person actually needs these supplements.

## 16.7. NUTRITION FOR ANAEROBIC ACTIVITY

Exercisers use two mechanisms for producing energy from the food they consume. The mechanism for creating anaerobic energy does *not* make use of oxygen, whereas the aerobic mechanism needs available oxygen from the air in order to produce energy. The anaerobic mechanism is characteristic of activities requiring great exertion in a short time span (mainly power activities). The aerobic mechanism, by contrast, is characteristic of lower-level activities for longer periods of time.

Different types of physical activities make different demands on our body's energy system. Some activities require intense effort for very short periods of time (e.g., horse-vaulting, broad-jumping, or pole-vaulting), others require regular movement with intermittent rapid activity (e.g., ball games such as football), and some require slow, steady muscular activity over long periods of time (e.g., marathon running, kayaking). Each of these activity types makes different demands on the muscles and on the type of fuel the muscles consume.

There are clear metabolic differences between activities requiring explosive power and those that demand long-term endurance. Power activities demand that exercisers be able to lift heavy weights, smash a concrete block, jump long or high distances, or push someone of equal or greater weight (as in sumo wrestling). Exercisers, who prepare their muscles for such activities in order to win competitions, should not only train properly, but also ensure suitable nutrition for this special effort; otherwise, they are not able to realize their full potential.

### *Energetic requirements for anaerobic activity*

Power activities depend on the *B<sub>2</sub>* type (*fast-twitch*) muscle fibres. Familiarity with the special qualities inherent in these fibres helps us to understand the nutritional recommendations for power exercisers. Fast-twitch muscle fibres have a very good ability to store glycogen (which is their source of energy) and, at the same time, they can create a tremendous amount of power. These muscle fibres store glycogen much in same way that other carbohydrates are stored in our body, but they have little ability to store triglycerides. The *A<sub>2</sub>* type (intermediate fast-twitch) muscle fibres also produce tremendous amounts of power. Unlike the *B<sub>2</sub>*, they can adapt to whatever type of training is being done and can also function like the fibres characteristic of aerobic activity and, therefore, they can withstand exertion over time. In other words, *A<sub>2</sub>* fibres behave like *Type 1* (*slow-twitch*) muscle fibres that are used in activity requiring regular movement over time. *Type 1* fibres are good at storing triglycerides, but weak in storing glycogen. The type of training that is carried out determines the behaviour of *A<sub>2</sub>* type muscle fibres. Power exercisers prefer muscles that can produce large amounts of power.

Track and field makes varying physical demands and athletes are often required to perform prolonged regular activities such as running long distances. Extensive aerobic activity causes *A<sub>2</sub>* fibres to lose some of their potential to produce explosive power and they begin to behave more and more like fibres trained for extended physical activity. Slow-twitch muscle fibres, thus, have the ability to store and burn fats, while fast-twitch muscle fibres have exceptional abilities to store and burn glycogen. Intermediate muscle fibres can be trained to behave either as fast-twitch or slow-twitch muscle fibres but, basically, they are closer in nature to the fast-twitch fibres.

The system that provides the available energy with maximal speed is the *phosphogenic system*. This system is very limited since it is able to produce energy for only the first five to eight seconds of effort, provided that the athlete is well nourished. In addition to relying on the phosphogenic system, muscles can also depend on the *glycolytic system* for producing anaerobic energy. Muscles have the ability to rapidly changing stored glycogen in the muscle into available energy without the need for oxygen. The glycolytic system functions with a time limit maximum of one and a half minutes. Therefore, athletes trying to move at maximum speed and power can combine the two anaerobic systems for about one and a half minutes of intensive exertion (Janssen, 2001).

### *The phosphogenic metabolic system*

This *phosphogenic* system provides available energy at maximal speed for what is called explosive power. Classic examples of where the system is used are weightlifting, high jumping, and sprints, as well as activities that require sudden bursts of exertion such as a "fast-break" in basketball, soccer, or hockey. This system is also able to provide up to eight seconds of available energy due to the phosphates stored in *adenosine triphosphate* (ATP) and/or in *creatine phosphate* (CP), energy-rich fuels used by muscle cells. The ability to produce energy from the phosphogenic system depends to a great extent on the ability of CP to provide a molecule of phosphate to produce ATP from the source material ADP (adenosine diphosphate, which contains only two phosphates in each molecule). Theoretically, the more creatine there

is in the muscle, the more the amount of CP can be increased for producing ATP. This is exactly the reason that many athletes consume creatine monohydrate as a nutritional supplement.

When the amount of ATP in the muscle is very large, it is possible to perform sudden actions or activities which require a series of rapid movements that is repeated at intervals. In essence, this system can determine who will be the winner in athletic competitions. Creatine is synthesized in the liver by three amino acids: arginine, glycine, and methionine. In addition, it is possible to obtain creatine from our food, especially meats.

Bringing a muscle to its maximal level requires proper preparation in terms of both training and nutrition. On the training level, exercisers have to perform appropriate training and repeated activities at high intensity whereby duration is not more than eight seconds. At the same time, on the nutritional side, they must ensure an adequate supply of energy and protein from food has to be available so that creatine can be produced.

There is limited verification that consuming creatine monohydrate as a supplement improves athletic performance. It may be that this improvement is attributable to athletes' improper nutrition and inadequate energy sources before the supplements were added to their diet. Whatever the case, it should be remembered that consumption of the supplement may have side effects. We know that storing creatine in the muscle entails water retention, which increases weight. In certain types of activities, weight gain can impede athletic performance. Damage has been found in renal (kidney) function among those using this supplement (even at recommended doses) that continues even after usage has stopped.

### *The glycolytic metabolism system*

Strenuous activities of an average duration of up to eight seconds requires so-called "available energy," which is energy produced in the phosphogenic system. Activities that last from eight seconds to a few minutes must also call on the almost-available energy reserves, the *glycolytic system*, which begins after the initial energy has been exhausted. When strenuous physical

activity is performed, our main source of energy is the glycogen stored in the muscle as carbohydrates. The energy produced here is important because it is usually available rapidly, but it provides only a small part of the energy used by the muscle. This energy is provided to the body only during the time-span between the beginning of the activity and the time needed for aerobic metabolism to start. When glycogen is depleted, the strenuous activity is stopped. Therefore, it is possible to continue with strenuous activity only up to a minute and a half. Afterwards, one has to wait from three to five minutes for muscles to replenish their sources of energy (glycogen for the glycolytic system and phosphocreatine for the phosphogenic system). In fundamentally aerobic types of sport such as marathon running, the anaerobic element determines the winner in the competition. If sprinters conduct their 100-metre run in a manner that they save some of the glycogen in their muscles until the end of the race, they succeed in finishing the race with a strong anaerobic sprint. Athletes in power activities perform tasks that mainly require energy provided by the anaerobic systems: the phosphogenic and glycolytic systems. Activities requiring high bursts of power for short durations, such as fifty-metre or hundred-metre sprints or weightlifting, require almost only anaerobic energy, the available energy (from the phosphogenic system) or almost available (from the glycolytic system).

The B2 fast-twitch muscle fibres, the main fibres that athletes use, have a high ability to use glucose as energetic fuel. But as noted, they have little ability to store fats and convert them to energy. This is the reason that athletes in power activities need very little fat in their nutrition since their bodies are simply not prepared to use it for its energy requirements. Athletes whose diet includes high proportions of fat while training and those engaging in tremendously high-energy activities would do well to reduce the fat percentage when frequency of training sessions decrease; otherwise, they gain weight.

Since the glycolytic system is the central metabolic system in anaerobic activity, carbohydrates are the main source of energy in power activities. Nevertheless, it appears this is not the prevailing opinion among athletes, many of whom tend to increase the protein content of their diet in place of carbohydrates. Athletes in power events usually try to increase the ratio of muscle mass in the body. Their assumption is that the larger the muscle

mass, the greater their potential to increase power and muscle strength. Since proteins are the building material of muscle, they conclude that they should increase the protein intake. This conclusion is only partially true. Weightlifters, for example, need no more than 1.5 grams of protein per kilogram of body weight. In actual fact, some athletes consume up to 4 grams of proteins per kilogram of body weight each day. Since the muscle is not capable of using more than 1.5 grams per kilogram of body weight for building, the excess protein serves as energy fuel or is stored as fat. Over-consumption of protein is not recommended since it generally causes a rise in the percentage of body fat. This increase is reflected in a *deceptive decrease in weight* since fat weighs less than muscle tissue, which is composed, for the most part, of protein. Another reason for ostensible weight loss is the deficiency of body fluids. The metabolism of excess protein creates a nitrogen buildup, which the body counters by increasing urination. Athletes who increase the proportion of body fat and lower the percentage of fluids only reduce their chances of winning in competition. Athletes who consume the required amount of carbohydrates can be sure of supplying enough fuel to the muscles for athletic activity. Their ability to train, in this case, is also higher due to the supply of glucose to the glycolytic system. Furthermore, if they do not receive sufficient carbohydrates, they have to start using proteins as a source of energy. This may lower their chances of building muscle and, at the same time, raise their risks of dehydration.

The ideal distribution of energy for anaerobic activity ranges from 60 to 70 per cent energy derived from carbohydrates, 18 to 23 per cent from fat, and 12 to 15 per cent from protein.

## 16.8. NUTRITION FOR AEROBIC ACTIVITY

In addition to the anaerobic process for creating energy, our bodies have another system for creating energy: the *aerobic metabolism system*, which makes use of oxygen. The aerobic system allows the body to burn energy for long periods by means of oxygen. It is the most important energy system for endurance athletes and it reaches its maximal level only when athletes are able to supply their muscles with enough oxygen to change phosphates into

ATP molecules. Unlike anaerobic metabolism, this path of energy can consume protein, fat, and carbohydrates by turning them into a substance called *acetyl* (coenzyme A). The faster the muscles work, the more energy is needed and the greater the amount of oxygen has to be to burn it. When the muscle works up to the point that heightened respiration can no longer provide sufficient oxygen, it begins to rely on energy from the anaerobic system, which operates without oxygen. Athletes who increase their anaerobic activity beyond the natural ability of their body will be forced to stop because of the disturbances created by the by-products of the *gluconeogenesis* process. The accumulation of nitrogen waste in the kidneys slows their filtering ability, which also affects the excretion of liquids from the body through sweat or urine. High aerobic fitness level means that one is able to supply muscles with enough oxygen when needed. Aerobic fitness indicates cardiovascular fitness, that is, a very high ventilation ability of the lungs. In this condition, the amount of anaerobic work the body performs is limited and muscle fatigue sets in later. Supplying the proper energy sources to the body is important because none of the systems mentioned operate efficiently if we do not supply the body with energy from the specific sources and in the right amounts for training. For example, we all have certain amounts of fat stored in our bodies. Fat is an excellent source of energy for aerobic activity, but in order to burn fat properly, we need carbohydrates. If athletes deplete their carbohydrate reserves, they are unable to burn fat normally, and their muscles will become fatigued. Fats cannot be burned if the body lacks carbohydrates.

Athletes engaging in endurance activities (such as long-distance running) are in constant movement for at least twenty minutes. They need a proper supply of energy and fluids for this activity to avoid exhaustion and raising their body temperature too high as a result of the continued burning of energy. This should be one of the most important aims for endurance athletes. It means supplying energy and fluids before, during, and after athletic training as well as competitions. Most endurance activity entails exertion that allows the use of fat as fuel. Nevertheless, athletes do not need to consume extra fats before or during competition because even the leanest has the necessary supply of fat in the body. On the other hand, carbohydrates are extremely essential for the

process of burning fats as a source of energy, beyond their importance as independent suppliers of energy. Therefore, the limiting factor in providing energy in the aerobic process is a lack of carbohydrates and not necessarily a lack of fats. Since the ability to store carbohydrates in the body is limited, carbohydrate reserves are depleted long before the fat stores. Athletes should aim at finding a way to supply enough carbohydrates during competition periods. While power athletes have to consume enough energy to maintain and build muscles, endurance athletes should consume enough carbohydrates to maintain their muscle activity level in their body over extended periods of time.

Athletes who exercise aerobically reach a state of faster aerobic metabolism than those who do not exercise aerobically. Up to five minutes may pass until enough oxygen is supplied by the lungs to “maintain” aerobic metabolism at a steady state. Theoretically, when athletes obtain oxygen supplies corresponding to the activity level they are performing, this activity can continue until or unless the levels of carbohydrates and fluids in the body are critically low. Therefore, it is important in prolonged aerobic activity to supply fluids and carbohydrates during the activity itself in order to prevent a decline in performance level.

The recommended daily energy intake for athletes exercising one and a half hours is forty-five calories per day for each kilogram of body weight. The longer the daily training time, the more calories the athlete has to consume. Physical activity entails tremendous loss of fluids through perspiration, in addition to the regular passing of fluids (urine), and may reach ten litres per day. Therefore, it is extremely important to replenish the supply of fluids in the body, or performance levels will decline. Even slight dehydration of about 2 per cent of body weight causes a noticeable drop in athletic performance.

In general, athletes should consume about twenty grams of carbohydrates per day for each kilogram of body weight. After activity of one hour or more, glycogen reserves are virtually exhausted and therefore it is important to renew the process of synthesizing glycogen after activity. A number of factors affect the renewed synthesis of glycogen: the timing of eating, quantities consumed, the type of carbohydrate eaten, and the level of damage caused to the muscle during

activity (if damage has occurred, synthesis is slower). Carbohydrates with a high glycemic index (e.g., carrots, cornflakes, honey, whole wheat bread, rice, and potatoes) may synthesize glycogen more efficiently than those with a low glycemic index. It is advisable to consume two hundred calories of carbohydrates every two hours after the conclusion of physical activity; the first two hundred calories should be ingested as soon after the activity as possible. The reason for this is that each gram of glycogen is stored with about three grams of fluids, and athletes should be sure to consume a lot of liquids with the carbohydrates before the activity as well. Endurance athletes need somewhat more protein than power athletes because some of the protein serves as fuel for energy in the former. Therefore, the recommended protein intake for endurance athletes is up to 1.6 grams of protein for each kilogram of body weight. The recommended proper proportions among food components for endurance athletes are: 60 per cent carbohydrates, 20 to 25 per cent fat that can also help to maintain weight, and 15 per cent protein.

## 16.9. GUIDELINES FOR PROPER NUTRITION

Before subjecting our body to any specific nutritional regime, which by its nature, limits our ability to eat whatever we want, it is important to consider the issue of nutrition. Certain existential priorities should not be forgotten: without oxygen a person can live for only few minutes, without water, a few days, *but without food, a few weeks*. That is, even if we deviate from whatever nutritional regime is recommended, we will not inflict irreparable harm on our body. If proper nutrition is a way of life, it is definitely permitted (perhaps even desirable) to deviate once in a while (perhaps once a month) and “spoil” ourselves by “pigging out” on sugars and fats. In any case, our body cannot absorb all the calories of such a meal in one day. According to the holistic approach to physical activity in the gym, wise nutrition is a part of the whole but by no means is it the whole.

Proper nutrition is based on two principles: food composition and quantity. Each component of our food has its own effect on our body functions, so our foods should include *all of the food components and in proper proportions*. It can be stated, more or less

categorically, that there is no need for *food supplements* in modern Western society. In cases of intensive physical activity or unbalanced nutrition, it may be necessary to take supplements after consulting with qualified authorities. Unjustified, unprescribed consumption of food supplements (in pill or powder form) may cause weight gain and/or a deficient, unbalanced menu. The menu should be based mainly on complex carbohydrates (vegetables and fruits) and, to a lesser extent, on proteins and fats, and even less on simple sugars. Any extreme deviation from these proportions indicates to the body that something is awry in the food supply and the body then resorts to defence mechanisms and fat storage.

Physical activity can exempt us from all types of weight-loss programs. It can help us to get rid of excess calories. Aerobic activity is a proven way of burning fats. On the other hand, increasing muscle mass as a result of power training may add overall weight (your body is heavier ...) and at the same time reduce fat mass (... but thinner) because muscle weighs more than fat. This is a welcome indication that a change is taking place in tissue composition: muscle tissue (which is active) is increasing while fat tissue (which is passive) is decreasing. Physical activity checks the tendency to overeat. It regulates our appetite and allows us to concentrate on other foods (so-called “spiritual” foods) that add quality and meaning to our lives.

Overweight and high fat tissue ratio are risk factors for developing medical problems such as coronary heart disease, high cholesterol, diabetes, high blood pressure, joint and posture problems, or lower back pain.

**Caloric balance** – Is the ratio between the total calories consumed by eating and the total of calories expended while performing physical activity and maintaining the body. When the number of calories consumed exceeds the number of calories expended, there is a *positive caloric balance* and our weight rises. In order to lose weight and reduce fat in the body, we need a *negative caloric balance*, which means burning more calories than we consume in our food. *There is no way to get around this principle.* In regard to daily caloric intake, it can be stated with absolute certainty that as we get older we need fewer calories. Calculating the number of daily calories each of us needs is complex and includes many factors. In general, infants up to age six months need about 110 calories per kilogram of body weight (e.g., an infant weighing six kilograms needs 660 calories

a day). A twenty-year-old man needs from 2,500 to 3,000 calories per day (about 40 calories per kilogram of body weight), and a sixty-year-old man requires an average of 31 calories per kilogram of body weight (1,400 to 2,200 calories per day). It is not enough to be aware of the guidelines for proper nutrition, they also need to be implemented, and efforts have to be made to avoid a positive caloric balance.

We do not advocate any particular nutritional program. Various books on nutrition (see the bibliography) recommend an array of menus and diets. The aim here is to present the most important information for proper food selection. The intent is also to raise an awareness of the importance and consequences of food components and their functions in the body. The following are general recommendations:

**Awareness** – Be actively aware of the composition of various foods and ways to prepare them. This helps you to choose foods that are suitable for you.

**Food selection** – Select foods by using knowledge of their nutritional composition. Be a regular reader of food labels before purchasing products.

**The food pyramid** – Build daily menus so that they are based on complex carbohydrates (fruit and vegetables) with fewer proteins and fats, and even fewer simple sugars (monosaccharides).

**Complete nutritional composition** – Make sure foods contain all the nutrients in the recommended proportions for the type of physical activity you engage in.

**Breakfast** – The most important meal. Try not to miss it.

**Drinking water** – Recommended before, during, and after the meal as well as before, during, and after physical activity. In prolonged endurance exertion, isotonic drinks are recommended.

**Fats** – Eat as little fatty food as possible. Especially, avoid animal fat, as it contains high levels of cholesterol.

**Sweets** – Not a substitute for food. Reduce sweet consumption, especially before physical activity.

**Salt** – Reduce over-consumption of salty foods.

**Vegetables and fruits** – Healthful and nutritious. Vegetables can be eaten without limit (their caloric value is relatively low) but fruit consumption should be somewhat more restrained because of their high sugar content.

**Budget** – Choose a given nutritional plan. Make sure its cost is reasonable so that you can adhere to it.

**Don't starve yourself** – Eat when you are hungry. Avoid letting yourself get to a state of such hunger that you cannot control yourself when you select your food.

**Variety** – Vary your menu. Make sure you have a variety of foods with enough nutrients so that you are not bored with the same food.

**Learn to educate your tastes** – It is definitely possible! Avoid eating only the foods you have always loved. Immediate gratification of your taste buds may encourage “bingeing” on foods that may not be healthy.

**Eat to satisfy your hunger, no more** – Beware of “eat as much as you can” establishments. They encourage overeating (to get your money's worth!). Avoid filling your whole plate with food. Large plates and thick slices affect the amount of food we eat. Try to eat from relatively small plates.

**Regular meals at regular meal times** – As much as possible, try to schedule regular eating habits, that is, devoting “quality time” for three regular meals and two snacks a day.

**Eat slowly and moderately** – Our satiety mechanism starts only after twenty minutes of eating. Take pleasure in the taste and learn the satisfaction of eating in moderation. If you eat quickly – you eat more!

**Aesthetics** – Try to ensure that your food is served aesthetically so that your eyes are also be satisfied. Remember that “your eyes are bigger than your stomach”!

**Advertisements** – Remember that you live in a consumer society. Avoid being seduced into “you *gotta* eat this” habits that food commercials try to transmit.

**Plan your training days** – It is recommended to schedule your physical activity for before mealtime.

**Physical activity** – Should be performed at least three hours after eating.

**Remember!** – Under conditions of starvation, the body adjusts to burning fewer calories in order to not waste energy. In this state, it tends to store food instead of burning it. This physical defence mechanism against starvation increases the desire to eat more food than the body actually needs. The result is that the excess food is turned into fat – which is what we are trying so hard to get rid of!

*Combining physical activity and proper nutrition will help to increase both quality of life and longevity.*

## 16.10. DRUGS

The use of “sport drugs” reflects an erroneous and harmful understanding of the essence of working out in the gym and of sport in general. They have harmful short- and long-term side effects, and many are irreversible. Despite this fact, drug use for enhancing gym workouts has become a widespread phenomenon, especially among bodybuilders. It is important to remember that the holistic approach sees health, not aesthetics, as the heart of physical activity. When the emphasis in training is on external markers, the health component is the first to suffer. On the other hand, if we work out according to the rules and dedicate the right amount of time to training, in the long run we also gain the desired aesthetic benefits. The use of drugs often leads to addiction. This means that the body begins to “demand” the drug at in ever-increasing dosage in order to achieve the same effect. Addiction has another even more dangerous aspect – the body begins to respond erratically when it does not receive the drug to which it is addicted.

The International Commission for Sport classifies “sport drugs” into five categories (Clarkson and Thompson, 1997).

**Amphetamines** – Reject feelings of fatigue, raise motivation, depress appetite, and heighten self-confidence. Exercisers in the gym tend to take amphetamines (or “uppers”) so that they can work out more and decrease their appetite. Amphetamines have side effects such as addiction, possible nervous breakdown (mental illness), increased body temperature, and potential loss of consciousness.

**Narcotic drugs (pain-killers)** – Increase the pain threshold, allowing exercisers to persevere for longer and improve achievements. Exercisers in the gym often take these drugs to reach a state of euphoria, to improve their achievements (breaking personal records), and to expand the scope as well as the extent of their workouts. Side-effects include addiction, destruction of bone tissue, susceptibility to infections, and impairment of the immune system.

**Anabolic steroids** – Produced from the male sex hormone testosterone, help to build muscles and increase power. Exercisers often take these drugs to increase strength, as well as muscle mass and circumference. The most common anabolic steroid in use today is growth hormone (GH).

Known side-effects include addiction, joint and muscle pains, mood swings, behavioural changes, acne on the face, back, and arms, depression and suicidal thoughts, and the possibility of sterility and impotence.

**Tranquillizers (beta blockers)** – Reduce resting and working heart rates, and lower blood pressure during exertion. Most commonly used by athletes in sports requiring precision such as marksmanship, golf, table tennis and, among exercisers, those working against high loads (in order to reduce the high blood pressure induced by intensive training). Side-effects include lowered blood sugar levels, sleep disturbances, depression, digestive system disturbances, and headaches.

**Diuretics** – Used mainly to reduce weight before competitions where competitors are classified by weight. Diuretics are also used to hide traces of other forbidden substances. Exercisers may take these substances to sculpt their body and appear more muscular. Side-effects include disorders of body heat regulation, stomach aches, fatigue, and impaired cardiac functioning.

In summary, physical training is still the most effective and safest means to attain and maintain fitness as well as health. No appropriate substitute has been found.

# 17: BUILDING A PERSONAL TRAINING PROGRAM

Having reviewed the principles of physical fitness theory and the practical options the gym can offer, we can combine the two and build a personal fitness program. In keeping with modern education approaches, physical education in school tries to adapt itself to the specific needs of each and every exerciser. Similarly, as the approach in this book makes clear, one training doctrine does not apply to all those who work out in the gym. Surprisingly, many gym frequenters do not have a proper training program. Working out without a plan is ineffectual because it lacks the supervision and monitoring necessary to assure proper work and training achievements. These exercisers work out according to the whim of the day and often “throw in the towel” in a relatively short time period.

A training program provides consistency, feedback, and effective time management. It strengthens determination and personal commitment, ties training to a realistic goal and instills a feeling of responsibility. A program is a form of “contract” between instructor and exerciser, with concomitant mutual responsibility.

## 17.1. THE PERSONAL QUESTIONNAIRE

Every exerciser should have a “personal file” that includes medical clearance and documents, attendance sheet, training program, and personal questionnaire. The personal questionnaire is a set of structured questions intended to elicit information necessary for determining the optimal training program. Relevant data in the questionnaire should be updated regularly. Building an individual training program is based first and foremost on essential data in the personal questionnaire that is completed by the instructor together with the exerciser.

Table 17.1. Confidential Personal Questionnaire.

|                                |                                    |                                   |
|--------------------------------|------------------------------------|-----------------------------------|
| Medical clearance valid until: |                                    | Photo of Exerciser                |
| First and Last Name            | Instructor's Name                  |                                   |
| Address                        | Type of Membership                 |                                   |
| Telephone                      |                                    |                                   |
| Date of Birth                  | Occupation/Profession              |                                   |
| Gender                         | Sports Background                  |                                   |
| Height                         | Body Type                          |                                   |
| Weight                         |                                    |                                   |
| State of Health                | Medical Restrictions               |                                   |
|                                | Regular Medications                | Training Period                   |
|                                | Perseverance                       | Training Frequency                |
| <b>PULSE</b>                   | <b>FAT MEASUREMENT PERCENTAGES</b> | <b>CIRCUMFERENCE MEASUREMENTS</b> |
| Resting:                       | Calf:                              | Gastrocnemius:                    |
| Target:                        | Thigh:                             | Quadriceps:                       |
| Maximal:                       | Hip:                               | Stomach:                          |
| Desired Range:                 | Triceps:                           | Chest:                            |
|                                | Stomach:                           | Arms:                             |
|                                | Subscapula:                        | Forearms:                         |
|                                | Chest:                             |                                   |

What does the exerciser want to achieve in the gym?

Exerciser's needs:

Training aims:

Notes:

Since the personal questionnaire includes personal details, all information must remain *confidential*. Only the personal trainer should have access to the data. A copy of the questionnaire can be appended to the exercisers' follow-up training program file so that they can work towards their stated goals during training. Questionnaires are completed by the exerciser together with the instructor, giving the instructor a first-hand opportunity to become acquainted with the exerciser and to identify specific needs from the outset.

In certain countries, entrance to the gym is not permitted without valid medical clearance. This is why *medical clearance validity* has to be noted at the top of the questionnaire. Gyms with a computerized database can use the information to notify exercisers before their medical clearance form is about to expire. It should be stated that a great deal of essential information, which can have significant consequences for developing a personal training program, is not disclosed to instructors despite the ergometric test (body functioning during exertion), which all exercisers should undergo. For this reason, instructors should work on the questionnaire in cooperation with the exercisers in order to elicit information relevant to developing a training program. The *instructor's name* should also appear on the questionnaire. Instructors serve as personal coaches and contact persons for questions throughout the training period.

It is important to have the exerciser's *address* and *phone number* for contact in case of absence. It is good communication to call, inquire about health, and encourage regular attendance. Instructors can also help to create interaction between club and exercisers by inviting the latter to social or cultural activities, including trips or parties organized by the gym, or by calling to wish them a happy birthday.

Knowing the *age* of the exercisers allows instructors to place them in the right target population. This information is also important when explaining the limitations characteristic of each age. Regarding *gender*, instructors should distinguish between males whose strength potential is greater, and females whose flexibility potential is higher.

*Resting pulse* cannot be measured in the gym since it is taken upon awakening. That means exercisers have to measure it themselves. If the gym does not lend out

a pulse-meter, exercisers can be instructed how to take their pulse. The recommended way is to place two fingers (forefinger and middle finger) on the wrist or under the jaw for fifteen seconds, then count the number of heart beats and multiply by four. By combining this data with the exerciser's age, it is possible to determine *target pulse* using the *Karvonen formula*. If it is decided to use the *Brick formula* instead, *maximal heart beat* has to be calculated and recorded by measuring heart rate at maximal effort. *Desired pulse range* reflects the actual heart rate to be expected during activity in order to realize program goals. Each pulse range serves different goals and is characterized by different energy sources. A more comprehensive explanation of pulse ranges and their connection to physical fitness programs appears in Chapter 2.

We usually do not fill in the *body type* box, since the average person is a mixture of the three generally accepted body types.

### *Body types*

**Mesomorph** – Is a term describing a muscular and athletic body type, with well-developed skeleton and muscles and stable upright posture.

**Ectomorph** – Describes a relatively thin body type, with a large surface area in comparison to weight, a narrow and slim body structure, and relatively small muscle mass for the weight.

**Endomorph** – Describes a relatively fat body type characterized by developed innards and weak muscles and skeleton.

The body type box should be completed only if there is a clear predisposition to one of these three types. In such cases, this information is important for determining the type of exercise program. The training program for an exerciser with an endomorphic structure is characterized by prolonged aerobic activity at intermediate load levels or less. On the other hand, the program for an exerciser with an ectomorphic structure needs minimal aerobic activity at medium to high load levels. An exerciser with a mesomorphic structure should have a program characterized by balanced aerobic and anaerobic activity.

A training program for the overweight exerciser is designed first and foremost to reduce fat tissue. Using *weight* and *fat percentages* and tables (Benardot, 2000), it can be determined if exercisers suffer from obvious overweight problems. Fat percentage can be measured electronically (if the gym has the equipment) or with a caliper. Using the caliper, fat folds are measured for calculating body fat percentage. This estimates only subcutaneous fat but, because of the close relationship between this and total body fat, the data can be used as an indirect measure. (For a detailed explanation of caliper measurement, refer to *Measurement and Assessment in Physical Education*, by D. Ben-Sira, G. Tennboym, and R. Lidor [1998], or *Advanced Fitness Assessment and Exercise Prescription*, by H. H. Vivian [2003]). The usual fat folds measured are as follows:

**Thigh** – Vertical fold measured on the anterior (front) side halfway between the hip joint and the knee.

**Hip** (Supraillium) – Diagonal fold to the centre of the pelvis, from the tissue above the ilial crest.

**Stomach** – Vertical fold one or two centimetres to the right of the navel.

**Underarm** (Subscapular) – Diagonal fold between the spine and the subscapular process, two centimetres from the process.

**Triceps Brachii** – Vertical fold on the posterior arm at the midpoint between the acromion process and olecranon process.

**Chest** – Men: diagonal fold midpoint between the armpit and nipple. Women: one third of this distance (closer to the armpit). If at all possible, retests should be conducted by the same instructor measuring exactly the same areas.

**Circumference** – A measure used for monitoring changes in body mass during the training program. This should be taken with a tape measure marked in millimetres. Monitoring is extremely important for exercisers because it provides them with feedback about changes taking place in the body as a result of training. Measurements are taken when muscles are relaxed. The following areas are usually measured:

**Gastrocnemius** – The broadest circumference of the muscle on the calf (to relax the muscle, measurement is taken in a sitting position with the exerciser's foot on the ground).

**Quadriceps** – The largest circumference of the muscle on the thigh.

**Belly** – At navel height.

**Hips** – At the broadest circumference.

**Chest** – At its greatest circumference.

**Arm** – Around the broadest circumference of the biceps.

**Forearm** – At the largest circumference near the elbow. It is highly recommended that the same instructor perform retests in exactly the same areas.

## State of health

This refers to the general health condition of exercisers. Do they feel well? Do they experience “positive energies” during the day? Do they experience frequent mood swings? In general, how do they feel physically: Good, weak, heavy or lumbering? These questions are intended to provide an indication of the exercisers' physical and mental health without invading privacy. The answers can help to identify weak points or limitations that may influence decisions pertaining to the design of the training program. For instance, research has found that about 10 per cent of the population in Western countries suffers from chronic depression. It is critical to elicit (with due sensitivity) whether or not the exercisers are among this segment of the population. If a tendency towards depression exists, personal attention is required at each training session. This means asking about their wellbeing and encouraging them to work out, especially on the days depression is evident (the natural tendency of these persons is to skip training when depressed). If they do come to the gym in a depressed state, it is advisable to concentrate on extra aerobic activity, which causes secretion of endorphins (a hormone similar in structure to opiates) in the brain, which alleviates depression. In case of severe depression, the entire training can be devoted to aerobic activities, providing they are types the exerciser enjoys. This symptom can be recognized with time and experience by its characteristic slow movements and reactions, lowered eyes, and general lethargy.

Knowledge about past injuries, fractures, or current limitations, etc., is essential. For example, if exercisers

are suffering from a herniated disc, the training program should not include exercises that impose pressure loads on the area. Instead, they should concentrate on numerous exercises to build up the muscles around the weakened disc area. If exercisers arrive with pain in the area of the herniated disc, *mild* aerobic activity (which alleviates pain) is advisable. However, it is crucial to avoid jolting activities (such as running or jumping). In case of injuries, physical activity in the injured area should not be totally avoided, but it should be at low exertion levels and, in extreme cases, without any resistance whatsoever, with emphasis on completing ranges of motion in the exercise. In times of injury, stress compression of the spinal vertebrae has to be avoided, and standing activities can be adapted for supine performance. For example, instead of standing presses, presses can be performed using elastic training bands while lying down. A partner standing over the exerciser holds the elastic.

As a follow-up, it is necessary to know if *medications* of any kind are taken on a regular basis. Some medications can affect pulse and blood pressure, causing changes and deviations in pulse rate during training. Therefore, changes may be attributable to the medications and not the training. It is advisable to see the instruction insert for the medication to learn about possible side-effects and to become alert to any complications.

### *Perseverance*

This question tries to clarify the exercisers' determination and tendency to a project, as reflected their perceived pain threshold. Pain threshold varies from person to person. Some exercisers feel pain during moderate exertion; others feel pain only at maximal exertion level. Exercisers need to provide information on their usual response to difficulties they encounter: do they persist until they overcome all difficulties, do they tend to give up at the slightest sign of difficulty, or are they somewhere in between? It is important to explain that truthful statements are needed to help instructors in program design. Exercisers who respond that they are usually persistent, but also tend to withdraw when they realize that the task is beyond their capabilities, should be diagnosed as "average." During training sessions, special attention should be paid to the "below

average" and the "above average" types. Exercisers whose perseverance level is below average have to receive frequent encouragement and their sessions need to be active. On the other hand, exercisers who show excessive zeal in attaining their goals may have to be "reined in" so that they avoid damage to themselves. The perseverance criterion helps to predict an exerciser's tendency to drop out or to continue training. This can be rated on a scale from 1-10, where 1 represents the lowest level of perseverance and 10 the highest. In general, an exerciser rated 1-4 on the scale is highly likely to drop out and therefore needs much reinforcement and motivational pitches. 5-6 is slightly below average with the potential to persevere. The first months are critical for such exercisers, as the best reinforcement they can receive is visible results, which will convince them to continue. Therefore it is important to maintain contact with such exercisers and make sure they do not miss sessions. 7-8 is considered average and reflects balanced exercisers aware of their abilities and ready to make the effort. They are usually patient and have the best chances of meeting their goals without getting injured. 9-10 indicates an above average level of perseverance with the potential for injuries and bodily harm during workouts.

However, in certain cases exercisers in this category may be tempted to take illegal substances or supplements that can harm their health in the short and long run. They may also have a tendency to skip meals or consume unbalanced meals. Such exercisers should be supervised and watched carefully.

### *Sport background*

The sport background takes into account the exerciser's history of physical activity. Did they engage in any sort of physical activity in the past; if so, in what framework and why did they stop? If not, why are they doing it now instead of previously? These and other questions provide information about their attitude to physical activity. This information can help us to understand the reason they left their previous sport or field of activity. It can also provide an indication of their attitude, approach, and motivation to adhere to physical activity in the future. Write impressions concisely, comparing differences in fitness levels, weight, awareness, motivation, and past

as well as present needs. For example, if an exerciser followed a physical activity regime in the past and stopped because of an injury, such a limitation must be taken into account in the new program. Care has to be taken not to overload the sensitive area. If the reason for stopping was overtraining (“I just had as much as I could”), the training program should place less emphasis on achievement and concentrate more on training variety and enjoyment. If the exerciser has no sports background, and the reason for starting now is muscle development, then it is certainly possible to develop a program to increase muscle mass while maintaining joint flexibility (barring medical limitations).

### *Occupation or profession*

It is important for determining the amount of physical activity in their daily life. Does the regular job require physical activity (e.g., mail deliverer, builder, gardener) or is the job sedentary (e.g., clerk, secretary, judge)? Work entailing physical exertion does not necessarily enhance fitness components (e.g., flexibility). Prolonged sedentary jobs may cause back pain and muscle atrophy, in which case the program requires an emphasis on aerobic activity combined with strength training and stretching. Some exercisers endure mental pressure and stress on the job (e.g., doctors, hospital nurses, prison wardens, security guards). The best program to build for them should combine stretches, aerobic activity (which helps to them to relax), strength training, and relaxation. People with jobs marked by prolonged standing should have programs that emphasize developing muscle strength combined with stretches. If the job involves a lot of walking, there is less need for aerobic activity, as the lower extremities develop strength endurance from the work. Whatever the job, the training program should include guidelines for proper nutrition.

### *Type of membership*

Membership may be individual, group, subsidized by work, etc., and can tell us something about the exerciser’s motivation. If training sessions are during work hours and subsidized by the employer, the arrangement as well as degree of intent on the part of the exerciser should be

questioned. Exercisers who register at their own expense can be assumed to have greater readiness to invest more effort in training. If exercisers register as a group, try to ensure that the entire group adheres to the program in order to provide each individual with extra social support to encourage perseverance. In general, it is important to encourage exercisers to attend training sessions from internal motivation, independent of outside factors.

Each program is designed for a two- to three-month training period, three times a week, or twenty-five consecutive training sessions four times a week. The *training period* clause should note whether the program will be quarterly (e.g., January to March) or by number of training sessions. It is important to let exercisers know immediately that there are no magic formulas or shortcuts. Only intelligent, diligent work (i.e., adhering to the training program) enables them to reach set training aims. Our intention is to ensure that exercisers forget about physical activity as a “passing incident” or a “one-off” and, instead, internalize the idea of a lifestyle change. A good training program is based on a *number of workouts per week* (usually three times, with twenty-four hours between sessions to provide muscle recovery time). Recovery occurs when muscles are developed. It is certainly possible to build a training program based on four or five times a week, depending on the type and intensity of training. This type reaches the training aims faster. Beginners are advised to start with a “three-times-a-week” program, to avoid becoming demoralized by a lack of results or overly sore muscles. A moderate program can be implemented even four times a week without undue concern.

### *What does the exerciser want to accomplish in the gym?*

This question is meant to help clarify the reason exercisers are coming to the gym. Answers should be *recorded verbatim*. Some goals may be objective and others subjective. Objective goals may pertain to medical conditions (e.g., lowering cholesterol levels, improving faulty posture). Subjective objectives may have no physical justification but simply involve the desire to overdevelop a specific, but unnecessary, fitness element, e.g., exercisers with sufficient strength for daily needs but who want to develop certain muscle groups (which

only cause physical asymmetries and perpetuate existing developmental gaps).

### *Personal needs*

These can be overt or covert, which means that we have to identify the “real needs,” which are not always the same as stated wishes. Even if objective wishes are provided, instructors can direct exercisers to consider additional needs that have been identified on the basis of professional experience. Examples of such covert needs are: correction of faulty posture, improving body proportionality, increasing muscle mass in neglected areas of the body, developing unnoticed fitness elements (e.g., flexibility, coordination), and teaching proper nutrition habits. Of course, exercisers may have already identified these, but ongoing feedback is often required to clarify them. Classic examples of needs are: losing weight, strengthening muscles, and improving a specific fitness element. Professional trainers are able to identify exercisers’ real needs and turn them into training aims.

### *Training aims*

These are the exerciser’s declared intentions after being assisted by the instructor to differentiate between the covert and the overt and the objective and the subjective reason. To complete the questionnaire on personal needs, a profound understanding of how to transform needs into aims is required. In the final analysis, exercisers’ needs should correspond to their aims. The purpose is clarification and individual distinction for goal setting. Many exercisers and trainers have difficulty in differentiating between exercisers’ needs and aims. In actual fact, the training program reflects the exerciser’s aims, which is the reason for aligning needs and aims. Only in this way do exercisers fulfill their needs and avoid inner conflict. Where gaps exist between needs and wishes, aspirations are not realized because the training program fails to address them. The result is frustration, and the decision to drop out of gym work is just a matter of time. Thus, even though the statement of needs is worded exactly the same as the aims, it is important for exercisers to understand the difference; they need to understand that their training aims should reflect their

needs, not necessarily their desires. Before preparing the training program, it is advisable to summarize the main ideas discussed about health background, sports background, and needs and aims and to coordinate expectations. This is an essential stage for ensuring harmonious communications between instructor and exerciser, needs and aims, strategy and work program.

### *Notes*

This is the place to put general notes or special information regarding the exercises.

## **17.2. THE TRAINING SESSION**

Most training programs are based on three units or sessions per week. A single session usually lasts about seventy-five minutes. This is the optimal time period for implementing the principle of perseverance in training. It is suitable for exercisers of all levels. Training programs differ in the emphasis on various exertion factors, including intensity, but duration remains constant for most. Exceptions will include special training for competitive athletes, which can last longer. For exercisers who are on a tight schedule and cannot complete a seventy-five-minute unit, the sessions can be shortened to forty-five minutes. Any less than this makes the training ineffective and often less safe. It should be noted that many exercisers do not work out according to a properly organized program. They may be unaware of the need and importance of a training program in achieving their goals. A well-scripted training program is the “jewel in the crown.” In general, people without a goal are unsuccessful. Each training session is a three-stage unit guided by the principle of progression: warm-up, training, and cool-down (relaxation).

### *The warm-up stage*

The purpose of the *warm-up* is to prepare the body systems for strenuous activity, both physically and mentally. The warm-up significantly reduces risk factors for microscopic tears, inflammations, and injuries to the kinesthetic system. In addition to raising body

temperature and pulse, it includes stretching exercises designed to improve the range of joint motion and prepare the musculo-skeletal system for exertion. There are many different ways of raising body temperature through aerobic activity on available equipment. The choice of apparatus should be based on exercisers' abilities and aims – it is the instructors' role to choose and adapt the warm-up to the exercisers' aims (see p. 82 under “Warm-up Methods”).

### *The training stage*

The main part of the session is, of course, the training stage. Despite its central role, the training stage should be the shortest of the whole unit. Developing muscle strength requires only several dozen seconds at high exertion levels. Therefore, the total time devoted to all power series for developing muscle groups should last no more than fifteen minutes. A properly organized training session containing fifteen minutes of strength training is more effective than a training session stretched out over twenty, thirty, or forty minutes with rest time and superfluous “chit-chat.”

This is the stage whereby the exerciser's aims are actually addressed using scientific principles upon which the program is based. When the aim of the program is to develop muscular strength or endurance, emphasis is on adjusting training variable quantities according to the overload principle: playing with the number of repetitions and sets in relation to rests between sets and percentages of RM<sub>1</sub>. When the aim is to increase cardiovascular capacity, the emphasis is on frequency combined with strength endurance training as the facilitating factor according to the extension principle.

### *The cool-down stage*

The *cool-down* stage, also known as the *relief* or *recovery* stage, should be an integral part of the each training session. In the cool-down, all body system parameters (pulse, temperature, metabolism) return to normal and the body is relieved of the tension, stress, and load of the training stage. This stage includes three components: moderate aerobic activity, stretches of all muscle groups

in the body, and a suitable relaxation technique. There are many different types of active and passive relaxation techniques. The choice should be made intelligently, based on the exerciser's needs. The cool-down stage marks the end of the training session and the transition to a calmer stage (see p. 84 for relaxation).

## **17.3. SCIENTIFIC TOOLS FOR BUILDING A TRAINING PROGRAM**

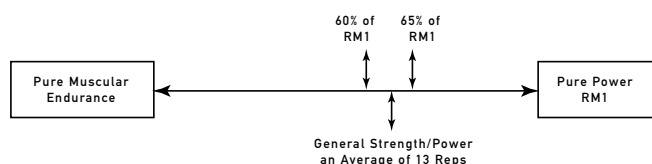
For training to be effective, the training program has to be based on each exerciser's maximal strength capacity – RM<sub>1</sub> (R is for *resistance* when measuring strength, or for *repetition* when measuring endurance, M is for *maximal*); otherwise, the training aims are not fulfilled. In cases of exercisers with little perseverance, power, or a low pain threshold, training is usually conducted below the RM<sub>1</sub> level and, thus, is not as effective. On the other hand, some exercisers with especially strong motivation or high pain thresholds (mainly women) work at a level that increases risk factors for injuries to the kinesthetic system.

It is advisable to explain the meaning of maximal strength capacity so that exercisers understand the fundamental concepts underlying the design of their training program. In one way or another, all training programs are determined by maximal strength capacity, which is always expressed as RM<sub>1</sub>. As was noted earlier, RM<sub>1</sub> is the maximal resistance (weight) that can be overcome (e.g., raised, pushed) in one repetition with safety. RM<sub>6</sub> is the maximal weight which can be raised for six consecutive repetitions, RM<sub>10</sub> for ten repetitions, and so on.

The various percentages of RM<sub>1</sub> for repetitions can be represented as a scale. For example, if we want to develop the strength component, we can perform up to six repetitions at 75 per cent or more of RM<sub>1</sub>. For working more on muscular endurance, we can schedule repetitions from twenty and up, at 50 per cent or less of RM<sub>1</sub>. By adhering to the overload principle, we can change the relationship between exertion factors. The associations among loads in the number of repetitions for each exercise, the number of sets, the tempo of activity, and the rest intervals between sets is directed towards the training aims and desired fitness components.

Many exercisers want to improve general strength or to be “stronger.” The term “strength” is borrowed from the idea of substance strength and is, therefore, inaccurate in this context. The term “strength” in the context of physical training expresses general strength which is thirteen repetitions at an average resistance of 60 to 65 per cent of RM<sub>1</sub>. This is the most effective range for hypertrophic reaction (increase in muscle mass). Illustration 17.1 presents a theoretical scale with RM<sub>1</sub> at one end and *pure muscular endurance* (as measured by the maximal number of repetitions that can be performed at minimum resistance) at the other end. The strength component appears on the scale at an average of thirteen repetitions and an average resistance of 60 to 65 per cent of RM<sub>1</sub>.

Illustration 17.1. The relationship between pure muscular power and pure muscular endurance.



Each of the five basic fitness components requires a different stimulus threshold in order to be improved:

**Strength** – 50 per cent or more of RM<sub>1</sub>.

**Flexibility** – 95 per cent or more of optimal/maximal range.

**Aerobic fitness** – Mainly from 70 per cent or more of optimal/maximal pulse.

**Coordination and speed** – 100 per cent of optimal/maximal ability.

Below this stimulus threshold we are dealing with physical activity and not physical training.

The various programs to improve cardiovascular capacity appearing in Chapter 3 offer a number of suggestions for achieving the aims described thus far. It is possible to combine the principles of several training methods when tailoring a training program appropriate for an individual

exerciser (see Table 17.2 to determine the number of desired repetitions in relation to the percentage of RM<sub>1</sub>).

## Determining RM<sub>1</sub>

Determining the maximal capacity of each and every muscle is an important tool for developing a training program. Maximal capacity or RM<sub>1</sub> reflects maximal resistance a muscle can apply in one repetition. Obviously, as muscles become stronger, the RM<sub>1</sub> also rises. Therefore, it needs to be revised every three months.

A developing muscle needs a minimum stimulus threshold of 60 to 65 per cent of RM<sub>1</sub> to develop strength. Exercisers who work at 50 per cent RM<sub>1</sub> do indeed strengthen their muscles, but they do not increase their mass (muscle volume). Hypertrophy (an increase of muscle mass) usually occurs only after work at 75 to 85 per cent RM<sub>1</sub>. This explains the importance of determining each exerciser's RM<sub>1</sub> in building a suitably adapted training program, and the reason it must be updated according to training aims.

## TWO METHODS OF DETERMINING RM<sub>1</sub>

### *Trial and error method*

This is mainly intended for advanced exercisers. They begin at average resistance on each apparatus and gradually raise resistance to their maximal capacity threshold. Experimentation continues until exercisers reach the point at which they can no longer overcome the resistance in one repetition. Using this method, the maximal weight an exerciser can overcome is the RM<sub>1</sub>. It is advisable to rest about three minutes between tests so that muscles can fully recover. This method is not recommended for beginners, who are more vulnerable to injuries such as microscopic tears or inflammation, and who lack experience in neutralizing body movement and swinging compensation. The salient advantage of this method is its precision.

Table 17.2. Training Aims and Main Training Variables.

| TRAINING VARIABLE<br>AIM                                                                    | RESISTANCE<br>LOAD AS<br>PERCENTAGE<br>OF RM1 | NUMBER OF<br>REPETITIONS<br>IN EACH<br>EXERCISE | NUMBER OF<br>SETS | PACE OF<br>ACTIVITY | REST<br>INTERVAL<br>BETWEEN<br>SETS |
|---------------------------------------------------------------------------------------------|-----------------------------------------------|-------------------------------------------------|-------------------|---------------------|-------------------------------------|
| MAXIMAL STRENGTH                                                                            | 80–100%                                       | 1–5                                             | 3–5               | slow                | 2–5 min                             |
| EXPLOSIVE STRENGTH                                                                          | 40–80%                                        | 6–10                                            | 4–6               | very fast           | 2–5 min                             |
| MUSCULAR ENDURANCE                                                                          | 40–70%                                        | 15–30                                           | 3–4               | medium              | 1–2 min                             |
| DEVELOPMENT OF<br>PHYSICAL FITNESS<br>WITH EMPHASIS ON<br>AEROBIC AND MUSCULAR<br>ENDURANCE | 20–40%                                        | 40–50                                           | 3–5               | fast                | 1–2 min                             |
| BODYBUILDING                                                                                | 50–80%                                        | 10–15                                           | 5–10              | slow                | 60–90 sec                           |

Table 17.3. Repetitions/power Relationship for RM1.

| RM     | PERCENTAGE<br>OF<br>RESISTANCE<br>FROM RM1 | NUMBER OF<br>REPETITIONS | LEVEL OF PREDICTION PRECISION                                 |
|--------|--------------------------------------------|--------------------------|---------------------------------------------------------------|
| RM1    | 100%                                       | 1                        | Very precise                                                  |
| RM2    | 95%                                        | 2                        |                                                               |
| RM3    | 90%                                        | 3                        |                                                               |
| RM4    | 85%                                        | 4                        | Precise, good predictor, harmless                             |
| RM5–6  | 80%                                        | 5–6                      |                                                               |
| RM7–8  | 75%                                        | 7–8                      |                                                               |
| RM9–10 | 70%                                        | 9–10                     | The lower we go from RM6, the less precise is the prediction. |

Table 17.4. Cell Components and their Contribution to Cell Growth.

| DEVELOPING CELL COMPONENTS | % OF CELL SIZE | TYPE OF STIMULUS                   |
|----------------------------|----------------|------------------------------------|
| Myofibrils                 | 20–30          | Strength, 6–12 repetitions         |
| Sarcoplasm                 | 20–30          | Strength + endurance               |
| Mitochondria               | 15–25          | Endurance, 20 repetitions and more |
| Fatty deposits             | 10–15          | Rest + diet, endurance             |
| Other components           | 4–7            | Strength, endurance, rest, diet    |
| Capillaries                | 3–5            | Endurance + prolonged stress       |
| Glycogen                   | 2–3            | Low-fat diet                       |
| Connective tissue          | 2–3            | Strength                           |

## Prediction method

This is intended for beginners, exercisers returning after an extended break, non-competitive exercisers, and those with injuries or cardiovascular diseases. RM<sub>1</sub> is calculated according to the table of proportions between repetitions and strength. The closer resistance is to maximum and the smaller the number of repetitions, the more precise the prediction.

Table 17.3 presents the relationship between number of repetitions and resistance, which is determined by the fitness components in the training aims (e.g., maximal power, strength, endurance).

Since it is not always possible to determine RM<sub>1</sub> directly, it can be predicted using RM<sub>5–6</sub>, which is equivalent to 80 per cent of RM<sub>1</sub>. This is the optimal intensity in terms of lower risk factors for injury and good predictive ability. Thus, if an exerciser's RM<sub>6</sub> = 80 kg, then 80 kg resistance is 80 per cent of his or her RM<sub>1</sub>. RM<sub>1</sub> in this case is calculated using a triple value (80 times 100, divided by 80) and in this way RM<sub>1</sub> will be 100 kg.

A common mistake is to calculate RM<sub>1</sub> directly from the resistance level of RM<sub>6</sub> (80 kg in our case) by supplementing the remaining 20 per cent. The result of such a calculation is 96 kg, which is incorrect.

## Cell components and their contribution to cell growth

A training program should take into account cell components that respond to training. If increased muscle mass is desired, it is not enough to work on strength training. This mainly stimulates the *myofibrils* (muscle fibres) which make up only 30 per cent of the cell. Endurance training should be included to stimulate the *mitochondria* (power stations) and *sarcoplasm* (cell fluid), which together comprise 55 per cent of the cell. Understanding the interrelationships among the specific types of physical activity and cell components enables exercisers to understand the processes occurring inside muscle cells. Instructors should explain these relationships to help exercisers attain training aims and desired results.

## 17.4. BUILDING A TRAINING PROGRAM

After the personal questionnaire has been completed, the training program can be designed in the following order and based on these considerations.

In the first week of training, exercisers are introduced to the apparatus. It is important for beginners to try out equipment that is relatively easy to operate without special knowledge or technical skills. This should include a comprehensive explanation of operating instructions and safety procedures. Emphasis should be on proper structured performance, rather than on intensity.

Recommended apparatus for this purpose are: fitness bike or treadmill, upper pulley, chest press, and knee extensors and flexors. The work on these apparatus activate large rather than small muscle groups and, therefore, avoids causing premature fatigue. In addition to performing the exercise, exercisers should understand the aim of the activity, and the relationship between the work and health benefits. Only after they have acquired basic knowledge and understanding of the ways in which the apparatus operates can they work with instructors to set goals and decide on appropriate exercises. When planning an annual training program for professional athletes, training should be divided into four seasons according to the principle of progression: preparation, transition, competition, and off-season. During the preparatory season, the emphasis is on building general fitness. The transition season should allow for a gradual shift from the emphasis of the preparatory season to that of the competitive season. During the competitive season, emphasis is placed on the specific activity performed in competition. Off-season provides time for physical and mental rest from the specific training, while continuing with some sort of activity that keeps physical fitness a “glowing ember” that can be “reignited” next season. Balance should be a central consideration in building a training program. One important type of balance assures a correct mix of activity intensity and fitness components. The most common mistake made by many instructors is to emphasize a certain fitness element, especially strength or cardiovascular capacity, while downplaying or ignoring other fitness elements (flexibility, coordination, and agility). Flexibility enables us to express our movement abilities properly and reduces risk factors for injury (cramps). Coordination

and agility are reflected in everyday functioning and affect a person's image. It is also important to maintain a balance in muscle tone between frontal and posterior muscles. Lack of balance is visible in posture disorders such as kyphosis (sunken shoulders and round back). A lack of balance between upper and lower parts of the body take the form of "chicken legs," that is exaggerated chest and arms atop spindly legs. To summarize, lack of balance can be both visible and functional.

Once it has been decided that the training program includes the use of a specific apparatus, exercisers need to become better acquainted with it. Various training principles presented in Chapter 3 can be used to meet exertion factor requirements. Obviously, the program should be chosen to meet individual needs. Many exercisers want advanced and difficult programs (e.g., *California sets* or the *Oxford method*), which can cause injuries and are certainly not suitable for their beginner abilities. We should advise beginners who want to develop muscle strength to follow the *Deloram method*: perform ten repetitions at 75 per cent of RM<sub>10</sub> and then ten repetitions at 100 per cent of RM<sub>10</sub>, a total of three sets for each exercise.

Maximal strength abilities can be determined after about two weeks of training and subsequent adjustment. A common mistake among instructors is to succumb to pressure from the client and seek maximal power levels much earlier. Attempting to determine maximal abilities before exercisers know and fully understand the apparatus, or adhere to safety regulations, very often results in injuries. Instructors should follow the principle of gradual progression from the initial stages in the gym and tailoring training programs for exercisers. Once instructors have had time to become better acquainted with exercisers' abilities and skills for operating the apparatus, maximal power abilities can be determined. These abilities vary from one muscle group to another, from one person to another, and from apparatus to apparatus.

The so-called "follow-up card," as well as the training program, should be updated for each training period. The body is endowed with the physiological ability to adapt to inherent exertions and resistances. When the load placed on the body no longer provides sufficient stimulus, the body stops improving. Muscles need significant exertion and repetitive stimulation (sets) to continue to

develop, become stronger, and grow. It is not enough to revise only the loads; the number of repetitions and/or sets and/or recovery times between sets and/or the number of sessions per week need to be revised as well. These amendments should be based on the exerciser's rate of advancement (adaptation) towards the training program goals while adhering to the principles of overload, gradual progression, and perseverance. In order to achieve the desired results, exercisers need to be patient and complete the entire training period.

### *Training program follow-up card*

This allows instructors to monitor the training program and its implementation. It forms the continuation or second part of the personal questionnaire. Relevant details on the card allow both exercisers and instructors to adhere to program aims without skipping or forgetting program stages or muscle groups. The training program on the follow-up card in Table 17.5 is an example of a general training program.

Using this structure allows us to clearly record any training program. The exercises or order of activities can be altered according to the training aims. The card is structured as follows.

A number of apparatus are suited to the *warm-up stage* (bike, treadmill, stepper, or E.F.X.) according to the training aims. During the *training stage*, it is important to include most of the muscle groups in the body. The follow-up card should record the relevant exercises and specific apparatus used for this purpose. The cool-down stage includes moderate aerobic activity, stretches, and relaxation using the method of choice. Listing the *major muscle groups* reminds exercisers to focus on specific muscles. The relevant exertion factors for each exercise should also be listed in order to reach the desired goals.

Table 17.5. Training Program Follow-up Card.

WARM-UP

| MAJOR MUSCLE GROUPS | APPARATUS | EXERCISE                        | EXERTION FACTORS                  | DATE |
|---------------------|-----------|---------------------------------|-----------------------------------|------|
| Legs                |           | Aerobic activity                | Duration-Tempo-Resistance-Program |      |
| Entire body         |           | Stretches for each muscle group |                                   |      |

TRAINING SESSION

| MAJOR MUSCLE GROUPS |                    | APPARATUS | EXERCISE         | EXERTION FACTORS | DATE |
|---------------------|--------------------|-----------|------------------|------------------|------|
| Legs                | 1. knee extensors  |           | knee extensions  | resistance       |      |
|                     |                    |           |                  | repetitions      |      |
|                     |                    |           |                  | sets             |      |
|                     | 2. knee flexors    |           | knee flexions    | resistance       |      |
|                     |                    |           |                  | repetitions      |      |
|                     |                    |           |                  | sets             |      |
|                     | 3. knee extensors  |           | leg presses      | resistance       |      |
|                     |                    |           |                  | repetitions      |      |
|                     |                    |           |                  | sets             |      |
| Arms                | 4. elbow flexors   |           | elbow flexions   | resistance       |      |
|                     |                    |           |                  | repetitions      |      |
|                     |                    |           |                  | sets             |      |
|                     | 5. elbow extensors |           | elbow extensions | resistance       |      |
|                     |                    |           |                  | repetitions      |      |
|                     |                    |           |                  | sets             |      |

Continue Table 17.5. Training Program Follow-up Card.

|                 |                           |  |                          |                            |  |
|-----------------|---------------------------|--|--------------------------|----------------------------|--|
| Abdomen         | 6. abdomen                |  | sit ups                  | resistance                 |  |
|                 |                           |  |                          | repetitions                |  |
|                 |                           |  |                          | sets                       |  |
| Chest           | 7. chest                  |  | horizontal arm adduction | resistance                 |  |
|                 |                           |  |                          | repetitions                |  |
|                 |                           |  |                          | sets                       |  |
| Legs            | 8. thigh adductors        |  | thigh adduction          | resistance                 |  |
|                 |                           |  |                          | repetitions                |  |
|                 |                           |  |                          | sets                       |  |
|                 | 9. thigh abductors        |  | thigh abduction          | resistance                 |  |
|                 |                           |  |                          | repetitions                |  |
|                 |                           |  |                          | sets                       |  |
| Shoulders       | 10. shoulder              |  | arm abduction            | resistance                 |  |
|                 |                           |  |                          | repetitions                |  |
|                 |                           |  |                          | sets                       |  |
| Back            | 11. scapula and trapezius |  | scapula adduction        | resistance                 |  |
|                 |                           |  |                          | repetitions                |  |
|                 |                           |  |                          | sets                       |  |
| Cardio-vascular | 12. rope                  |  | skipping rope            | ten seconds, to one minute |  |

COOL-DOWN

|                                 |                                          |                                                                  |  |
|---------------------------------|------------------------------------------|------------------------------------------------------------------|--|
| Stretches for all muscle groups | Appropriate background music can be used | Moderate aerobic activity, stretches, Jacobson relaxation method |  |
|---------------------------------|------------------------------------------|------------------------------------------------------------------|--|

## 17.5. SAMPLE SPECIFIC TRAINING PROGRAM – ADULT BEGINNER LEVEL

The training program for adult beginner levels includes a completed personal questionnaire. It is based on many years of experience, which have proven that this method achieves the best results with minimal injury. It is a recommendation only and does not rule out other methods. The aims of the program are to:

1. Build a physical fitness base.
2. Increase muscle mass.
3. Teach the exerciser to work on all muscle groups and fitness elements.
4. Heighten awareness and motivation for physical training.
5. Enable all beginning exercisers to succeed in the challenge of persevering.

It is also useful for those who have exercised in the past and wish to begin again and for those who are returning after injury.

For the warm-up stage, we use the recumbent bicycle, as this is the easiest of all the aerobic apparatus. If the main exertion factor is duration, exercisers pedal for about twenty-five minutes at 60 rpm. The treadmill can be used for aerobic activity if that is the aim and if exercisers can continue for twenty-five minutes. Although bicycling or walking on the treadmill for this amount of time may seem impossible to some adult beginners, after a number of sessions they find that it is achievable. We can encourage exercisers by reminding them that this training load burns significant quantities of calories. To make it easier for exercisers to complete the twenty-five-minute task, we prefer not to work on the load factor of exertion, which is secondary in importance to duration. If exercisers' fitness levels improve during the training period, load can be increased to suit their new fitness level and aims. After the aerobic activity, we add seven to ten minutes of stretches to the warm-up, which should take about thirty-five minutes of the overall time. In some cases, beginning exercisers are exhausted at the end of the warm-up and are too tired to continue with the training stage. In such cases, many instructors tend to "give in" and shorten the warm-up stage. Such concessions are enormously

damaging educationally: they weaken exercisers' long-term perseverance, accustom them to negotiating about workload, allow them to think there are shortcuts in training, encourage them to indulge in self-leniency, and, in some extreme cases, to "wallow in self-pity." It is preferable that beginner exercisers find it difficult to complete the prescribed training stage, as long as they adhere to the principles of perseverance and gradual progression. They should not give up on following set program aims.

Some exercisers feel uneasy because they tend to perspire excessively, and others feel uncomfortable seeing their flabbiness jiggle about during moderate aerobic activity. For these individuals, aerobic exercises in water might be more comfortable. In clubs with pools, moderate swimming can be combined as part of the aerobic stage of warm-up. However, it is important to remember that sitting in a sauna or steam room is no substitute for a warm-up. It is merely a passive means of losing fluids.

At the end of the warm-up, technical performance and the ability to mobilize muscular motor units become better while risk factors are significantly reduced. Having succeeded in rising to the warm-up "challenge" without discounts or concessions, exercisers can proceed to the next stage.

The training stage is composed of nine stations in four rotations (see p. 29 under the "rounds method"). It is important to perform these exercises according to the principle of gradual progression, as noted on the follow-up sheet. Incidentally, the literature recommends three to six sets for optimal improvement of muscle strength among the general population (excluding athletes).

The training can be described in serial form as: 4 x 12345678. After three months of adaptation, it is possible to alter the program to a more advanced level. The training stage can be built as a combination of the "rounds" and "body distribution" methods, applying the overload principle. For example, training according to muscle group order 247247 includes: *Standing barbell biceps curl*, *Machine seated leg extension*, *Seated lat pulldown*, and again *Standing barbell biceps curl*, *Machine seated leg extension*, *Seated lat pulldown*. This

kind of serial combination means repeatedly loading the same muscle group and raising the stimulus threshold (increasing loads), increasing the number of repetitions, and shortening rest periods. As exercisers progress, the “sets” or any other method can be substituted. The cool-down stage includes moderate aerobic activity, jogging on a treadmill, stretching body joints according to the instructions, and relaxation using the Jacobson method.

The duration of the three stages of a training session is about an hour and a quarter. The program should be carried out three times a week, preferably with a twenty-four-hour break between sessions. Exercisers should adhere closely to a program like this one for a period of three months. It is advisable to drink water as needed.

## **17.6. SAMPLE SPECIFIC TRAINING PROGRAM – CHILD BEGINNER LEVEL**

The training program for the child beginner level includes a completed personal questionnaire. It is based on many years of experience, which have proven that this method achieves the best results with minimal injury. However, it is a recommendation only and does not rule out other methods. The aims of the program are to:

1. Improve physical activity component (e.g., strength, coordination, flexibility, endurance).
2. Improve motor performance skills.
3. Improve body composition.
4. Improve bone health.
5. Lose unwanted pounds to help overweight kids.
6. Enable all beginning exercisers to succeed in the challenge of persevering.

For the warm-up stage, we use the recumbent bicycle or treadmill, as this is the easiest of all the aerobic apparatus. If the main exertion factor is duration, exercisers pedal for about twenty minutes at 60 rpm. The treadmill can be used for aerobic activity if that is the aim and if exercisers can continue for twenty minutes. Although bicycling or walking on the treadmill for this amount of time may seem impossible to some child beginners, after a number of sessions they find that it is achievable. We can encourage exercisers by reminding them that this training load burns significant quantities of calories. To make it easier for exercisers to complete

the twenty-minute task, we prefer not to work on the load factor of exertion, which is secondary in importance to duration. If exercisers’ fitness levels improve during the training period, load can be increased to suit their new fitness level and aims. After the aerobic activity, we add seven to ten minutes of stretches to the warm-up. The total warm-up should take about twenty-five to thirty minutes. In some cases, beginning exercisers are exhausted at the end of the warm-up, and are too tired to continue with the training stage. In such cases, many instructors tend to “give in” and shorten the warm-up stage. Such concessions are enormously damaging educationally: they weaken exercisers’ long-term perseverance, accustom them to negotiating about workload, allow them to think there are shortcuts in training, encourage them to indulge in self-leniency, and, in some extreme cases, to “wallow in self-pity.” It is preferable that beginner exercisers find it difficult to complete the prescribed training stage, as long as they adhere to the principles of perseverance and gradual progression. They should not give up on following set program aims.

Some exercisers feel uneasy because they tend to perspire excessively, and others feel uncomfortable seeing their flabbiness jiggle about during moderate aerobic activity. For these individuals, aerobic exercises in water might be more comfortable. In clubs with pools, moderate swimming can be combined as part of the aerobic stage of warm-up. However, it is important to remember that sitting in a sauna or steam room is no substitute for a warm-up. It is merely a passive means of losing fluids.

At the end of the warm-up, technical performance and the ability to mobilize muscular motor units become better while risk factors are significantly reduced. Having succeeded in rising to the warm-up “challenge” without discounts or concessions, exercisers can proceed to the next stage.

The training stage is composed of nine stations in four rotations (see p. 29 under the “rounds method”). It is important to perform these exercises according to the principle of gradual progression, as noted on the follow-up sheet. Incidentally, the literature recommends three to six sets for optimal improvement of muscle strength among the general population (excluding athletes).

Table 17.6. Personal questionnaire for adult program.

**CONFIDENTIAL PERSONAL QUESTIONNAIRE**

|                                                                                                                                                                    |                                   |                         |                                           |                             |                                  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|-------------------------|-------------------------------------------|-----------------------------|----------------------------------|
| NAME OF GYM                                                                                                                                                        |                                   | ☐ DATE                  |                                           |                             |                                  |
| DOCTOR'S APPROVAL VALID UNTIL ☐ PHOTO                                                                                                                              |                                   |                         |                                           |                             |                                  |
| FIRST NAME                                                                                                                                                         | DATE OF BIRTH<br>1970             | ADDRESS                 |                                           |                             |                                  |
| LAST NAME                                                                                                                                                          | SEX<br>Male                       | TELEPHONE               |                                           |                             |                                  |
| RESTING HEART BEAT<br>— 77                                                                                                                                         | HEALTH<br>CONDITION<br><br>Normal | MEDICATIONS<br><br>none | MEDICAL<br>LIMITATIONS<br><br>none        | PERSEVERANCE<br><br>Average | BODY BUILD<br><br>Average, sound |
| TARGET HEART BEAT<br>—153                                                                                                                                          |                                   |                         | WEIGHT<br><br>77<br><br>HEIGHT<br><br>174 |                             |                                  |
| MAXIMAL HEART BEAT<br>—                                                                                                                                            |                                   |                         |                                           |                             |                                  |
| DESIRED RANGE<br>OF HEART BEAT<br>— 70%                                                                                                                            |                                   |                         |                                           |                             |                                  |
| SPORTS BACKGROUND Irregular, sporadic                                                                                                                              |                                   |                         | LENGTH OF TRAINING January-March          |                             |                                  |
| OCCUPATION Lawyer                                                                                                                                                  |                                   |                         | FREQUENCY OF TRAINING Three times a week  |                             |                                  |
| TYPE OF MEMBERSHIP Private                                                                                                                                         |                                   |                         |                                           |                             |                                  |
| FAT MEASUREMENT PERCENTAGES calf _____ thigh _____ hip _____ triceps _____ stomach _____ underarm _____ chest _____                                                |                                   |                         |                                           |                             |                                  |
| CIRCUMFERENCE MEASUREMENTS gastrocnemius _____ quadriceps _____ stomach _____ thorax _____ arms _____ forearms _____                                               |                                   |                         |                                           |                             |                                  |
| WHAT DOES THE EXERCISER WANT TO ACHIEVE IN THE EXERCISE ROOM?<br>a) Lose weight; b) Bodybuilding and development c) Improve fitness                                |                                   |                         |                                           |                             |                                  |
| EXERCISER'S NEEDS<br>a) Improve fitness elements (especially cardiovascular endurance); b) Bodybuilding and development; c) Lose weight; d) Improve faulty posture |                                   |                         |                                           |                             |                                  |
| AIMS OF TRAINING<br>a) Improve fitness elements (including cardiovascular endurance); b) Bodybuilding and development; c) Lose weight; d) Improve faulty posture   |                                   |                         |                                           |                             |                                  |
| NOTES-                                                                                                                                                             |                                   |                         |                                           |                             |                                  |

Table 17.7. Follow-up card of the training program for adults.

|                                        |                     |                |                        |                                     |      |      |
|----------------------------------------|---------------------|----------------|------------------------|-------------------------------------|------|------|
| FOLLOW-UP CARD OF THE TRAINING PROGRAM |                     |                | NAME OF EXERCISER      |                                     |      |      |
| (Name Of Gym)                          |                     |                | PHOTO                  |                                     |      |      |
| STAGE IN TRAINING SESSION              | MAJOR MUSCLE GROUPS | APPARATUS      | EXERCISE               | ENDURANCE FACTORS                   | DATE | DATE |
| WARM-UP                                | legs                | recumbent bike | recumbent cycle (14.4) | Resistance-<br>According to ability |      |      |
|                                        |                     |                |                        | Pace-<br>60 RPM                     |      |      |
|                                        |                     |                |                        | Duration-<br>25 minutes             |      |      |

STRETCHES FOR EACH MUSCLE GROUP

|                  |         |                         |                             |                                       |                                   |  |  |
|------------------|---------|-------------------------|-----------------------------|---------------------------------------|-----------------------------------|--|--|
| TRAINING SESSION | Legs    | Thigh- quadriceps       | Knee extension on apparatus | 1. Machine seated leg extension (6.3) | Resistance<br>Repetitions<br>Sets |  |  |
|                  | Arms    | Biceps brachii          | Standard bar                | 2. Standing barbell biceps curl (9.3) | Resistance<br>Repetitions<br>Sets |  |  |
|                  | Abdomen | Abdominal muscles       | Mattress                    | 3. Supine bent-knee crunch (7.1)      | Resistance<br>Repetitions<br>Sets |  |  |
|                  | Chest   | Chest and posterior arm | Chest press on apparatus    | 4. Machine seated chest press (8.1)   | Resistance<br>Repetitions<br>Sets |  |  |

Continue Table 17.7

| STAGE IN TRAINING SESSION |                                 | MAJOR MUSCLE GROUPS | APPARATUS                                | EXERCISE                                                                          | ENDURANCE FACTORS                 | DATE | DATE |
|---------------------------|---------------------------------|---------------------|------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------|------|------|
|                           | Legs                            | Hamstrings          | Knee flexors on apparatus                | 5. Machine seated leg curl (6.4)                                                  | Resistance<br>Repetitions<br>Sets |      |      |
|                           | Shoulders                       | Shoulder girdle     | Upper pulley                             | 7. Seated lat pulldown (11.2)                                                     | Resistance<br>Repetitions<br>Sets |      |      |
|                           | Back                            | Scapular adduction  | Lower pulley                             | 8. Seated low pulley cable crossover scapular retraction (13:11)                  | Resistance<br>Repetitions<br>Sets |      |      |
|                           | Cardiovascular                  | Legs                | rope                                     | 9. jumping rope                                                                   | about half a minute               |      |      |
| Cool-down                 | Stretches for all muscle groups |                     | Appropriate background music can be used | Moderate aerobic activity, stretches, relaxation according to the Jacobson method |                                   |      |      |

Table 17.8. Personal questionnaire for children’s program.

CONFIDENTIAL – PERSONAL QUESTIONNAIRE

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                 |                     |                                                                                                                                                                                                                                                                                                                                   |                    |          |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|----------|
| NAME OF GYM                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                 |                     |                                                                                                                                                                                                                                                                                                                                   |                    |          |
| MEDICAL CLEARANCE VALID UNTIL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                 |                     |                                                                                                                                                                                                                                                                                                                                   | PHOTO OF EXERCISER |          |
| INSTRUCTOR'S NAME                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                 |                     |                                                                                                                                                                                                                                                                                                                                   |                    |          |
| FIRST AND LAST NAME                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | DATE OF BIRTH   | GENDER              | ADDRESS                                                                                                                                                                                                                                                                                                                           |                    |          |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                 |                     | TELEPHONE                                                                                                                                                                                                                                                                                                                         |                    |          |
| RESTING PULSE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | STATE OF HEALTH | REGULAR MEDICATIONS | MEDICAL RESTRICTIONS                                                                                                                                                                                                                                                                                                              | PERSEVERANCE       | BODYTYPE |
| TARGET PULSE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                 |                     |                                                                                                                                                                                                                                                                                                                                   |                    |          |
| MAXIMAL PULSE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                 |                     |                                                                                                                                                                                                                                                                                                                                   |                    |          |
| DESIRED PULSE RANGE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                 |                     | HEIGHT                                                                                                                                                                                                                                                                                                                            |                    |          |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                 |                     | WEIGHT                                                                                                                                                                                                                                                                                                                            |                    |          |
| SPORTS BACKGROUND    No sport background. Beginners.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                 |                     | TRAINING PERIOD                                                                                                                                                                                                                                                                                                                   |                    |          |
| OCCUPATION/PROFESSION    student                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                 |                     | January to March                                                                                                                                                                                                                                                                                                                  |                    |          |
| TYPE OF MEMBERSHIP    Private                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                 |                     | TRAINING FREQUENCY                                                                                                                                                                                                                                                                                                                |                    |          |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                 |                     | Three times per week on non-consecutive days                                                                                                                                                                                                                                                                                      |                    |          |
| FAT MEASUREMENT MERCENTAGES    calf ____ thigh ____ hip ____ triceps ____ stomach ____ subscapula ____ chest ____                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                 |                     |                                                                                                                                                                                                                                                                                                                                   |                    |          |
| CIRCUMFERENCE MEASUREMENTS    gastrocnemius ____ quadriceps ____ stomach ____ chest ____ arms ____ forearms ____                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                 |                     |                                                                                                                                                                                                                                                                                                                                   |                    |          |
| WHAT DOES THE EXERCISER WANT TO ACHIEVE IN THE GYM?                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                 |                     |                                                                                                                                                                                                                                                                                                                                   |                    |          |
| <b>EXERCISER'S NEEDS - FAST FACTS:</b> <ul style="list-style-type: none"><li>• Adult supervision is the most important safety factor in strength training.</li><li>• Children will gain strength, but muscle size will not increase until after puberty.</li><li>• A good program emphasizes proper form and technique rather than competition</li></ul> 1. improve physical activity component (strength, coordination, flexibility, endurance)<br>2. improve motor performance skills<br>3. improve body composition<br>4. improve bone health.<br>5. lose unwanted pounds help overweight kids<br>6. gaining more self confidence |                 |                     | <b>TRAINING AIMS</b> <ul style="list-style-type: none"><li>1. Improve physical activity component (strength, coordination, flexibility, endurance)</li><li>2. Improve motor performance skills</li><li>3. Improve body composition</li><li>4. Improve bone health.</li><li>5. Lose unwanted pounds help overweight kids</li></ul> |                    |          |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                 |                     | <b>NOTES</b>                                                                                                                                                                                                                                                                                                                      |                    |          |

Table 17.9 Training program follow-up card for children's program.

| <b>TRAINING PROGRAM FOLLOW-UP CARD</b><br>(Name of Gym) |                                 |                                 | <b>NAME OF EXERCISER</b><br><br><b>PICTURE</b> |                                                                                       |                                                            |      |  |
|---------------------------------------------------------|---------------------------------|---------------------------------|------------------------------------------------|---------------------------------------------------------------------------------------|------------------------------------------------------------|------|--|
| STAGE OF TRAINING SESSION                               | MAJOR MUSCLE GROUPS             | APPARATUS                       | EXERCISE                                       | EXERTION FACTORS                                                                      | DATE                                                       | DATE |  |
| <b>WARM-UP</b>                                          | legs                            | Treadmill or recumbent bicycle  | Aerobic activity                               | Duration – 20 min<br>Tempo – moderate<br>Resistance<br>Program – According to ability |                                                            |      |  |
|                                                         | Entire body                     | Stretches for each muscle group | Chose from list                                |                                                                                       |                                                            |      |  |
|                                                         | Stretches for each muscle group |                                 |                                                |                                                                                       |                                                            |      |  |
| <b>TRAINING SESSION</b>                                 | 1. Shoulder girdle              | Upper pulley                    | Seated lat pulldown (11.2)                     | Resistance 50% RM <sub>1</sub>                                                        |                                                            |      |  |
|                                                         |                                 |                                 |                                                | Repetitions 12                                                                        |                                                            |      |  |
|                                                         |                                 |                                 |                                                | Sets- 2                                                                               |                                                            |      |  |
|                                                         | 2. Legs                         |                                 |                                                | Squat – without barbell (6.9)                                                         | 60% from Repetition Maximum Resistance Against body weight |      |  |
|                                                         | 3. Abdominal                    | Mattress                        |                                                | Supine bent – knee crunch (7.1)                                                       | 60% from Repetition Maximum Resistance Against body weight |      |  |
|                                                         | 4. Scapular                     | low pulley cable crossover      | Seated scapular retraction (13.11)             | Resistance 50% RM <sub>1</sub>                                                        |                                                            |      |  |
|                                                         |                                 |                                 |                                                | Repetitions 12                                                                        |                                                            |      |  |
|                                                         |                                 |                                 |                                                | Sets- 2                                                                               |                                                            |      |  |
|                                                         | 5. Legs                         | Machine seated                  | Seated leg extension 6.3                       | Resistance 50% RM <sub>1</sub>                                                        |                                                            |      |  |
|                                                         |                                 |                                 |                                                | Repetitions 12                                                                        |                                                            |      |  |
|                                                         |                                 |                                 |                                                | Sets- 2                                                                               |                                                            |      |  |
|                                                         | 6. Hands & Shoulders and Back   | hand ergometer                  |                                                | Activity on hand ergometer 14.6                                                       | ten seconds, to 20 seconds                                 |      |  |

Continue Table 17.9

| STAGE OF TRAINING SESSION | MAJOR MUSCLE GROUPS             | APPARATUS                                | EXERCISE                                                         | EXERTION FACTORS                                           | DATE | DATE |
|---------------------------|---------------------------------|------------------------------------------|------------------------------------------------------------------|------------------------------------------------------------|------|------|
| TRAINING SESSION          | 7. legs                         | Machine seated                           | Leg curl 6.4                                                     | Resistance 50%RM <sub>1</sub>                              |      |      |
|                           |                                 |                                          |                                                                  | Repetitions 12                                             |      |      |
|                           |                                 |                                          |                                                                  | Sets- 2                                                    |      |      |
|                           | 8. Hands & Shoulders and Back   | Low pulley                               | seated row 11.7                                                  | Resistance 50%RM <sub>1</sub>                              |      |      |
|                           |                                 |                                          |                                                                  | Repetitions 12                                             |      |      |
|                           |                                 |                                          |                                                                  | Sets- 2                                                    |      |      |
|                           | 9. Abdominal                    | Mattress                                 | Supine bent-knee sit-up with twist/cross 7.8                     | 60% from Repetition Maximum Resistance Against body weight |      |      |
| COOL-DOWN                 | Stretches for all muscle groups | Appropriate background music can be used | Moderate aerobic activity, stretches, Jacobson relaxation method |                                                            |      |      |

## 17.7. COMMON MISTAKES EXERCISERS MAKE IN THE GYM

The instructor's function is not restricted to program development. Throughout the training period, instructors have to monitor exercisers to ensure the exercises are executed properly. Many exercisers tend to deviate from the training program and make training mistakes, which may endanger them. It is important to supervise and make sure that mistakes are avoided, even though a training program agreement exists.

### **Working without considering maximal strength ability (RM<sub>1</sub>)**

– Training that does not take maximal strength ability into consideration is faulty because exercisers do not heed their capabilities at that specific time. This kind of training can be either a waste of time if the training load is too light or injurious if the training load is too high.

### **Not recording or following up on the training program**

– Surprisingly, many exercisers in the gym are overly casual about updating their follow-up record card and keeping track of their activities and achievements. In such cases, it is difficult to identify and monitor the factors contributing to successes or failures in carrying out the training program. For the best possible results, and to identify and analyze exercisers' achievements, it is essential to record and monitor types of exercises, number of repetitions, number of sets, and load levels.

**Overtraining** – Some exercisers overly prolong their training sessions, up to as much as two hours or more. In the absence of order and organization, exercisers may activate the same muscle groups many times or at random, which can cause a feeling of “strained muscles.” Such training sessions are ineffective, tiring, and potentially injurious.

**Lack of sufficient recovery time** – When training is too frequent, it does not allow the body enough time to recover properly and to rebuild muscles between sessions (see Table 17.2). It is better to miss a session than to add extra sessions, which may result in injuries and/or lead to enforced periods of inactivity later.

**Imitating exercisers** – Many exercisers, especially beginners, seek role models, which are most likely at a higher level. Frequently, beginners imitate exercises that are too complex or difficult. It is important to remember that all exercisers have their own personal abilities and limitations. They

should adopt a program based on “know thyself” and not on “know thy neighbour.”

**Overload** – Many exercisers, beginners and advanced, are tempted to lift loads that are too heavy. Sometimes the motive is competitive. This type of activity increases the risks inherent in lifting weights too heavy for one's ability.

**Exacerbating differences** – Many exercisers tend to concentrate on strengthening already strong muscles rather than building up weak ones. The result is development of the wrong muscle groups, both in terms of physiology and of health, instead of surmounting weak points. The results of such practices are faulty posture and asymmetry – a lack of body proportion – that makes movement difficult.

**Lack of balance among fitness components** – Aerobic training sessions that are too long or frequent and are substituted for strength training, hinder body development, and vice-versa. Only adherence to a training program that combines all of the fitness components leads to optimal results. Aerobic and strength training must be regulated and supervised in keeping with an exerciser's needs and aims.

**Skipping warm-up** – Many exercisers seem to believe that warm-up wastes precious time, and that, if they shorten or omit it, they have more time and strength for the training stage. Instructors should make sure that exercisers follow through with the process of warming up. This is especially true if intensive exercises are to be performed. Specific, as well as general, warm-up is essential.

**Training until it hurts** – “No pain, no gain is the name of the game” for many exercisers. That is, they believe that if they do not reach their pain threshold, the session has not been effective. With time, such exercisers develop an “addiction to pain.” They should know that pain is actually a warning mechanism just before injury occurs. It is a “red light” telling us that our judgment was wrong on the tolerable amount of exercise, load, or frequency. Effective training ends with a desire for more – not with pain.

**Holding breath during exertion** – When working at high loads, exercisers may have a tendency to hold their breath during activity. Make sure to inhale and exhale with each chest expansion or contraction.

**Working on small muscles before gross muscles** – Small muscles tend to tire relatively quickly (especially in power exercises). If they fatigue too soon, they cannot assist the larger muscles in performing the exercises; thus, gross muscle development and effectiveness is reduced.

**Swinging movements during exercises** – When working against high resistances, exercisers may get “stuck” at the start of or during a movement because the load is too heavy. To complete the range of joint motion and subsequent return movement, they use swinging movements to gain momentum. This use of inertia to complete the movement does not help those muscle groups we wish to focus on because swinging bypasses the weak points in the movement, which is the actual focus of our efforts. Whether exercisers encounter difficulty starting or completing a movement, the solution is the same – they should perform the exercise slowly and with complete control, or reduce the load (resistance).

**Movement compensation** – “Movement compensation” is another tactic some exercisers use when trying to overcome a load that is too heavy or when the technique is faulty. Exercisers call other muscle groups into action or make use of movements that are irrelevant to the exercise in order to complete it. In the long run, movement compensation can ruin joints not involved in the exercise. For example, if the load is too heavy in standing presses (for developing biceps), the tendency is to compensate by using back and leg muscles. Instead of resorting to such indirect solutions, exercisers should try to identify and solve the difficulty in the movement or decrease the resistance when necessary.

**Stagnant training program** – When a training program is not updated every three months (or twenty-five training sessions), it loses its effectiveness. Updating the data is the mutual responsibility of the exerciser and the instructor.

**Lack of perseverance** – Training irregularly or taking long breaks between training sessions undo any progress towards developing physical fitness. The body also tends to get used to inactivity (during periods without training), which causes regression. Apart from the lack of satisfactory physical results, exercisers also experience feelings of dissatisfaction, unhappiness with training, and frustration. One of the instructor’s responsibilities is to make sure that exercisers adhere to their set training schedule.

**Fewer repetitions versus high resistance** – Some exercisers mistakenly believe that they can develop their body properly through fewer repetitions at higher resistance. It is important to adhere to thirteen repetitions per set when the training aim is to increase muscle mass. This does not apply to training programs for professional athletes who are developing “explosive power.”

# REFERENCES

- Alduby, D. (ed.) 1982. *Posture and Physical Activity*. (pp. 66–68). Netanya: Zinman College of Physical Education and Sport Sciences.
- Alter, J. M. 1990. *Sport Stretches: 311 stretches for 41 sports* (2nd ed.). Champaign, IL: Human Kinetics.
- American College of Sports Medicine 1995. *Guidelines for Exercise Testing and Prescription for Children, the Elderly, and Pregnancy*. Philadelphia: Lippincott, Williams, and Williams, 220–240.
- Andreson, B. 2005. *Stretching* (3rd ed.). Bolinas, California.
- Armitage-Johnson, S. L. 1994. Day-to-day operations: Developing policies and procedures. In T. Baechle (ed.), *Essentials of Strength Training and Conditioning* (pp. 475–500). Champaign, IL: Human Kinetics.
- Armitage-Johnson, S. L., 2001. Maintenance and layout in the gym. In *Resistance Training Manual*. Israel: Israeli Army (In Hebrew).
- Avery, D., A., D.Faigenbaum, L. Wayne, R. Westcott, L. LaRosa, and C. Long. 1999. The effects of different resistance training protocols on muscular strength and endurance development in children. *Pediatrics* 104(1). Boston, MA.
- Benardot, D. (2000). *Nutrition for serious athletes* (1st ed.). Human Kinetics. 73–97; 123–137; 141–178.
- Ben-Sira, D., G. Tennboym, and R. Lidor. 1998. *Evaluation and Measurement in Physical Education and Sport*. Netanya: Wingate Institute. Recs Publications (In Hebrew).
- Berger, B.G. 1993. Introduction to exercise and psychological well being. *International Journal of Sport Psychology* 24, 87–93.
- Blais, M. R., N. M. Berire, M. S. Fortier, L. G. Pelletier, K. M. Tuson, and R. J. Vallerand. 1995. Toward a new measure of intrinsic motivation, extrinsic motivation, and a motivation in sports: The sport motivation scale (SMS). *Journal of Sport and Exercise Psychology* 17, 35–53.
- Bouzan, T. 2003. *Strong head: How to gain good physical and intellectual fitness* (pp. 177–188). NY: Harpercollins.
- Bray, G. A. 1990. Exercise and Obesity. In C. Buouchard, R. Shephard, and T. Stephen (Eds.), *Exercise Fitness and Health: A Consensus of Current Knowledge* (pp. 497–510). Champaign, IL: Human Kinetics.
- Brick, M. 1994. *Precision Multi-Sport*. Finland: Polar Electro.
- Carta Encyclopaedia for Family Wellness. 1999. Israel. Carta Jerusalem. 117–119.
- Clarkson, P. M., and H. S. Thompson. 1997. Drugs and sport: research findings and limitations. *Sport Med* 24(6), pp. 366–384.
- Cooper, K. H., and M. Cooper. 1988. *The New Aerobics for Women*. (pp. 28–32). New York: Bantam Books.
- Crossly, N., 2004. Fat is a sociological issue: Obesity rates in late modern, “body-conscious” societies. *Social Theory and Health* 2, 222–253.
- Demory-Luce, D., May 2005. Fast food and children and adolescents: implications for practitioners. *Clinical Pediatrics* 44(4), 10 and 279.
- Doyne, E. J., D. J. Ossip-Klein, E. D. Bowman, K. M. Osborn, J. B. McDougall-Wilson, and A. B. Neimeyer. 1987. Running versus weight-lifting in treatment of depression. *Journal of Consulting and Clinical Psychology* 55, 748–754.
- Faigenbaum, A. D., and W. L. Westcott, 2000. *Strength and Power for Young Athletes*. Champaign, IL: Human Kinetics.
- Galley, P. M., and A. L. Foster. 1982. *Human Anatomy* (pp. 7–10). Church: University of Livingstone.
- Gilad, N., 2004. Health Certification, *Dinamics*, Vol. 3, February, Netanya, Israel: Wingate.
- Harvcook, *Orot*. No. 70.
- Howley, E. T., and B. D. Franks. 2003. *Health/Fitness Instructors Handbook*. Champaign, IL: Human Kinetics. (4th ed.). (pp. 97–110).

- International Health, Racquet, and Sportsclub Association (IHRSA). 2002. *State of the Health Club Industry*. IHRSA Annual Report.
- Janssen, P. 2001. *Lactate Threshold Training*. Champaign, IL: Human Kinetics (pp. 1–24).
- Johnson, D. 1993. In D. Morris (ed.), *Observations of the human body*. (pp. 124–126). Tel Aviv: Ma'ariv Publications. (In Hebrew).
- Johnson, B. L., and K. J. Nelson. 1986. *Practical Measurements for Evaluation in Physical Education* (4th ed.). New York: MacMillan.
- Kanitz, M. 1988. The pulse meter. *Running World*, 9, pp. 6–10. (In Hebrew).
- Kenneth, A. R., J. Dwyer, and S. Makin. 1999. Self-efficacy and participation in vigorous physical activity by high school students. *Health Education and Behavior*, 26(1), 12–25.
- Leith, L. M., and A. H. Tylor. 1990. Psychological aspects of exercise: A decade of literature review. *Journal of Sport Behavior* 13, 219–241.
- Lipovetsky, N. 2000. The effect of nutritional treatment using the Mediterranean diet and changes in life style on serum lipid profile. *Medical Nutrition* 2, pp. 38–42.
- Lipovetsky, N. and Ayelet, S. 1997. The connection between trans fats in the diet and cardiovascular diseases and heart attacks. *Medicine* 133, 544–547.
- Maimonides. *Laws and Views*. No. 25.
- Maimonides. *Laws and Views*. 70(5) (In Hebrew).
- McArdle, W. D., F. Katch, and V. L. Katch. 2001. *Exercise Physiology: Energy, Nutrition, and Human Performance* (5th ed.). Philadelphia, Lippincott, Williams, and Wilkins.
- Nice, S., and O. Inbar. 2003. *Physiology of Exercise*. Ramat –Gan. Focus Press.
- Pinchas, Y. and A. Moyal. 2004. The effect of intense or moderate physical activity on the ability of children and adolescents to concentrate during different hours of the day. *The 26<sup>th</sup> Annual Education and Environment Yearbook*, pp. 219–232 (In Hebrew).
- Qadaaya al-Lahw wa'l-Tarfeeh, p. 295. Retrieved 12 July 2005 from <http://www.islam-qa.com>.
- Roaf, R. 1978. *Posture* (1st ed., pp. 21–22). London: Academic Press.
- Run, T. August, 2002. Culture in the gym. *Physical Education and Sport* 57(6) 24–32 (In Hebrew).
- Sears, B. 2003. *OmegaRx Zone: The Miracle of the New High-Dose Fish Oil*. New York: HarperCollins. pp. 62–67.
- Sears, B. 1999. *The Zone Diet*. London: Thorsons Publishing. pp. 24–43.
- Silver-Rosenberg, A. 1996. *Thoughtful Nutrition. Food and Nutrition in States of Health and Illness*. Open University Press, pp. 46–150 (In Hebrew).
- Steindler A. 1964. *Kinesiology of the Human Body Under Normal and Pathological Conditions* (2nd ed., pp. 241–254). Springfield: Charles C. Thomas Publishers.
- The Biosphere. 1995. *Journal of the Ministry for Environmental Quality* 24 (9–10). June - July.
- Vivian H. H. 2002. *Advanced Fitness Assessment and Exercise Prescription* (4th ed.). Champaign, IL: Human Kinetics.
- Wills, J. D., and L. F. Campbell. 1992. Why people exercise: Motives for fitness. *Exercise Psychology* (pp. 3–58). Champaign, IL: Human Kinetics.



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Working out in the gym has become one of the most popular sport activities in the western world. Thanks to tremendous scientific advances, the gym or fitness room has become a highly effective venue for body management. It helps to satisfy a broad array of physical, health, mental, and social needs, and offers suitable training conditions for a wide range of target populations.

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