

Strength and Power Training

In simple terms, strength is defined as the ability to apply force against resistance. Strength enhances the performance and execution of many athletic skills. All the skills athletes must perform against resistance will benefit from improving strength. In sports, resistance is produced by water in swimming and rowing, force of gravity in running and jumping, and by an opponent in wrestling, martial arts, or team sports.

Strength training for children has been a controversial topic. In the past, children were discouraged from using weights for fear of injury or prematurely stopping the growth process. Recent studies, however, have shown injury risk is low, and strength training may help prevent injury. Most injuries in athletics occur at the ligaments and tendons. A well-designed strength-training progression will result in strengthening the ligaments (which hold together the bones that form joints) and tendons (which anchor muscles to bones), and as a result, allow the athlete to better cope with the strain of training and competitions. Strength training not only helps prevent injuries now but also provides a strong foundation for the later stages of high-performance athletes.

Another misconception about strength training is that it applies only to bodybuilders or power lifters. As demonstrated in the past two decades, many athletes have improved their performance faster using strength training than just performing the skill of the chosen sport. Strength training is an integral part of many athletes' training: football, baseball, track and field, rowing and canoeing, wrestling, tennis, and so on. Now the philosophy has so drastically changed that some people believe no one can be fast before being strong, no one can increase the height of a jump or takeoff without strength training, and no one can throw

or shoot a ball without having strong arms. Indeed, strength training has gained its important role in most sports.

In addition to improving performance and being a safeguard against injuries, strength training has health benefits. As a direct result of strength training, the mineral content of the bones increases serving later in life as a preventative measure against osteoporosis. According to medical data, women are more prone to osteoporosis, therefore strength training should be part of the physical education and training program of young girls (Committee for the Development of Sport of the Council of Europe, 1982). The benefit of strength training can also be social and psychological, in which training enhances an individual's discipline and mental determination to accomplish a task. Furthermore, a strong person seems to have high self-esteem and confidence. Finally, strength training has to be part of a lifestyle and healthy living, because by increasing the body's proportion of lean muscle mass, it also increases metabolism and in the process burns more calories than a sedentary lifestyle.

Strength training can be a positive component of a child's active lifestyle; however, you must carefully design it for a specific age or sport (Bar-Or and Goldberg 1989; Bompa, 1993a). Before participating in a strength-training program, young athletes must be ready physically and psychologically, and must understand the technique and role of strength in performance improvement. Both the instructor and the child should be aware of safety factors, including spotting and how to use different types of equipment. Equally important is that the supervising instructor is competent in the area of strength training, both in the technique of lifting and training methodology.

Before beginning a strength-training program, a child should have a thorough medical examination. This will determine any potential illness (such as heart problems) that may prevent the child from doing strength training or any type of physical training. With clearance from a physician, children with certain physical or mental disabilities can participate in a safe and professionally conducted strength-training program.

Terminology

The literature uses several terms interchangeably—weight training, resistance training, power training, or strength training. Because you can develop strength without weights or applying force against resistance, I have selected the term strength training to express force produced by a group of muscles.

You can also combine strength with other factors such as speed or endurance. In the first case, strength and speed result in *power*, or the rate at which you can generate force. This is usually fast, with explosiveness, such as in batting or jumping. The second combination, strength and endurance, is called *muscular endurance*, which results in the ability to perform many repetitions against a resistance, as in rowing, swimming, and cycling.

A group of muscles perform the sport skills. The larger and more powerful muscles, primarily responsible for performing technical skills, are called *prime movers*. Other muscles that cooperate in accomplishing the movement are called *synergist muscles*. *Antagonist muscles*, which are mainly on the opposite side of the bone, act in opposition to the synergists. All the motions are, therefore, influenced by give and take, by the contraction of synergists (also called *agonists*), and a balanced and controlled relaxation of the antagonists.

While an athlete is performing a motion with this critical interaction between agonists and antagonists, the role of other groups of muscles is to support a limb so the needed muscles can produce the motion. During pitching, for instance, the abdominal muscles contract to fix the lower part of the trunk so the arms can throw the ball. These supporting muscles are called fixators, or stabilizers, because they keep one part of the body or limb stable while another part contracts to perform a motion.

The load in strength training is expressed in pounds or kilograms and calculated in percentage of one repetition maximum (1RM), or the highest load you can lift in one repetition. You can easily test this as exemplified in a bench press. To find 1RM, the athlete can start with a small load, say 60 pounds. If the athlete lifts this easily, then make the next load heavier (i.e., 80 pounds, etc.). The highest load the athlete lifts in one repetition is called 1RM or 100%. Use this load to calculate the percentage for training, in most cases between 30 and 95 percent of 1RM.

The *number of repetitions* refers to how many times to repeat an exercise in a set. The following guideline will assist you:

- For a load of 100 percent, perform just one repetition.
- If the load is 95 percent, two or three repetitions are possible.
- At 90 percent of 1RM, three or four repetitions are possible.
- For a load of 85 percent, an athlete can do five or six repetitions.
- If the load is 80 percent, an athlete can do 8 to 10 repetitions.
- For a load of 75 percent, an athlete normally performs 12 repetitions.
- For 70 percent of 1RM, an athlete can lift 12 to 15 repetitions.
- Between 60 and 70 percent, a trained athlete can easily perform 18 to 20 repetitions.
- If the load is 50 percent, an athlete can perform more than 25 repetitions per set.

During a strength-training session, young athletes can perform one or two sets per exercise. Late postpuberty athletes can go beyond that, up to three, but in a progressive way, and increasing the number of sets over two to four years. For young athletes, there is no reason to perform more than two or three sets. In doing so, the number of exercises have to be low, six or seven exercises.

Between sets always take a rest interval (RI) to rest and relax muscles before performing the next exercise. The suggested programs will always have a rest interval of two or three minutes.

Laws of Strength Training

Three basic laws for the foundation of strength training should underlie a good strength-training program. These rules apply to anyone involved in strength training during the stages of growth and development, but are especially important to the young athlete who has just started along the road to high performance.

Law One: Develop Joint Flexibility

Most strength-training exercises, especially those employing free weights, use the whole range of motion of major joints, particularly knees, ankles, and hips.

For example, in deep squats the weight of the barbell compresses the knees and may cause strain and pain if the athlete does not have good flexibility at the knee joint. If deep knee squats are used in children's training, the load must be very low in order to avoid strain.

In a low squat position, the lack of good ankle flexibility forces the performer to stay on the balls of the feet and toes, rather than on the flat of the feet, which ensures a good base of support and balance. Therefore, developing good ankle flexibility during prepubescence and pubescence must be a major concern. Consequently, athletes seek flexibility development as an injury prevention strategy as well as for its own merits. Start during prepubescence and pubescence and maintain in later stages of athletic development.

Law Two: Develop Tendon Strength Before Muscle Strength

Muscle strength always improves faster than the tendons' abilities to withstand tension and the ligaments' resistance to preserve the integrity of the bones forming the joints. Faulty use of the principle of specificity and the lack of a long-term vision cause many training specialists and coaches to constantly stress just the specific exercises for a given sport. Consequently, they do not pay attention to the overall strengthening of ligaments, particularly at an early age when time is not pressing.

Athletes strengthen tendons and ligaments through a program designed to attain *anatomical adaptation* (to progressively adapt the anatomy of young athletes), and I discuss it in this chapter. Tendons attach the muscles to bones. Their main function is to transmit the pull or force that muscle contraction generates against the bone, which moves a given joint. Vigorous strength training without proper anatomical adaptation of tendons and ligaments can result in injuries of muscle attachments (tendons) and joints (ligaments). Tendons and ligaments are trainable, resulting in their enlargement (increase in diameter) increasing their ability to withstand tension and tearing.

Law Three: Develop Core Strength Before Limbs

The result of misunderstanding the principle of specificity is that training specialists direct most of their attention toward developing arms and legs. This misunderstanding is because athletes play most sports with the arms and legs. Therefore many trainers concentrate on strengthening these two segments of the body, believing that the stronger they are the more effective they will be.

Although it is true that legs and arms are the performers of all athletic skills, the trunk is the link between them. The legs and arms are only as strong as the trunk! A poorly developed trunk leads to a weak support for the hardworking arms and legs.

Long-term strength-training programs should not revolve on only the arms and legs of the body, but should include the abdominals, lower back, and spinal column musculature. Consequently, when preparing training programs for young athletes, especially during prepubescence and pubescence, exercises should start from the core section of the body and work toward the extremities. In other words, before strengthening the legs and arms, concentrate on developing the link between them, the support, the core muscle groups of the trunk.

The abdominal and back musculature provides the trunk with an array of muscles, whose bundles run in different directions and surround the core area of

the body. This provides a tight and powerful support for the wide range of physical moves.

Back muscles are the long and short muscles that run along the vertebral column and work with the rotator and diagonal muscles as a unit, taking part in sideways bending, turning the trunk, and rotating.

Abdominal muscles are the anterior, lateral, and obliques that can pull in opposite directions through fibers that cross the abdominal wall. This enables the trunk to bend forward, sideways, rotate, and twist. The abdominals play important roles in many sport skills; therefore, weak abdominal muscles can restrict the effectiveness of athletes in many activities.

All trunk muscles can work as a unit to stabilize and keep the trunk fixed during movements of the arms and legs, especially in throwing activities from baseball to track and field.

Adapting Strength Training for Young Athletes

Scientific studies have demonstrated that both boys and girls gain in strength following strength training (Bar-Or and Goldberg, 1989; Micheli, 1988; Ramsay et al., 1990; Sale, 1986). Comparisons of children in all three stages of growth and development (prepubescence, pubescence, and postpubescence) show that postpubescent children make the greatest gains. This is often as much as two or three times that of prepubescent children and almost twice that of pubescent children.

Most gains in postpubescent children are the result of growth in muscle mass (hypertrophy), as well as nonmuscular factors, such as neuromuscular or nervous system adaptation to training. Although strength gains are visible in prepubescent and pubescent children, gains in muscle mass are not. Strength improvements in early age are not, therefore, the result of muscle enlargement (hypertrophy) but rather the ability of the central nervous system (CNS) to activate or stimulate the muscles (Bompa, 1993a; Sale, 1986). We see this in the improved ability of children to perform a skill efficiently and with force and power. Consequently, most muscles learn to cooperate, synchronizing their actions and contracting the chain of muscles involved in strength training. The result is increased force in the intended direction of movement.

Strength gains for male athletes during postpuberty and maturation are mostly the result of muscle enlargement due to the large increments, from puberty on, of male hormone (testosterone). Female athletes cannot report similar gains during these periods because their testosterone levels are tenfold lower than in the male counterpart (Fox, Bowers, and Foss 1989). Even nonathletic males increase their strength and size markedly compared with females, for the same biological reason. As a consequence, athletes increase trainability of strength rapidly during puberty and maintain it during the following development stages.

Considerations for Prepuberty

The prepuberty years are characterized by a constant growth that favors developing fundamental movements and basic skills. Individual variations in motor performance among children are so diverse that they can change over a short time. Certainly heredity, the natural qualities children inherit from their parents, plays an important role in individual performances and their variations (Matsui, 1983).

Physique and strength are generally related for boys; overall body size influences physical achievements. Excess body fat, however, plays an adverse role in most motor activities.

Physical achievements increase markedly and linearly with age, but gender differences in average strength (particularly lower body strength) do not seem to be drastically different. Boys seem to do better in strength-related activities for the upper body, such as throws, relative to activities of the lower body, such as sprinting. Girls tend to perform better in balance and flexibility (Duda, 1986; Smith, 1984).

Considerations for Puberty

Motor performance improves with age during puberty, but the development pattern is not uniform for the same age, sex, and task (Malina, 1984). For girls, strength performance levels off during puberty and does not visibly change afterward. For boys, strength increases with age at an average rate, with marked acceleration during growth spurts, when there are also visible increments in muscle mass. This probably reflects gains in testosterone level and a social factor, because for boys peer pressure seems to motivate them to look bigger and be stronger. Because large increments in muscle size are not possible, especially during early puberty, it is important for everyone involved in children's sports to discourage young athletes from taking part in strength training solely to create big muscles. Such gains will be possible only after hormonal changes have occurred during this growth stage, because increments in muscle mass parallel sex organ development (Bailey, Malina, and Mirwald, 1985).

From puberty on, boys are significantly stronger than girls in upper body and arms. There appears to be a lesser difference for leg strength. In general terms, strength visibly relates to body size and fat-free muscle mass, which gives boys the advantage because they tend to participate in more physical activities than girls (Kraemer and Fleck, 1993).

Regarding power, tests such as the standing long jump show similar performances for boys and girls during prepuberty, but from puberty on these gender differences in power change visibly. At the same time, gains in excess body fat for some girls appear to lower their performance proficiency.

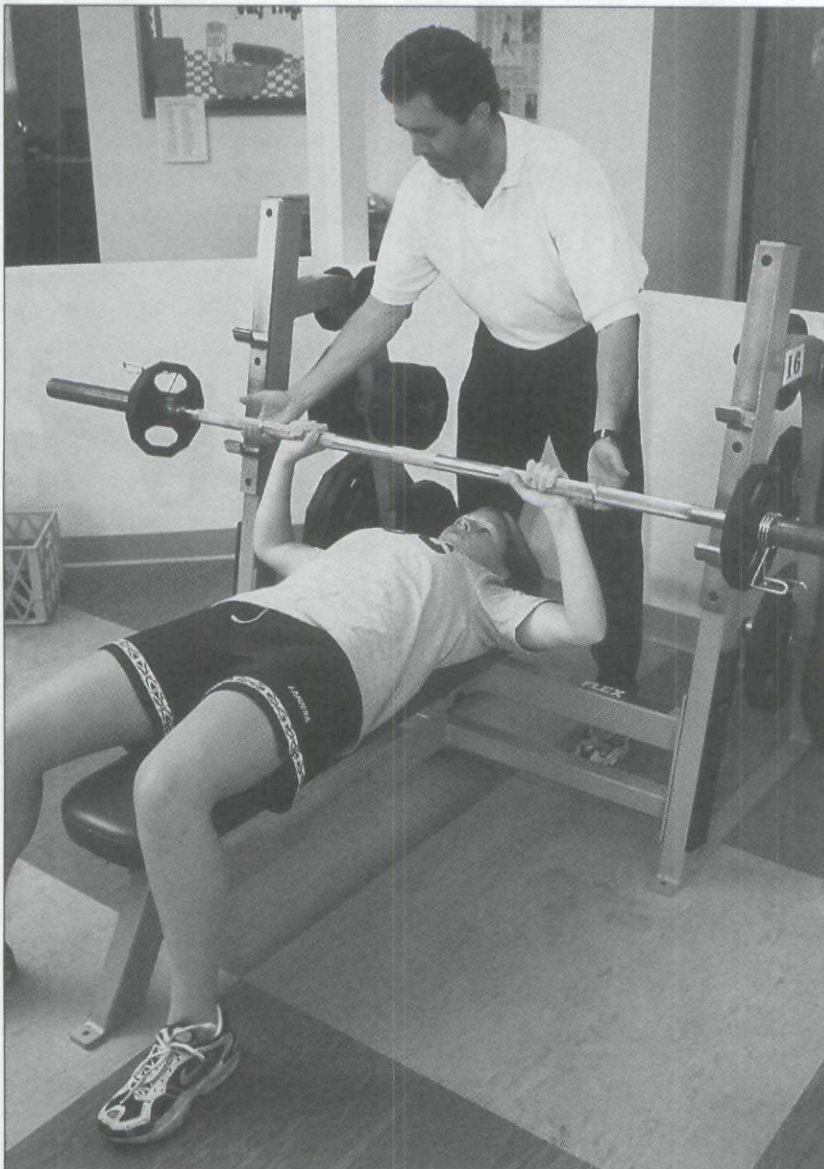
Considerations for Postpuberty

Postpuberty signals a large difference in motor performance relative to gender. During adolescence, the difference between girls and boys seems to accelerate in tasks and performances related to strength due to boys' adolescent growth spurt. From this stage on, few girls perform as well as boys in strength, which was possible during prepuberty. These differences reflect sex differences, especially because boys grow larger in size. Social and motivational factors are important considerations in interpreting children's performances, with involvement in physical activities being directed more toward boys than girls.

Some boys decline in performance during peak height increases in growth spurts. Often children at this stage grow 5 to 10 centimeters (two to four inches) per year, which obviously affects performance. This is especially true for girls, who experience a greater decrease in strength due to growth and leverage changes (Bailey, Malina, and Mirwald, 1985; Kraemer and Fleck, 1993; Micheli, 1988). Following this phase of fast growth in height, most strength and power scores

start to improve again, demonstrating good adaptability to challenging training loads. On top of this, peer pressure to be strong and look big makes it difficult for some boys to resist the temptation to use drugs that increase muscle size. This is when it is necessary for parents, educators, and coaches to explain the danger of drugs and to demonstrate that there are better alternatives, such as the periodization of strength training.

It becomes evident that some children grow faster (early maturers) than others of the same age (late maturers). Girls who experience menarche at an early age (during puberty) are slightly stronger than those who attain it later. By the time girls reach postpuberty, early maturers are less strong than late maturers because of gains in relative body fat, combined with decreased activity in the upper-body region. Early maturers tend to be heavier and taller than late maturers. Their upper body and abdominals are weaker because they grow more quickly. Their strength in relation to body size decreases because of quicker growth spurts, compared with late maturers. When the growth spurt is over, and training gains



become visible again, early maturers seem to have a strength advantage over late maturers. This is particularly so in the legs, the strength of which girls sometimes retain during maturation.

Early maturing boys perform better than average and late maturers. Average maturing boys increase linearly until late adolescence. From this stage of development on, there are negligible differences in strength performance between early and average maturing boys. Boys who reach early sexual maturation, however, perform better in strength-related movements (Borms and Hebbelinck, 1984; Malina, 1984). Later maturers, on the other hand, rarely catch up with early maturers in most strength power-related motor tasks. Again, body size seems to significantly influence performance. However, later phases of athletic development (high performance) may not retain any advantages or disadvantages of the early growth and development stages). It is important, therefore, to understand and follow a long-term periodization of athletic development, which guarantees a gradual and complete development of the abilities necessary for all sports.

In conclusion, training programs for children have to consider the dynamics of growth and development for each stage. Programs for both boys and girls should be similar and well-balanced for the first two development stages, but completely separate for postpuberty. As part of a well-rounded training concept, strength plays a major factor for general fitness. To maintain proportional strength between the upper and lower body in girls, from puberty and especially postpuberty on, programs should emphasize upper-body, trunk, and shoulder girdle strength, because they tend to be weaker in these areas.

Preventing Injuries

Children may experience injuries by lifting heavy weights during their growth, especially during prepuberty and puberty. Children, especially prepubescents, cannot activate their muscles as adults do and are therefore more prone to certain injuries than adults (Fleck and Falkel, 1986; Rovere, 1988). A lack of knowledge in training and appropriate load progression, improper posture during lifting, and weak abdominal muscles are in most cases the culprits for children's injuries. Young athletes experience lower back problems and knee injuries.

Growth plate injuries, compression injuries in the shaft of the bones, are the most serious injuries. A growth plate fracture during childhood may result in shortness of a limb. These injuries occur most often in contact sports. Young children are extremely susceptible to serious damage from sudden violent forces because the ligaments that protect major joints are stronger than the growth plates. Consequently, trauma that would cause ligament damage in adults will often cause growth plate fractures in children.

Muscle overload can also create serious injuries in children. Extreme muscle contractions transmitted along the tendons, which can cause muscle tearing in adults, can cause the muscle and tendon to separate from the main structure of the bone in children. If such injuries stop growth the result could be deformity and functional impairment.

Injuries such as strains, sprains, and soft tissue damage are far more common and yet much more difficult to prevent than growth plate injuries. These injuries occur frequently in highly organized competitive sports programs. Although they

are not necessarily serious, they can slow the overall development of athletic talent.

A well-structured strength-training program, a well-designed long-term periodization, like the ones I present in this chapter, is safe for children. Following the suggested programs is a key assurance against injuries. It is equally important to know that bigger, stronger children, especially during late puberty and postpuberty, are more likely to experience injuries. They feel ready for heavy loads. What these young adults misunderstand, however, is that the ossification process is not yet completed, and as a result, muscles should not pull against connective tissue with maximum force.

Among the most effective injury-prevention techniques are the following:

- Use strength-training programs designed to prevent injuries. A well-planned and long anatomical adaptation phase, as suggested by the models, can result in building injury-free athletes. Athletes who do not experience any weight-training program have a three to one injury rate compared with those who do.
- Design a compensation strength-training program for all muscles, especially for the abdomen, to balance the strength of the lower back and the rotator cuffs, to avoid shoulder pain. These tend to be the neglected areas in training.
- Do not abuse specificity in training programs for children by using constant exercises specific for the sport. Multilateral training at an early age will pay off at maturation. Specificity of training at an early age has a greater chance in creating overuse injuries.
- Do not expose athletes to maximum loads over 70 to 80 percent of 1RM or explosive lifts with free weights during prepuberty, puberty, and early postpuberty. This is too strenuous for anyone, let alone for a young body with an immature anatomical development. In fact, *discomfort should not be part of the early years of training, period!*
- Thorough instruction in lifting techniques, especially free weights, must be part of any strength-training program. An adequate phase of learning lifting technique, with no or light weights, is a logical requirement by any instructor with a long-term vision.
- Close supervision at all times is necessary for a problem-free gym. Children, especially prepubescent and pubescent, have short attention spans and are not necessarily highly motivated for strength training; therefore, you should constantly guide and supervise them. Have equipment serviced regularly, and always return weights to their safe place.
- Never use faulty or worn equipment. Before lifting with free weights, such as barbells, make sure that the collars are secured to prevent the discs from falling off and harming the body.

Circuit Training

You can use simple circuit training (named as such because the stations are organized in a circle) with six to nine stations, to develop basic strength by using exercises listed on pages 116-148. Tables 6.1 and 6.2 are provided as examples. Consider the following characteristics of organizing a circuit training program:

- Training should last between 15 and 20 minutes. You can progressively increase it to 30 minutes toward the end of prepuberty.
- Arrange the exercises so they alternate limbs, body parts, and muscle groups. I suggest the following order for the exercises: legs, arms, abdomen, and back.
- The number of exercises is between six and nine.
- For new exercises, the coach must teach the proper technique. Correct execution should take priority over the number of repetitions.
- The instructor should not demand a certain speed or have the children complete an exercise or circuit as fast as possible. At this stage of development, these things are not important. For children to enjoy performing a circuit of exercises, they must do them *at their own speed*.
- The movements should look smooth. Children should be able to perform them without experiencing discomfort. A grimace is a sign of discomfort with a stressful activity. At this stage of development stress is categorically undesirable. Where there is stress there is no fun! Stop any activity before children experience discomfort. Do not push! Let children have a positive physical experience.
- As much as possible, introduce exercises into the circuit that are enjoyable, fun, and that the children will be interested in performing.
- Provide constant rewards and encouragement for good technique and individual improvement. Circuit training should be an environment for individual improvement, challenge, and personal satisfaction, and not competition between children. However, children should know from the beginning that they cannot expect improvements all the time and for all exercises and activities. The road to a good performance is full of gratification and frustration, and constant improvement is not always the case. Consistent and persistent work, however, is always rewarded in the long run.

Remember that during prepubescence, children should *not lift heavy loads*. No child should attempt to know how much they can lift, their maximum weight, or one repetition maximum. The medical and scientific professionals strongly

Table 6.1 Circuit Training With Six Exercises

Exercises	Number of reps/duration in sec	Rest interval (sec)
• Push-up	4 - 6 (8)	30
• MB scoop throw	10 - 12 (15)	30
• Dumbbell curl	8 - 10 (12)	30
• Hang hip flexion	5 - 8	60
• Dumbbell shoulder press	8 - 12	30
• Two leg skip	60 sec	120

Note: Depending on the abilities of the athletes involved, a child may perform 1-2 circuits and toward the end of puberty even 3 circuits.

MB = Medicine ball

Table 6.2 **Circuit Training With Nine Exercises**

Exercises	Number of reps/duration in sec	Rest interval (sec)
• Push up	6 - 8 (10)	30
• Hip thrust	6 - 10	30
• Single-leg burpee	8 - 10/leg	60
• MB trunk raise	6 - 8	30
• MB scoop throw	10 - 12 (15)	30
• Abdominal crunch	6 - 8	30
• Dodge the rope	60 sec	60
• Dumbbell curl	8 - 10 (12)	30
• Loop skip	90 sec	120

Note: Start with one circuit and over time progressively increase to two, then to three.

discourage using heavy loads (especially with free weights) during childhood, particularly during prepubescence and pubescence, due to possible growth plate injuries (American Academy of Pediatrics, 1983).

The exercises and training characteristics I suggested previously are adequate to build the base for future phases of strength development. With the activities children perform during puberty, they will build the foundation for the training to come during adolescence and maturation. To do it any other way would mean burnout for the young athletes, and they will lose interest in sports before they reach their best performance levels at physical and psychological maturation.

Periodization Models for Strength

Table 6.3 refers to a long-term periodization model for strength. It is an overview, which refers to the development stages, training method, volume (quantity), intensity (load), and means of training.

Strength-Training Model for Initiation

View the suggested model for prepuberty as preparatory time in which the athlete develops the foundation for high performance in an enjoyable, fun, and playful environment. High performance at athletic maturation does not depend on strength training during prepubescence. The body at this stage is susceptible to injury with excessive stress. Regimented, stressful strength training using machines not only puts prepubescent athletes at serious risk for injury, but also leads to burnout and hurts the careers of potential high performers. Therefore, you should view strength training for prepubescent children only as an additive to the technical work and general skill development, and limit it to the athlete's body weight or medicine ball exercises.

Table 6.3 Periodization Model for Long-Term Strength Training

Stages of development	Forms of training	Training methods	Volume	Intensity	Means of training
Initiation	• Simple exercises • Games/play	• Informal circuit training (CT)	• Low	• Very low	• Own body • Partners • Light medicine balls
Athletic formation	• General strength • Relays/games	• CT	• Low to medium	• Low	• Medicine ball • Light free weights
Specialization	• General strength • Specificity	• CT • Power training • Low impact plyometrics	• Medium • Medium-high • Maximum	• Low • Medium • Submaximum	• As above • Free weights
High performance	• Specificity	• Maximum strength • Power/plyometrics • Muscular endurance	• Medium • Medium-high • Maximum	• Medium to high • Submaximum	• Free weights • Other types of machines

Note: The progression in training methods, volume, intensity, and especially the cautious transition from simple exercises (initiation) to general, then to specific.

Remember that multilateral development is the major scope of training for prepuberty. By playing sports (the more varied the better), children develop basic strength, general endurance, basic speed of short distance, and good coordination. For instance, if a child participates in a recreational swimming program, he or she can also take a few gymnastics classes to develop basic flexibility and balance. While playing games, a young athlete is also developing endurance, speed, coordination, agility, and space orientation and performing a variety of skills. This multitude of skills will result in a harmonious physical development rather than a sport-specific narrowness.

Although children spend most of the time performing the chosen sport, play, and games, they should dedicate 20 to 30 percent of their training time per week to physical training, from strength to flexibility. They should perform such a program informally, free from regimentation and rigidity and full of enjoyment and fun.

You should see the whole strength-training program for prepubescent and pubescent athletes as adapting the anatomy of children to prepare the muscles, tendons, and joints for the training stress of high performance at maturation. The aim of the program is overall, harmonious, and proportional body development, as called for in the principle of multilateral development. During the stages of growth and development, six to eight years of progressive development, the athletes should prepare so they are injury free in the later development stages. This requires a careful progression in the program.

When creating a plan, give attention to the training guidelines, such as multilateral development, individualization of any program and exercises, and a progressive load increment, discussed in chapter 1.

Strength-Training Model for Athletic Formation

You should view a training program for pubescence as continuing to build the foundation of training necessary for an athlete to specialize in a sport. Such a base is paramount for the success many athletes aspire to during the high-performance phase. Therefore, view puberty as an important stage in the equation for producing high-quality athletes.

Although pubescent children grow rapidly during this stage, sometimes 10 to 12 centimeters (4 to 5 inches) per year, adequate strength training is essential for the young athletes. The intensity of the loads used for training should still be low, because hard training during pubescence may affect normal growth and contribute to injuries (Matsuda et al., 1986).

From puberty on, boys and girls will have different gains from strength training. The development of sexual organs in boys results in high levels of growth hormones (some 10 times higher levels of testosterone than girls). For this reason, boys get bigger and stronger than girls.

Scope of Training

You should view strength training as part of overall development. Multilateral training or developing a high variety of skills and basic motor abilities, such as flexibility, endurance, and speed, is still an important goal.

For strength training, the aim of the program is a proportional and harmonious body and musculature development. Except sports in which athletes achieve high performance during late puberty and early adolescence, resist falling into the trap of specificity. Do not stress training methods and especially do not employ exercises specific for selected sports only. Stressing specificity at this early stage will mean rapid adaptation, causing the athletes to reach good performance at an unnecessarily young age. As children improve fast, the temptation increases to push them higher, use heavier loads, and demand better performance. This stress in training is often exacerbated by entering the young athlete into more and difficult competitions. The result of this approach can be predictable: high stress and burnout. The goal of strength training in pubescence is to further the base of strength for the high-performance phase. As was demonstrated during the 1992 and 1996 Olympic Games, most medalists were in their late 20s and early 30s. Consequently, avoid specificity; work for multilateral development; build a solid base for the future; and most importantly, create an environment that is fun, enjoyable, and a positive physical experience. Remember the Roman dictate, *Festina lente*, which means hurry up slowly!

Program Design

A strength-training program designed for pubescence should continue to apply the three basic laws of strength training. Do further work on developing joint flexibility, strengthening the tendons, and improving the core area of the body.

Developing a good strength base, with harmonious muscles, is a major goal of strength training at this stage. This will prepare the athletes anatomically for the training stress they will meet during postpubescence and maturation. The direct benefit of such long-term progression is creating injury-free athletes. With good progression this is a possibility.

A training program for pubescence represents an advanced link with training for high performance. Although you may employ similar means of training using the same types of equipment, such as exercises requiring your body weight and a partner, the number of repetitions and resistance will be slightly more challenging. Continue exercises with medicine balls, mostly throws and relays. Seek the foundation of power using the athlete's body weight, and develop speed and power by using medicine balls. Increase the weight of the ball slightly, from two to four kilograms (five to nine pounds). Use exercises with dumbbells and wall pulleys to develop the strength base and adapt the tendons and ligaments.

Because they are slightly increasing the total amount of work, children will experience some fatigue. This will be especially true if they perform skills of a given sport and 30 minutes of circuit training for strength development in the same day. Cease activity before feeling pain. The instructor should constantly observe the young athletes and learn how much they can tolerate before they feel discomfort.

A sign of comfortable physical exertion is that training still looks effortless. To achieve this, children should focus on the task while being relaxed, to prevent muscle strain. They should understand that, although the agonistic muscles contract, the antagonists should relax.

At this stage of training, children can experience free weights with light and simple barbells available in most gyms. However, this does not mean Olympic weightlifting techniques. Rather it is for them to learn what kinds of exercises they can perform with a barbell. The main reason for suggesting barbells and not sophisticated machines is that athletes can perform a greater variety of movements in different positions and planes. Using a barbell, it is easier to mimic a skill pattern that an athlete will perform during postpubescence and maturation. Before thinking about training, however, the instructor should thoroughly teach correct lifting techniques. This is crucial to avoid possible injuries. Most gym machines are not designed for the length of children's limbs.

Consider the following key elements for basic technical instructions:

- Teach basic stance, with feet parallel at shoulder width. This position will guarantee a good support base, giving the child controlled balance. This means that as a child performs, for example, upright rowing, he or she will not lose balance.
- Lead the lift with neck and shoulders. For example, when lifting the barbell from the floor to the chest or shoulders (this is called clean), the athlete should concentrate on starting and leading the move with the neck and shoulders. Do not focus on the barbell, it will follow the upper body lead. Flex the arms in the second half of the action. This technique will eliminate the error of shooting the legs (leading with the hips and, therefore, leaving the upper body behind); such errors can result in lower back strains.

Most concerns should address multijoint movements, such as the previous one, or performing a half squat. Because half or deeper squats are popular exercises, the progression of teaching is as follows:

1. Learn the correct technique without any weight (free squats).
2. Learn to balance up the barbell you will use in the future by placing a stick on the shoulders, with hands toward the ends of the stick.
3. Go through the motion using dumbbells, one in each hand, and lifting them on the sides of the body.
4. Use just a barbell with no additional weights attached.
5. Use slightly increased loads while concentrating on a correct technique.

If an instructor is not aware of the correct technique, he or she should learn this from a specialist. In any case, understand that this progression is a long-term proposition. It usually takes a couple years before the athlete uses a heavier load and, normally, this is in late postpuberty.

As children develop a better training background, they should progressively experience slightly more challenging training demands, meaning skills for technical development, speed, agility, and strength. In this way, their adaptation will reach higher ceilings, illustrated by their growing capacity to tolerate work and progressively increase their physical potential. To achieve this, the total training demand has to progressively increase following a certain methodology, such as the following:

1. Increase the duration of a training session. Assume that training is twice a week for one hour. To slightly increase the training capacity, the instructor adds 15 minutes to each session. Now the child will train twice at 75 minutes, for an additional 30 minutes per week. Over time, such progressive increments may go up to 90 minutes per session. The 90-minute session does not mean just strength training. It includes technical and tactical work; speed; agility; and, toward the end of the session, strength training.

2. Increase the number of training sessions per week. Considering that a 90-minute session is long enough for training, a new training challenge will come from increasing the number of sessions from two to three per week.

3. Increase the number of repetitions per training session for all types of activities and skills, such as technical, tactical, and physical. If for a certain period the coach feels that three times at 90 minutes per week is what the children can tolerate, the next training increment will come from performing more work in the 90 minutes. This means more technical drills or exercises for physical development. Consequently, slightly decrease the rest interval between drills, and challenge the children to adapt to high training demands.

4. Increase the number of repetitions of skills and drills per set. When you exhaust the previous three options, higher training demand will come from increasing the number of repetitions of drills or exercises performed per set. In this way, the new training task is to progressively adapt a child to perform the increased number of repetitions nonstop, without a rest interval between them.

You must apply this proposed progression carefully, over a long time. It may take two or three years to increase the training load from two 60-minute sessions a week to three 90-minute sessions a week. An experienced instructor will certainly make a smooth and careful transition.

The strength-training increment can be from 20 to 30 and even 40 minutes per session toward the end of pubescence. The circuit-training method still satisfies

the needs of strength development, except that the number of exercises can increase progressively up to 10 or 12, with 8 to 15 repetitions per exercise.

Strictly adhere to individualization so that training programs match individual potential. Similarly, the speed of performing an exercise must be a child's natural choice, without additional pressure from the instructor. This allows the child to find his or her way, according to individual rhythm of growth and development, which can be drastically different between two children of the same age.

The instructor may use rewards as a motivational tool. However, give any rewards (i.e., praise for achieving a task) for individual self-improvement rather than for being the best athlete in the group.

During pubescence, children should experience various track and field events, with lowered weight for throwing implements (i.e., use tennis balls rather than javelin), and shortened distance for sprinting (50 meters or 55 yards rather than 100 meters or 110 yards). The advantage of learning basic skills, and developing speed and power, is that later there will be a valuable positive transfer, for example, from javelin throw to pitching in baseball or from good sprinting abilities to football, basketball, or soccer. Therefore, the multilateral base for prepubescence and puberty is not just a concept to be concerned with, but an athletic necessity for high performance.

Training Program

A strength-training program for puberty can successfully use the circuit-training method. You can use tables 6.1 and 6.2 with circuits of six and nine exercises as training guidelines. Parents or instructors can easily create other programs using many of the following exercises. Please adjust the number of repetitions and the number of circuits according to the potentials of the children in the program.

Strength-Training Model for Specialization

From postpuberty on, the training program changes slightly, compared with the first two growth and development stages, when the major scope was multilateral. With the foundation athletes create during prepubescence and pubescence, training for postpubescence becomes progressively specific to the needs of the selected sport. With such a background, strength training diversifies to include power and to progressively use the periodization model for each competitive year.

As a result of increasing growth hormones, mostly for boys, muscle size and strength will be noticeably larger during postpubescence. From this stage of development up to maturation, boys will increase the proportion of muscles from approximately 27 percent to about 40 percent of total body mass. Under such circumstances, strength will certainly improve drastically. Although this will be slightly different for girls, they will also improve their strength to much higher levels (Hebbelinck, 1989; Malina, 1984).

Scope of Training

Postpubescence is a development phase that includes young athletes with a difference in chronological age of two or three years. Therefore, you must carefully

and progressively monitor the introduction of training specificity according to the needs of the sport.

Maintain multilateral training during postpubescence, although you will progressively alter the proportions between it and sport-specific training in favor of specificity. Of equal importance is maintaining work for strength improvements and functionality of the core area of the body.

You should view specificity of strength training as incorporating exercises that mimic the motion the prime movers (agonistic muscles) perform. The athlete must angle and plane the motion specifically to the technical skills of the selected sports. However, you should implement specificity so it does not disturb the harmonious development of the other muscles (antagonists).

Because strength training diversifies to address the specific needs of a sport, the athlete will develop different components of strength, such as power and muscular endurance. Employ specific training methods to address such needs. As a direct result, you must also understand and implement periodization of strength per competitive year.

Program Design

Following the first one or two years of postpubescence, when pubescent-specific training still applies, training becomes progressively sophisticated. You may use additional training methods and more sophisticated training machines.

As training becomes more complex and strength plays an important role, you should monitor the stress in training. As athletes add more power and heavier loads, training intensity takes a toll through the fatigue they are experiencing. To prevent a critical level of fatigue and potential injury, the instructor should know how to increase the intensity in strength training appropriately. I suggest the following progression:

1. Decrease the rest interval between sets from 3 minutes to 2.5 minutes.
2. Increase the number of sets per training session, especially for the higher percentage of 1RM.
3. Increase the training load. According to the principle of progressive increase of load in training, increase the load in steps, usually three, followed by a regeneration week (refer to chapter 1 for an explanation of the step method). To adapt to the new load, the athlete must maintain a training program of similar intensity for approximately a week, followed by a new load increment.

Figure 6.1 illustrates a hypothetical load increment over four weeks. The training load increases from step to step by approximately 10 percent, except the regeneration week when it decreases by 20 percent. Please note that the load per step refers to the training program for one day, which the athlete must repeat two or three times, depending on the number of training sessions per week.

Apply this progression over a long time. In doing this, it is normal to expect that athletes will use high percentages, close to 100 percent, at the end of postpubescence and

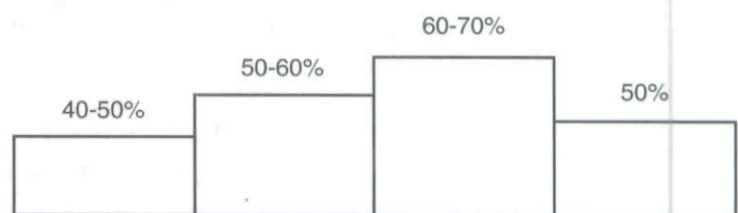


Figure 6.1 Percent increase of training load for a four-week cycle.

during maturation. Similarly, you can increase the number of sets to two, four, or higher to challenge the muscles for adaptation and improvement.

As the complexity of training increases, you may be tempted to employ sophisticated strength machines or Olympic weightlifting moves, such as clean and jerks and snatch, with the belief that by doing them, strength for the selected sport will quickly improve. I strongly discourage using these methods, as they are technical, sometimes dangerous, and not sport specific.

The market offers other types of machines in addition to the universal gym. Among them are the following:

- Variable resistance machines, which vary the resistance to match the dynamics of an exercise. With these, the prime movers can contract maximally or near maximally throughout the range of movement.
- Isokinetic machines, which have a system that makes the speed of exertion constant throughout the range of movement.

Although these and other machines might be ideal for providing resistance to some muscles, the problem is that they allow the movement to occur only in a predetermined direction and plane.

In using more sport-specific exercises and methods, specificity in strength training becomes dominant as the athlete approaches the stage of high performance. So the instructor has to select the type of equipment that best suits the needs of the sport. Although you can use some machines in certain training phases (i.e., maximum strength phase), free weights seem to be more practical. They have a greater mechanical similarity to most athletic skills and coordinate different muscle groups. Although a proper technique is more difficult to learn, free weights allow the athlete to perform moves in various directions and planes. The athlete can duplicate most of the dynamic nature of sport actions to create a sport-specific acceleration throughout the range of motion. In fact, this is one of the most important advantages of free weights.

Free weights are popular but can cause injury if improperly used. Besides teaching the technique, the instructor should ensure that a spotter is constantly assisting the performer. The main objective of spotting is safety and injury prevention.

As the instructor introduces a new movement, he or she should do the following:

- Explain the main elements of lifting.
- Demonstrate the correct technique.
- Have the athlete perform the movement with low load and remark on execution.
- Explain and demonstrate the role of the spotter.

An effective spotter, usually one of the instructors or an experienced athlete, should do the following:

- Know the technique of lifting as well as the appropriate spotting technique.
- Give the performer the necessary technical clues.
- Throughout the performance, know the program (number of repetitions) in order to be attentive and effective in his or her role.

The methodology of developing strength changes and becomes more difficult as the athlete approaches maturation. The athlete is now seeking to train for maximum strength or one of its components, power or muscular endurance, not only to develop general strength.

Training Program

Postpuberty includes young people from the ages of 13 and 14 up to 18, or the beginning of maturation. Because there are so many biological and psychological differences among young people in this age range, I have decided to divide the training program into two parts: early and late postpuberty.

Training Program for Early PostPuberty

Because the biological and psychological potentials of early postpuberty children (approximately 14 to 15 years old) are closer to puberty than adulthood, a training program can still use circuit training with great benefit for continuous athletic improvement. The great difference between a circuit-training program for puberty and early postpuberty lies in the following:

- Exercises are more difficult.
- Load for some exercises will be higher.
- Rest interval between exercises will be lower.

Two examples of circuit training are presented here (tables 6.4 and 6.5). The second one is more difficult and has more power exercises such as plyometrics.

Use the suggested load and number of repetitions flexibly. For some they might be too difficult, for other young athletes too easy. Therefore, please adjust the program to individual potentials.

Table 6.4 Circuit Training for Early Postpuberty

Exercises	Number of reps/duration in sec	Rest interval (sec)
• Pull-up	4 - 8	30
• Leg press 50kg/110lb	10 - 12	30
• Trunk twist	8 - 10	30
• Lats pull down 40kg/88lb	6 - 8	30
• Slalom jump	30 sec	60
• Arm curl 40kg/88lb	6 - 8 (10)	30
• MB trunk raise	6 - 8	60
• Push-up	6 - 8 (10)	30
• Cone jump	30 sec	120

Note: Do two circuits. Adjust weights as per children's potential.

**Table 6.5 Circuit Training for Early Postpuberty
(More Challenging)**

Exercises	Load	Number of reps/duration in sec	Rest interval (sec)
• Leg press	60kg/132lb	12 - 15	20
• Pull-up	—	4 - 6	30
• V-sit	—	4 - 6 (8)	30
• Vertical hop	—	30 sec	30
• Chest press	40kg/88lb	6 - 8	20
• Trunk extension	—	6 - 8 (10)	20
• Scissors splits	—	30 sec	30
• Lats pull down	40kg/88lb	6 - 8 (10)	20
• Cone jump	—	30 sec	120

Note: Do two circuits. Apply program as per individual potential.

Training Program for Late PostPuberty

Late post-puberty includes athletes approximately 16 to 17 years old. Assuming that strength training follows technical work, it is a complementary activity that can have a duration of 30 to 60 minutes, especially during the competitive phase. You can change this trend during some segments of the preparatory phase by organizing a strength-training session apart from technical or tactical training. In either case, the instructor should make sure that the athletes have a comprehensive warm-up.

Table 6.6 refers to an annual plan in which the competitive phase is during the summer months. Based on this model, you can create a different plan in which the competitions are either in the fall (i.e., football) or winter (i.e., skiing, basketball, etc.). You can easily apply table 6.6 to an endurance sport in which the volume would be high but the intensity (load) low to medium. Please note that below the training phases I have indicated the periodization of strength or the type of strength to be training in that phase.

Training Program for Each Type of Strength

I suggest here a training program for each type of strength—maximum strength (see table 6.7) and power development (see table 6.8). Anatomical adaptation is the only exception here, for which you can organize a circuit training as mentioned earlier.

Please adjust the program according to your environment, the equipment available to you, and, most important, the abilities and backgrounds of your athletes. For athletes reaching maturity (18 years or more) in college athletics, or professional athletes, I suggest you consider another book of mine, *Periodization of Training for Sports*, published by Human Kinetics in 1999.

As parents or instructors may organize their own programs, I ask that you please consider the following important points:

- Do not use loads over 80 percent of 1RM. Your athlete may not be ready for it.
- Alternate per week workouts for maximum strength and power.
- In any program try to have two exercises for both arms and legs.
- Athletes must perform power exercises dynamically and explosively.
- Do not shorten the rest interval. If anything, increase it!
- Do not push! Your athlete still has a few years ahead of him or her before using heavy loads (over 80 percent) or taxing workouts.

A training log is always convenient for keeping records of your athlete's training and monitoring his or her progress more efficiently. Please refer to the training log in table 6.9.

Table 6.6 Periodization Model for Strength Training for Annual Plan for Late Postpuberty

Dates	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
Training phase	Preparatory						Competitive				Transition	
Periodization of strength	AA			- M $\times$ S < 80% - Power			Power				AA	

Notes: AA = Anatomical adaptation.

MxS = Maximum strength with a load below 80% of 1RM.

Table 6.7 Strength-Training Program for Maximum Strength (<80%)

Exercises	Load % 1RM	Number of reps	Number of sets	Rest interval (sec)
• Leg press	70 - 80%	6 - 8	2	2
• Chest press	70%	8	2	2
• Abdominal arch	—	8 - 10 (12)	1	1
• Trunk extension	—	12 - 15	1	1
• Half squat	60 - 70%	10 - 12	2	2
• Drop push-up	—	6 - 10	1	1
• Leg curl	50%	8	2	3
• Pull-up	—	Maximum	2	2
• Inclined overhead leg lift	—	8 - 10	1	2

Note: — means no load or own body weight.

Table 6.8 **Strength-Training Program for Power Development**

Exercises	Number of reps	Number of sets	Rest interval (min)
• Wall push-up	8 - 10 (12)	2	2
• Knee-tuck jump	15 - 20	2	2
• Abdominal thrust	8 - 10	1	1
• Trunk extension	6 - 10	1	2
• MB chest throw	15 - 20	2	2
• Double-leg burpee	8-10	2	2

Table 6.9 Training Log

	Sets					
Exercises	1	2	3	4	5	6

Enter exercise load and number of repetitions per set (example 180×6).

Exercises for Prepuberty

From the multitude of exercises for strength training, the following exercises are guidelines only and not restrictions. You can use other exercises, depending on the environment and facilities.

DUMBBELL SIDE RAISE

Area worked: shoulders

1. Begin standing, feet apart, arms at the side.
2. Lift the arms up above the head.
3. Return to starting position.



DUMBBELL CURL

Area worked: biceps

1. Begin standing, arms extended down in front of the hips, palms facing upward.
2. Flex right elbow, lifting weight toward right shoulder.
3. Return to starting position. Repeat with the left arm.

DUMBBELL SHOULDER PRESS

Area worked: shoulders, especially trapezius

1. Begin standing, holding the dumbbells at shoulder level.
2. Press dumbbells straight above the shoulders.
3. Return them to starting position.



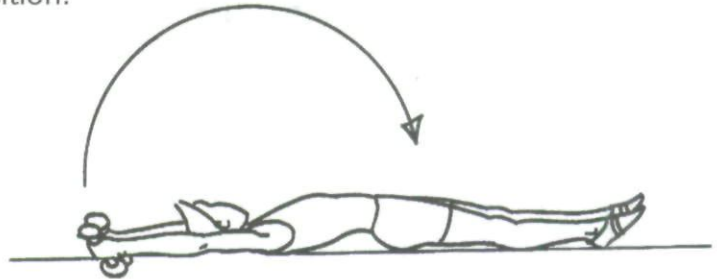
DUMBBELL OVERHEAD RAISE

Area worked: shoulders

1. Lie on your back, arms along the body.
2. Raise both arms up and over the head to the floor.
3. Return to the starting position.

Variation

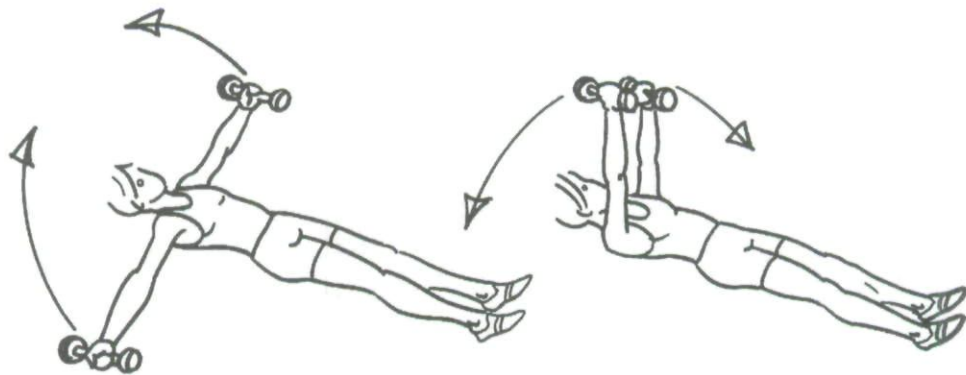
Repeat the same with each arm alternately.



DUMBBELL FLY

Area worked: chest and shoulders

1. Lie on your back, arms extended to the sides.
2. Raise both arms to vertical (above the chest).
3. Return to starting position.



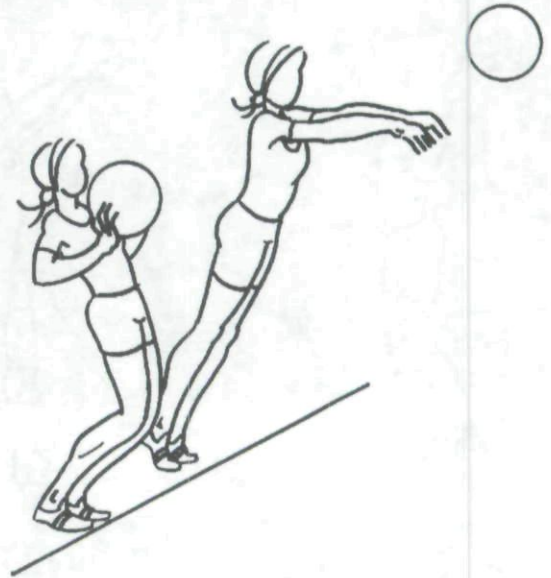
Athletes perform most medicine ball exercises with catching and throwing. The thrower performs the action progressively faster, achieving maximum acceleration at the end. The catcher anticipates the ball by extending the arms forward to receive it. As the athlete catches the medicine ball, the arms flex progressively to absorb the shock. After absorbing the shock, the athlete can maintain momentum, and by performing a semicircular motion, the speed of the ball accelerates, culminating in another throw.

Note: Suggested weight for the medicine ball is 2 kilograms (4 pounds) for prepuberty, 3 to 4 kilograms (7 to 9 pounds) for puberty, and 4 to 6 kilograms (9 to 13 pounds) for postpuberty.

MEDICINE BALL CHEST THROW

Area worked: shoulders and arm extensors (triceps)

1. Begin standing, two partners facing each other, 8 to 10 feet apart, with partner A holding a medicine ball in front of the chest.
2. Partner A extends the arms up and forward, throwing the ball toward the chest of partner B.
3. After catching the ball, partner B throws the ball back to partner A.



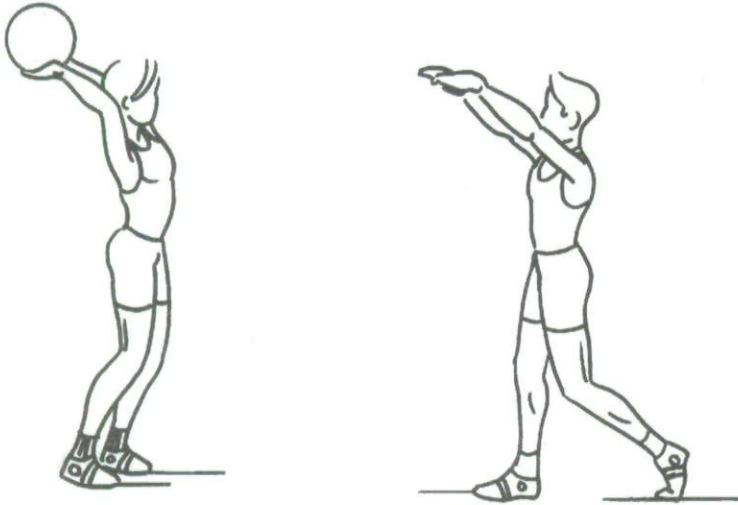
MEDICINE BALL TWIST THROW

Area worked: arms, trunk, and oblique abdominal muscles

1. Partner A faces partner B with his or her left side, holding the ball at hip level.
2. Partner B faces partner A anticipating the ball with arms extended forward.
3. Partner A turns the body to the left, arms extended, releasing the ball through the side toward partner B.
4. After catching the ball, partner B takes the same starting position (side facing partner A), performs a rotation, returning the ball to partner A in the same manner.



MEDICINE BALL FORWARD OVERHEAD THROW



Area worked: chest, shoulders, arms, and abdominal muscles

1. Partners face each other, 2.5 to 3 meters (8 to 10 feet) apart, with partner A holding the ball above the head.
2. Partner A extends the arms backward, then immediately forward toward the chest of partner B.
3. After catching the ball, partner B returns it to partner A with the same motion.

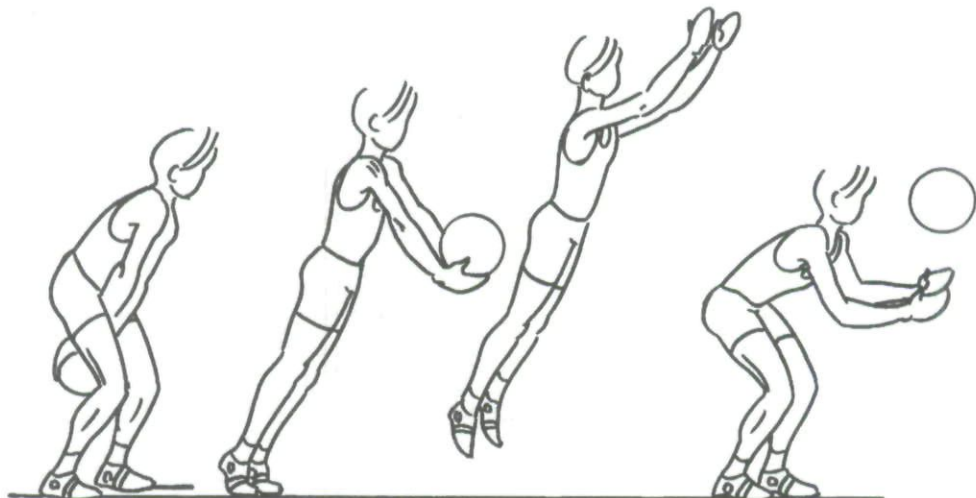
MEDICINE BALL SCOOP THROW

Area worked: ankles; knees; hip extensors; and arm, shoulder, and back muscles

1. Begin standing, feet apart, holding the ball between the legs.
2. Bend the knees, then immediately extend them, throwing the ball vertically with the arms.
3. Extend arms upward to catch the ball, and return to the starting position.

Variation

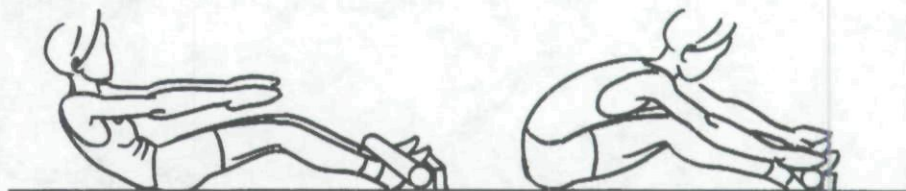
You can perform the same exercise with a partner.



ABDOMINAL CRUNCH

Area worked: abdominal and hip flexor muscles

1. Lie on the floor, arms along the body, with either a partner or furniture holding your feet on the ground. Knees are slightly bent.
2. Raise the upper body up and forward, touching the knees with the chest.
3. Relax and bring the trunk slowly back to starting position.



MEDICINE BALL BACK ROLL

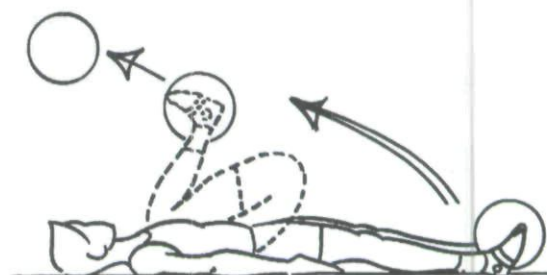
Area worked: abdominals and hip flexors

1. Lie on the back, arms along the body, holding a medicine ball between your feet, with knees slightly bent.
2. Raise the legs above the head.
3. Lower legs back to starting position.

Variation

You can perform the same exercise with a partner, throwing the ball backward overhead.

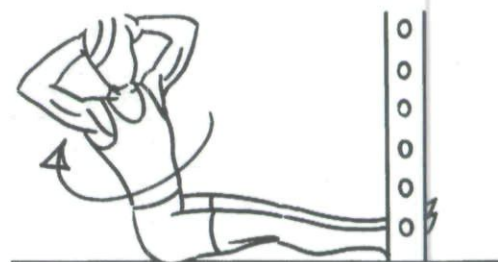
Note: When the ball is above your face, place your palms over your face to catch it so it doesn't fall on your face or head.



TRUNK TWIST

Area worked: abdominal obliques

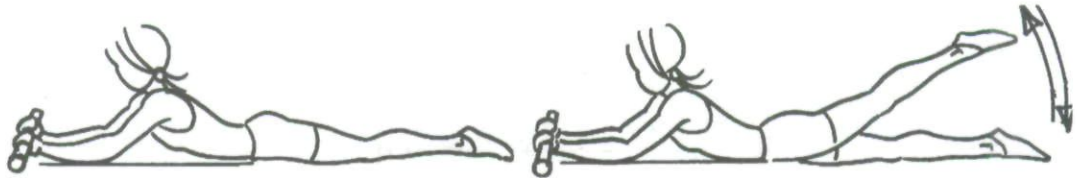
1. Sit with a partner holding your feet or resting them under a heavy object or stall bars; hands are behind your neck, knees slightly bent.
2. Lean slightly back, with the trunk in an oblique position. Turn the trunk to the left as far as possible.
3. Return to the starting position, and turn the trunk to the right as far back as possible.



SINGLE-LEG BACK RAISE

Area worked: hip extensors and spine muscles

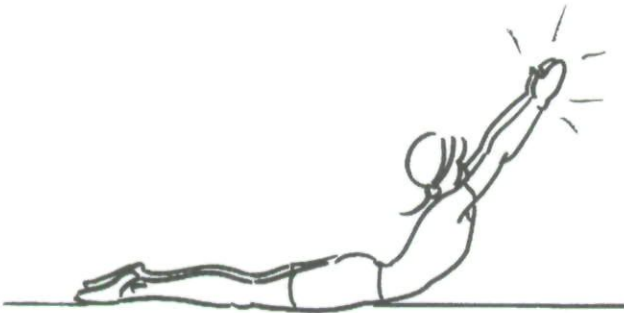
1. Lie on stomach, arms extended forward.
2. Lift left leg upward as high as possible.
3. Lower the left leg to the floor and lift the right leg.



CHEST RAISE AND CLAP

Area worked: lower back muscles

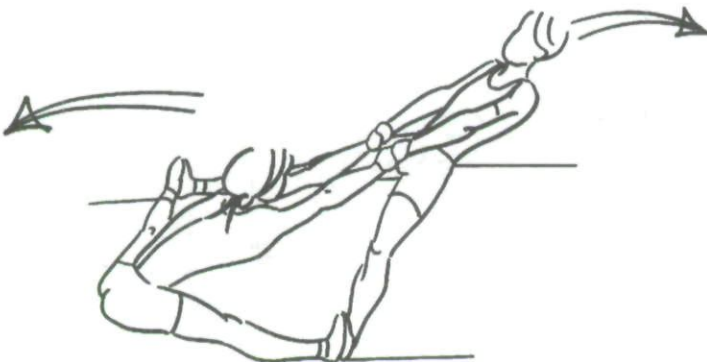
1. Lie on stomach, arms extended forward on the floor.
2. Raise the chest with arms extended and perform two or three claps.
3. Relax trunk and lower arms to the floor.



SEATED BACK EXTENSION

Area worked: back and shoulder muscles

1. Sit, feet apart, two partners facing each other, arms extended in front of the shoulders, hands firmly grasped.
2. Partner B performs an upper-body extension and partner A resists it slightly, so partner B can perform the motion slowly.
3. Repeat with partners changing roles.



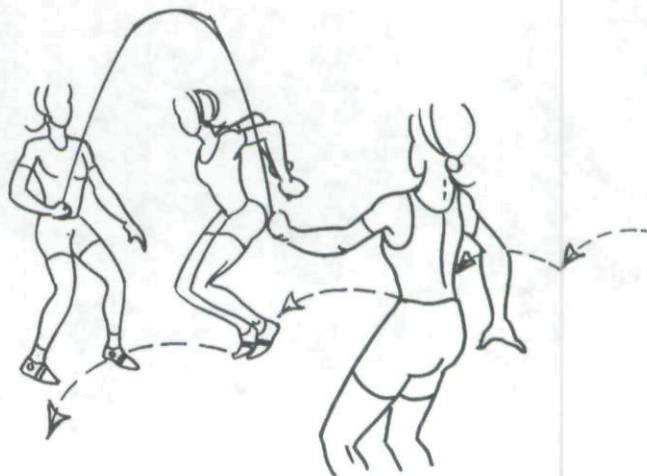
TWO-LEG SKIP

Area worked: calf and knee extensor muscles

1. Two children hold the ends of a skipping rope, with the third ready to skip the rope.
2. Rope holders rotate the rope, while the performer jumps up and down to avoid being hit by the rope.
3. Stop the action after 15 to 20 seconds, and change roles.

Variations

- One-leg skip on the spot.
- Two-leg forward skips.
- One-leg skip forward.
- Two-leg backward skips.
- One-leg backward skips.
- Alternate one- and two-leg skips forward and backward.



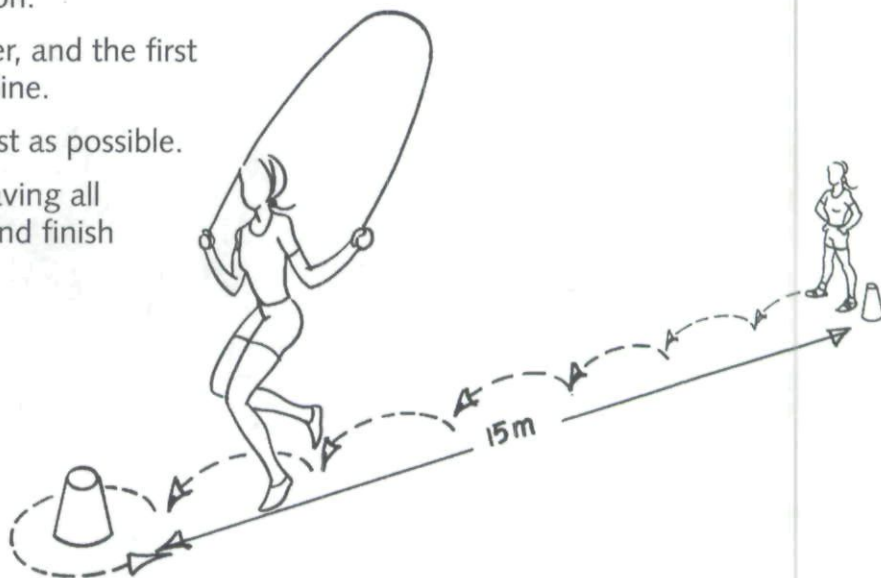
LOOP SKIP

Area worked: calf and knee extensors

1. Two teams are lined up behind a starting line. Each team has a cone 15 meters or yards in front of them.
2. At the signal, players skip the rope while moving forward, loop around the cone, and return to starting position.
3. The rope goes to the next player, and the first performer goes to the end of the line.
4. Each player skips the rope as fast as possible.
5. The winning team is the one having all players skipping over the course and finish line first.

Variation

Time individual performance (going over the course from start to finish).



DODGE THE ROPE

Area worked: calf and knee extensors

1. A group of players form a circle. In the middle of the circle there is a player holding the end of a skipping rope. The distance from the player in the middle to the circle is equal to the length of the rope.

2. The player in the middle swings the rope in a circle at ankle height. As the rope approaches each player, he or she jumps over it.

3. When the rope hits a player, he or she goes in the middle of the circle.



ZIGZAG MEDICINE BALL THROW

Area worked: arms and shoulders

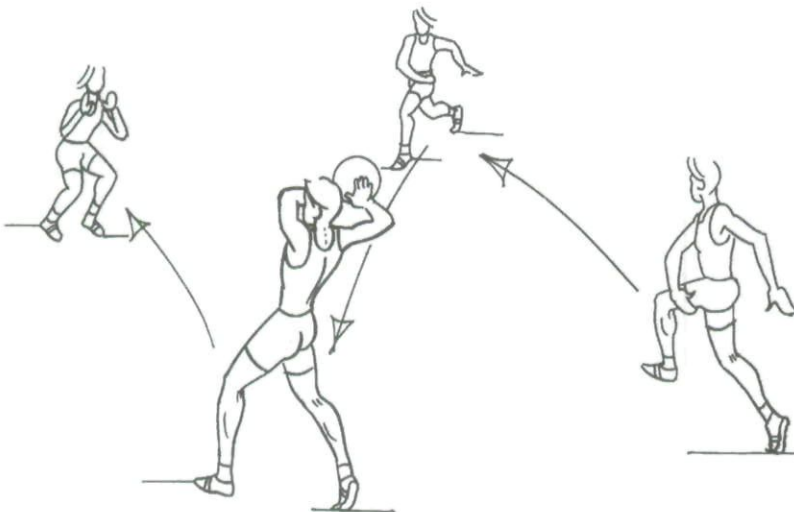
1. Two equal teams line up where they can throw a ball in zigzag: 4 meters (10 feet) aside and in front of each other. The first player holds a medicine ball.

2. Throw the ball with two hands, from player to player.

3. The first team that completes the course is the winner.

Variation

Throw the ball with one hand, overhead with two arms, and from the side.



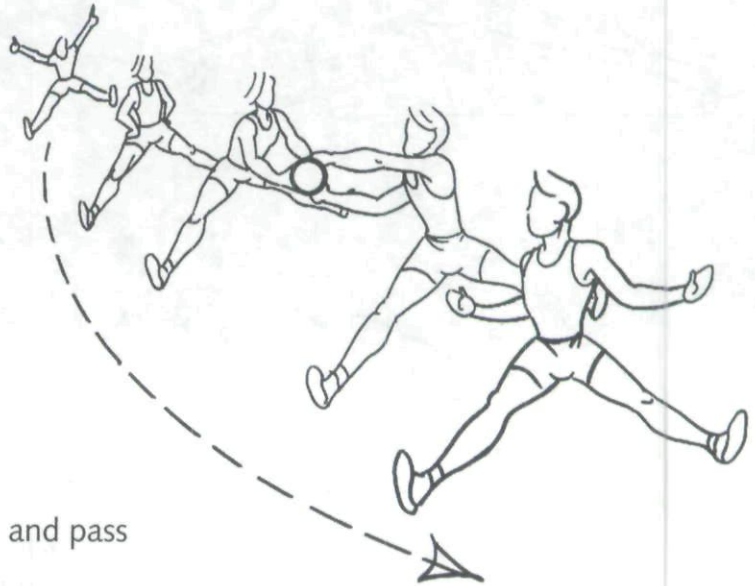
MEDICINE BALL SIDE PASS RELAY

Area worked: abdominal obliques and shoulders (deltoids)

1. Two equal teams sit with their feet apart.
2. The first player holds the ball.
3. Calculate the distance between players so they can perform the pass comfortably.
4. The first player rotates to the right, passing the ball to the next player.
5. Continue this as fast as possible to the end of the line.
6. The last player stands up, runs to the front as quickly as possible, sits down, and starts the series again.
7. The relay is over when the first player is at the end of the row.
8. The winner is the team that finishes first.

Variations

- Pass the ball alternately to each side.
- Pass the ball back over the head.
- Hold the ball between your feet, roll over, and pass the ball to the feet of the next player.



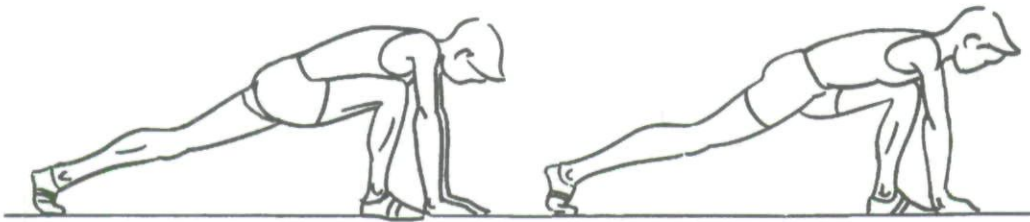
Exercises for Puberty

Exercises for puberty allow benefits such as developing coordination and agility, but in a form of play or games in which the children perform a basic strength exercise. The variety of movements children perform help them develop basic coordination and agility and awareness of how muscles work in different positions.

SINGLE-LEG BURPEE

Area worked: shoulders and back muscles

1. Push-up stand, right leg bent under the chest, the left leg extended backward.
2. Exchange leg positions by bringing the left leg to the starting position, right leg backward.



3. Repeat same to fatigue.

Variation

Double-leg burpee

PUSH-UP



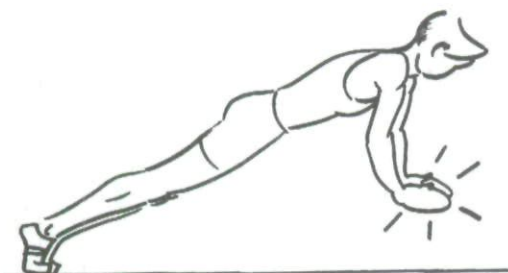
Area worked: shoulders, triceps, and back muscles

1. Push-up stand, elbows extended.
2. Bend elbows to lower body to floor level.
3. Return to starting position.

CLAP PUSH-UP

Area worked: shoulders, triceps, wrist extensors, and back muscles

1. Push-up stand, elbows extended.
2. Bend elbows to lower body to floor level, and extend the elbows vigorously above the floor.
3. At the highest level, push the palms against the floor and quickly perform a clap.



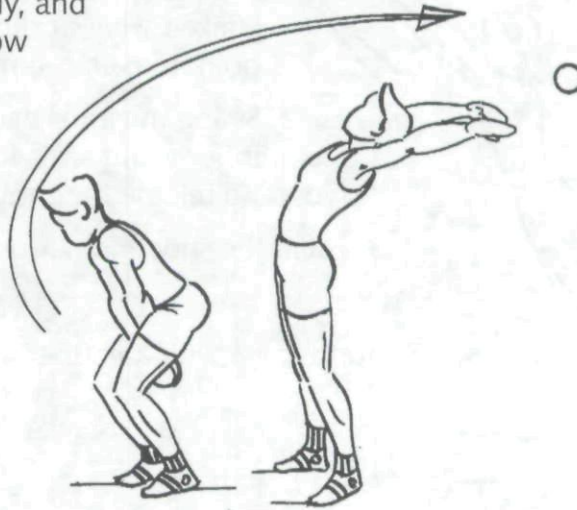
4. As the body descends toward the floor, place the palms again on the floor and push up aggressively to continue the exercise.

5. After you perform the desired number of repetitions, return to starting position.

BACKWARD OVERHEAD SHOT THROW

Area worked: hip and knee extensors, back, and shoulder muscles

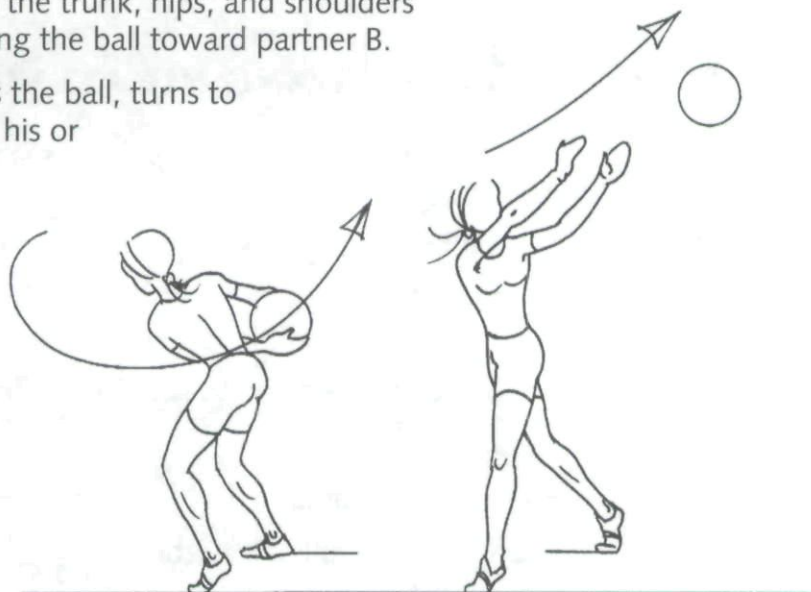
1. Stand, feet apart, hands holding the shot between the legs.
2. Extend knees, hips, and upper body, and by swinging the arms backward, throw the shot backward overhead.
3. Bring arms relaxed along the body, take a shot, and repeat.



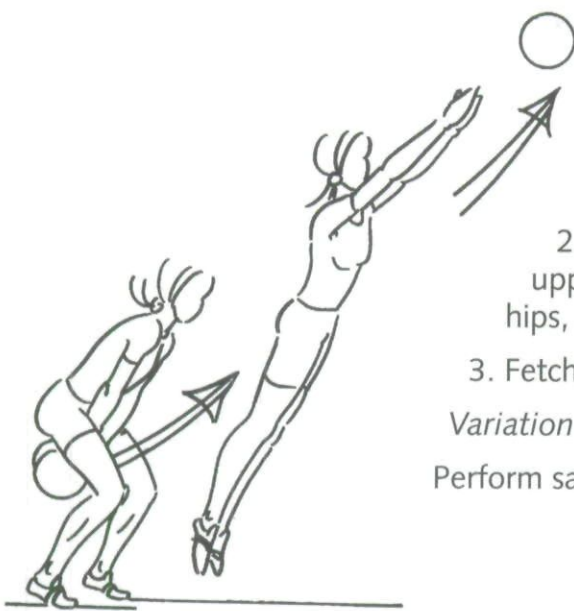
MEDICINE BALL SIDE THROW

Area worked: abdominal obliques, leg extensors, and shoulder muscles

1. Partner A holds the medicine ball on right side of the hips, back facing partner A.
2. Partner A rotates the trunk, hips, and shoulders dynamically, throwing the ball toward partner B.
3. Partner B catches the ball, turns to face partner A with his or her back, and repeats same.



FORWARD SHOT/MEDICINE BALL THROW



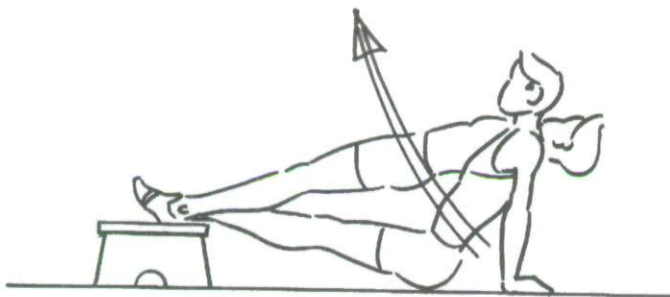
Area worked: leg extensors, hips, back, and arm and shoulder muscles

1. Stand facing direction of throw, hips and knees flexed. Feet at shoulder width, shot/medicine ball held on both palms, arms fully extended.
2. Swing the arms back between the legs. Swing the upper body and arms forward, extending the knees and hips, and release the shot/medicine ball forward.
3. Fetch the shot and perform same again.

Variation

Perform same with a partner 4 meters (15 feet) apart.

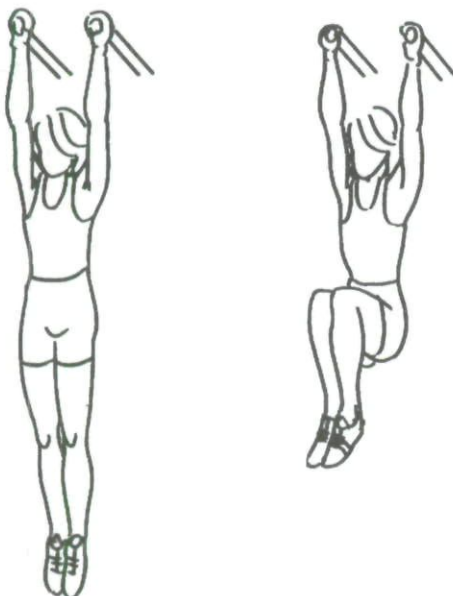
HIP THRUST



Area worked: abdominals, hip flexors, and arm and shoulder muscles

1. Sit, feet rested up on a bench or any high object (one foot above ground), hands on the ground, slightly behind the hips.
2. Thrust the hips upward to horizontal (or higher), in full body extension.
3. Relax and lower hips to starting position.

HANG HIP FLEXION



Area worked: abdominals, hip flexors, and finger flexor muscles

1. Hold body hanging straight down by gripping with the hands on a high bar, rings, or something similar.
2. Lift both knees up, toward the stomach.
3. Relax and return legs to starting position.

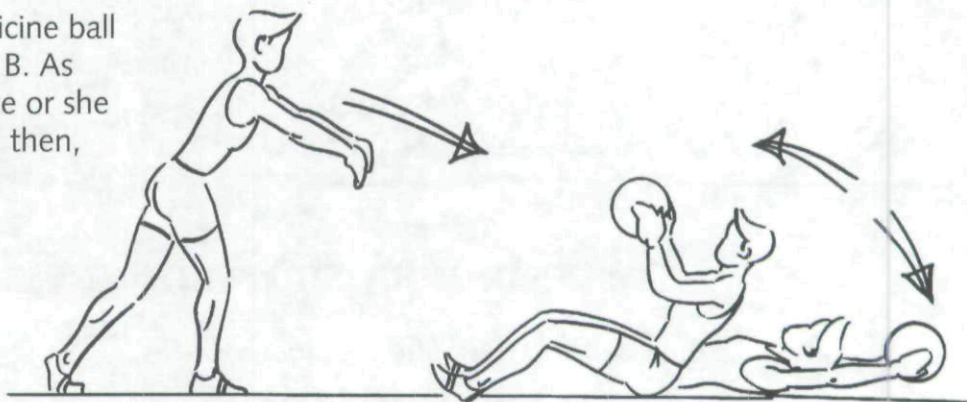
Variations

- One leg at a time.
- Lift legs with knees straight.

MEDICINE BALL SIT-UP THROW

Area worked: abdominal and shoulder muscles

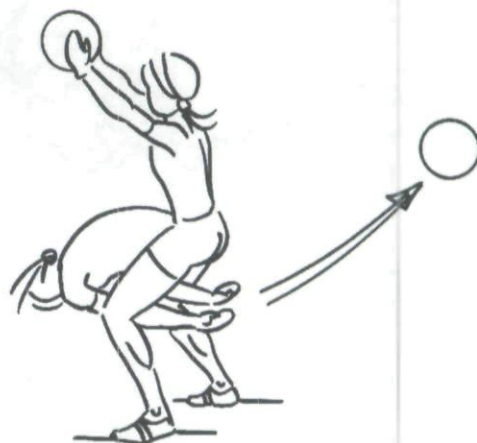
1. Partner A stands, feet apart, holding the ball. Partner B sits, feet apart, knees slightly flexed.
2. Partner A tosses the medicine ball toward the chest of partner B. As partner B catches the ball, he or she rocks back toward the floor, then, using the momentum of an upper-body forward thrust, throws the ball back to partner A.
3. Return to starting position. Alternate roles.



BETWEEN-LEG MEDICINE BALL BACKWARD THROW

Area worked: abdominal and shoulder muscles

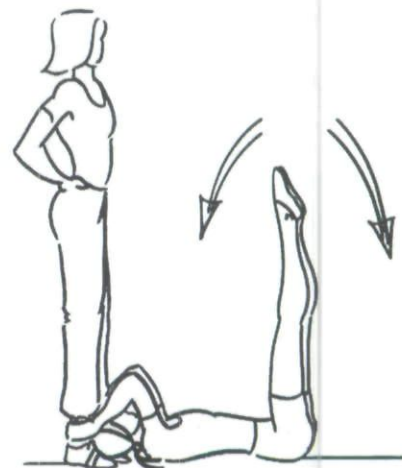
1. Partner A stands, feet apart, holding a medicine ball above head. Partner B faces the back of partner A.
2. Flex hips dynamically, bringing hands between legs, releasing the medicine ball backward toward partner B.
3. Partner B catches the ball, turns around, and performs same toward partner A.



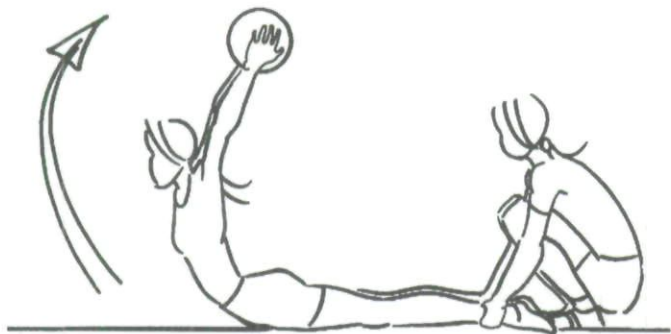
DOUBLE-LEG SIDE LIFT

Area worked: oblique abdominal muscles

1. Partner A stands, feet apart, while partner B lies down, head near partner A's feet, and grasps the ankles of partner A.
2. Partner B lifts the legs up to vertical, lowering them to the floor, up again to vertical, and down again to the other side.
3. Return legs to starting position. Alternate roles.



MEDICINE BALL TRUNK RAISE



Area worked: back, hips, and shoulder muscles

1. Partner A is lying on his or her stomach, holding the ball above the head. Partner B supports A's ankles.
2. Partner A raises the ball by arching the back.
3. Return to starting position.
4. Each partner performs alternately.

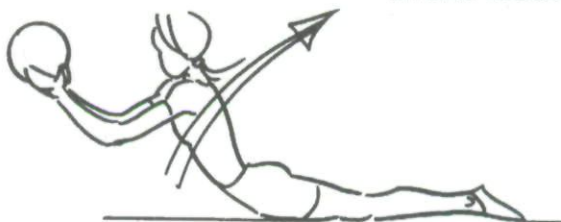
TRUNK RAISED MEDICINE BALL THROW

Area worked: back and shoulder muscles

1. Lying on their stomachs, head to head, 3 meters (10 feet) apart, partner A grasps the ball that rests on the floor.
2. Partner A arches the body back, lifting the ball, then throws it to B.



3. Partner B catches it and throws it back to A.



OVERHEAD MEDICINE BALL BACKWARD THROW

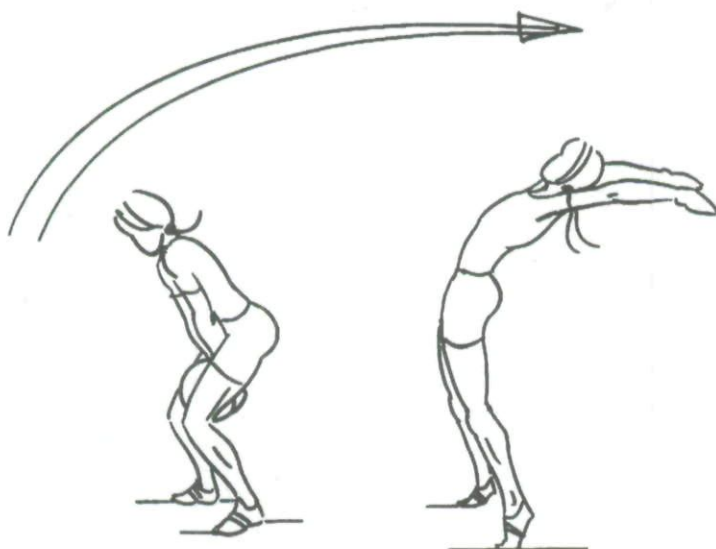


Area worked: back and shoulder muscles

1. Begin standing, feet apart, holding medicine ball between your legs.
2. Swing arms up and backward, arch body, and throw the ball backward.
3. Fetch the ball and do the same again.

Variation

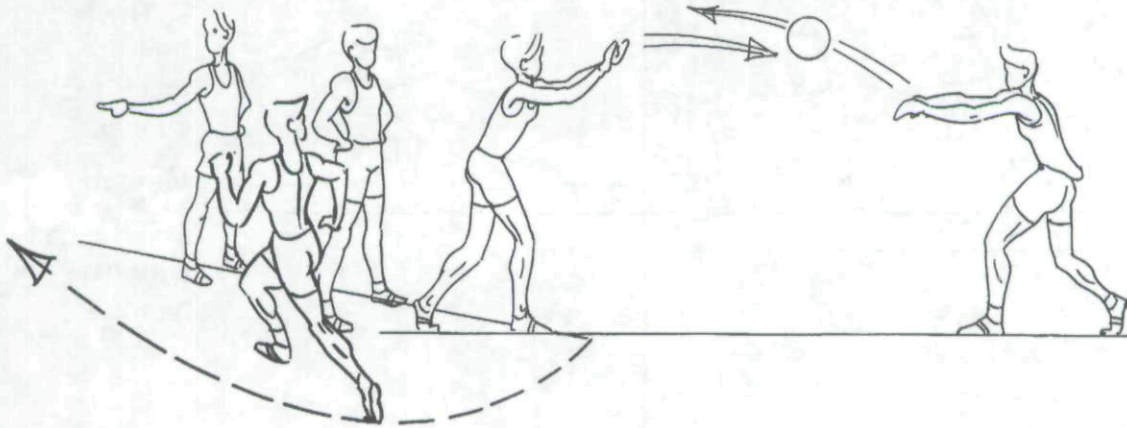
Perform the movement with a partner.



MEDICINE BALL CHEST PASS RELAY

Area worked: arm strength; leg strength; acceleration

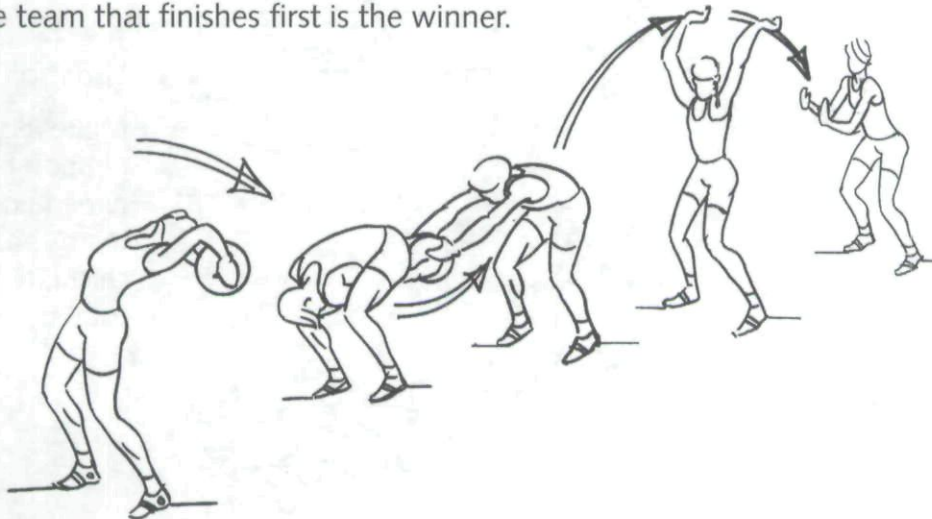
1. Two or more teams line up facing their captain.
2. He or she passes the ball to the first player who passes it back, goes to the end of the line, and sits down.
3. The team that finishes first and sits down quickly is the winner.



OVER-UNDER BRIDGE RELAY

Area worked: knee extensors, abdominals, and trunk extensors

1. Teams pass the medicine ball alternately over the head and between the legs.
2. The last player runs quickly with the ball to the front of the line and starts again.
3. The team that finishes first is the winner.



ROLL MEDICINE BALL UNDER THE BRIDGE

Area worked: shoulders and legs (sprinting)

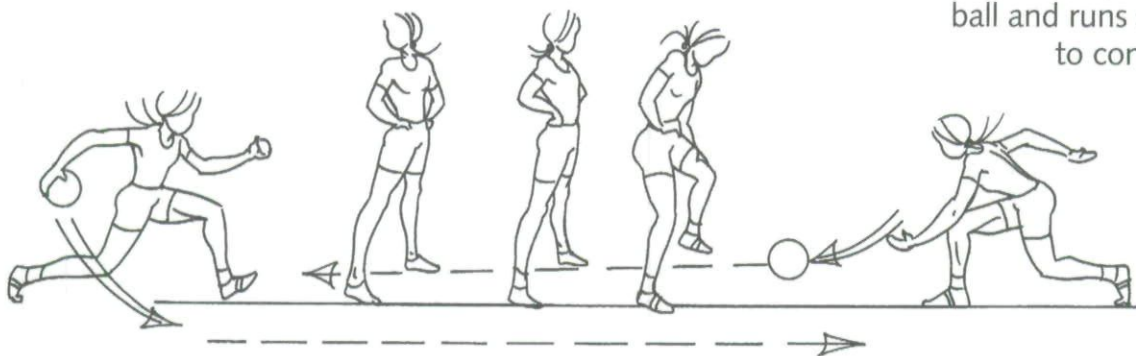
1. Teams stand in line, feet part. The first player rolls the ball between the legs to the last player in line, then moves to the back of the line.

2. The last player catches the ball and runs quickly in front to continue the task.

3. The team that finishes first is the winner.

Variation

Roll the ball with two hands.



OBSTACLE RUN RELAY

Area worked: balance, leg power (sprinting)

1. Create an obstacle course from the equipment and objects you have available.

2. Mark the course so each player has to perform the same task.

3. Time each athlete's performance to check individual improvement.

Variation

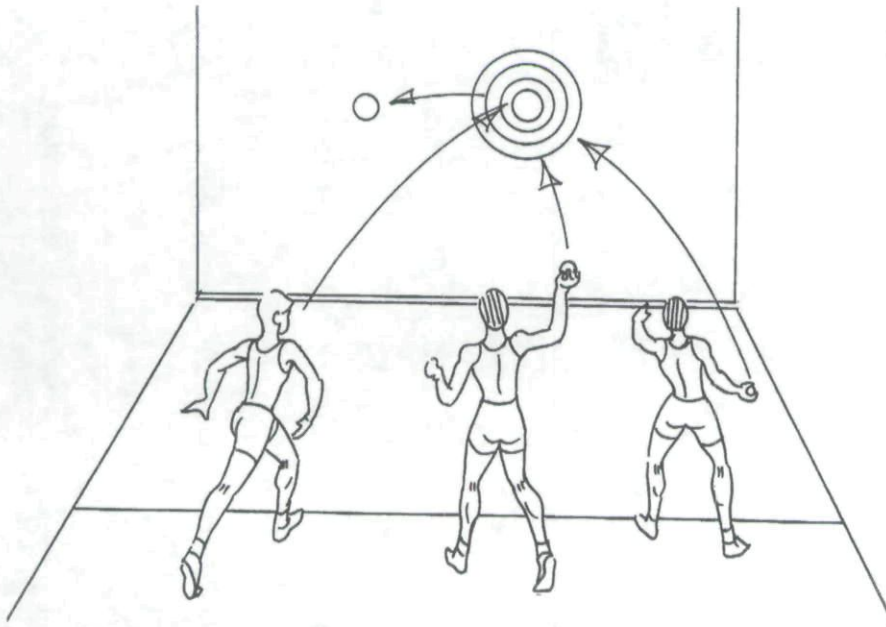
Make a competition between equal teams and calculate their total time.



BASEBALL OR TENNIS DART GAME

Area worked: shoulder strength and accuracy in throwing

1. Draw five circles on a wall. The inner circle is 30 centimeters (one foot) in diameter, and subsequent circles are 20 centimeters (eight inches) apart. The value for each circle should be 10 to 6, meaning if the athlete hits the inner circle he receives 10 points, the next circles are worth 9, 8, and 7 points, and the outer circle is worth 6 points. Draw lines at 15 meters (50 feet), 20 meters (65 feet), and 30 meters (100 feet).
2. Athletes have three throws from each distance, using overhand technique (like javelin throw or pitching).
3. Every time the ball hits an area, the athlete receives the specified score.
4. The sum of all throws represents the final score for each athlete, and all are ranked at the end of the game.
5. You could do the same with athletes in teams.



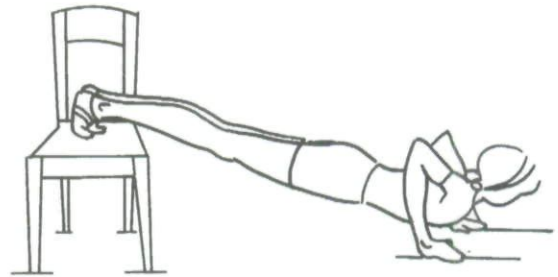
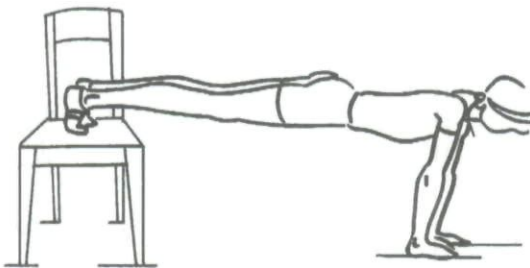
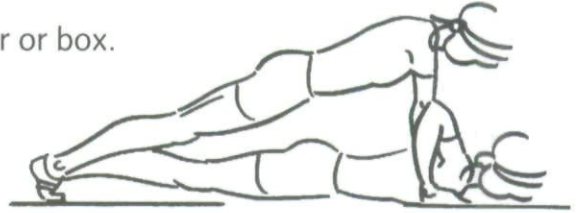
Exercises for Early Postpuberty

Most of the suggested exercises don't require a lot of equipment, and therefore can be performed at home or in a health club.

PUSH-UP PROGRESSION

Area worked: shoulders and elbow extensor muscles/triceps and trapezius

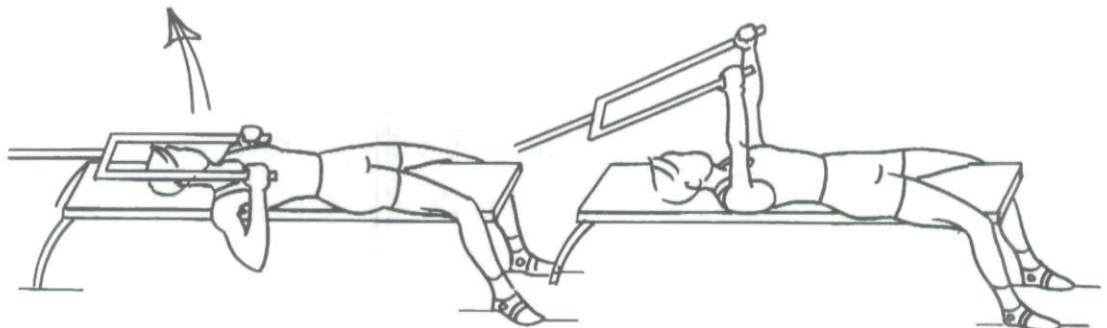
1. Push-ups against the wall (feet away and push vigorously against the wall to bring body to vertical).
2. Inclined palms supported on a chair or box.
3. Push-ups on the ground (knees).
4. Regular push-ups.
5. Clap push-ups.
6. Inclined, feet on a chair or box and hands on ground.
7. Clap push-ups from the same position as 6.



CHEST PRESS

Area worked: triceps (elbow extensors), shoulders, and chest

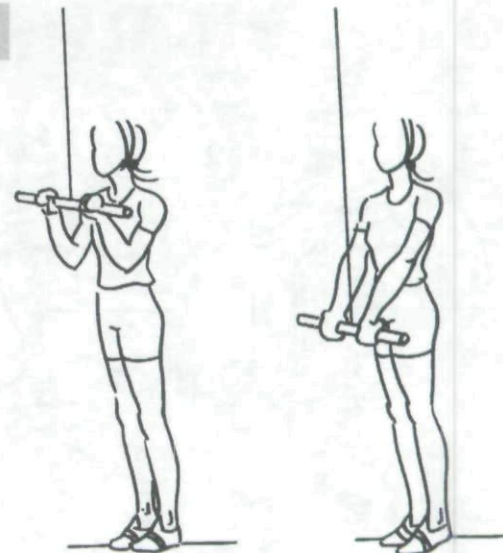
1. Lying on the back, grasp the handle of a universal gym, barbell, or any other chest press machine. Bend knees, place them on a bench or on the floor.
2. Press the handle up.
3. Lower the handle slowly to the starting position.



CABLE TRICEPS (ELBOW) EXTENSION

Area worked: elbow extensors (triceps) muscle

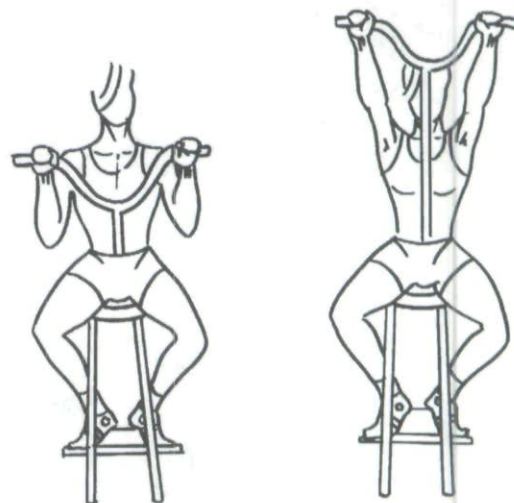
1. Stand, feet apart facing the machine. Grasp the bar, palms down, elbows bent, hands at chest height.
2. Press the handle down to hip height.
3. Return slowly and with control to starting position.



SHOULDER PRESS

Area worked: shoulder and elbow extensor muscles (trapezius and triceps)

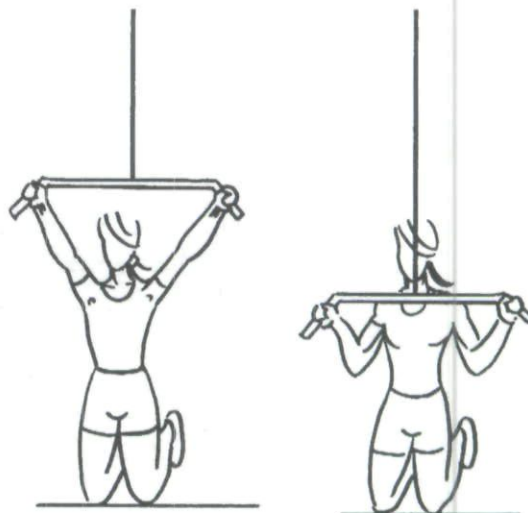
1. Sit, with your hands palm up, placed on the handle.
2. Press handle vertically.
3. Return slowly to starting position.



LATS PULL DOWN (FRONT)

Area worked: arm flexors and lats (latissimus dorsi) muscles

1. Kneel, facing the machine, grasping the handle.
2. Pull down the handle in front to chest level.
3. Return to starting position.

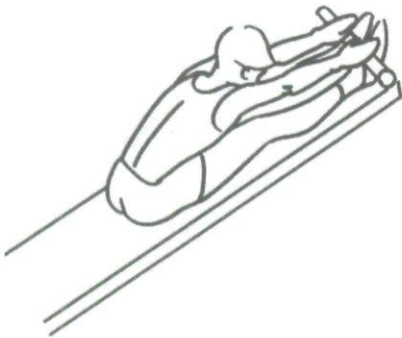


ARM CURL



Area worked: elbow flexors (mostly biceps) muscles

1. Sit, arms extended, elbows resting on the pad. Place hands, palms up, on the small pad or handle.
2. Bend elbows to bring pad or handle to chest level.
3. Return to starting position.



INCLINE BENCH SIT-UP

Area worked: abdominals

1. Lie on the bench, knees bent and feet supported behind the pad, arms above the head.
2. Raise upper body to touch the feet with the hands.
3. Return to starting position.

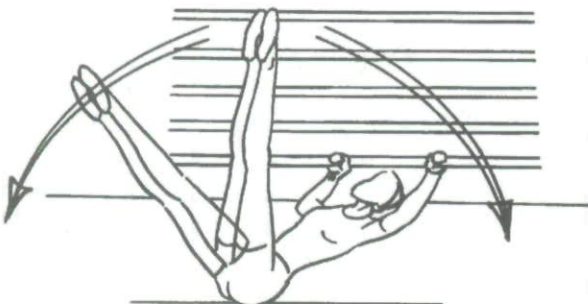


V-SIT

Area worked: abdominal and hip flexor muscles

1. Lie on floor, arms extended over the head.
2. Bring arms and legs up into a V-sit.
3. Return to starting position.

ABDOMINAL RAINBOW



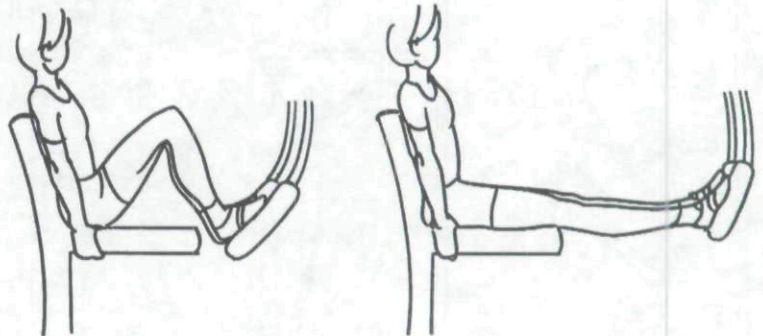
Area worked: oblique abdominals and hip muscles

1. Lie with your head near the lowest rung of a stall bar, hands gripping it.
2. Lift legs up and lower them to the right side. Lift them on the other side.
3. Rest legs on floor.

LEG PRESS

Area worked: knee extensors (quadriceps muscles)

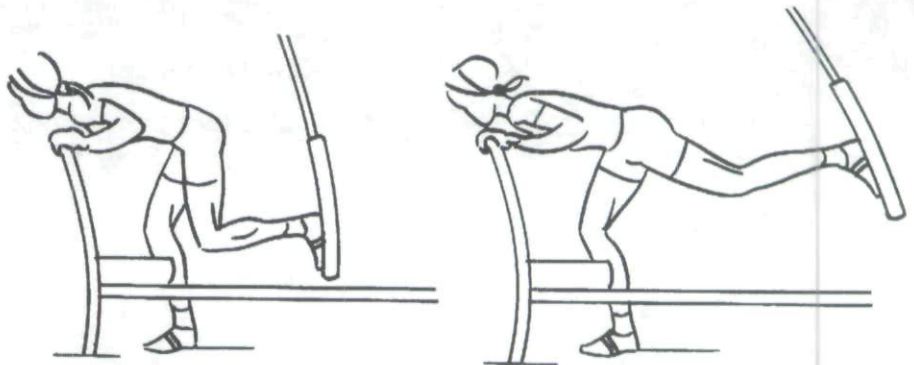
1. Sit on a leg press chair, place the balls of your feet on the paddle.
2. Press the paddle to full leg extension.
3. Return to starting position.



REVERSE LEG PRESS

Area worked: knee extensors and buttock muscles

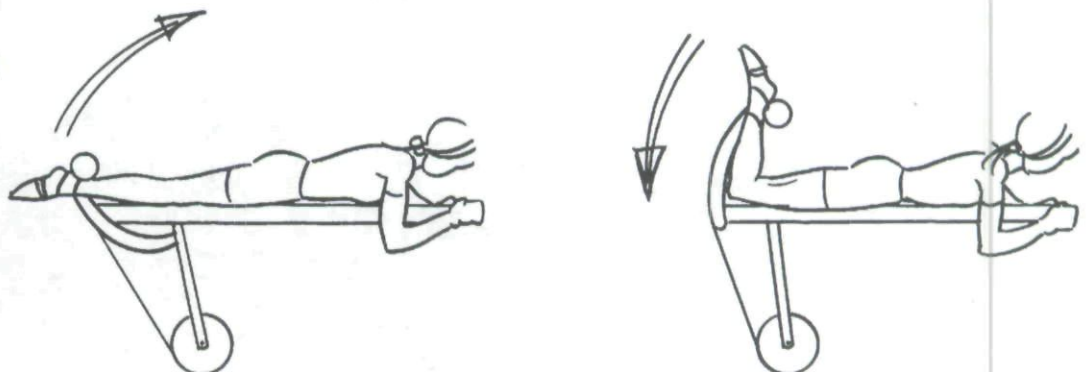
1. On a leg press machine, facing away from the machine, place the ball of a foot on the paddle, the other on the floor, and hands on the T of the back support.
2. Push the paddle backward to a full extension.
3. Return to starting position and alternate legs.



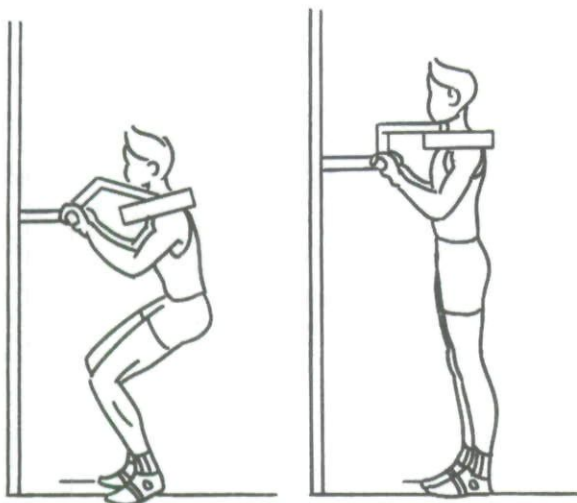
LEG CURL

Area worked: knee extensors (hamstrings) muscles

1. Lie on the stomach, place heels under the top padded roller, extend knees.
2. Flex (bend) the knees, bringing pad as close to buttocks as possible.
3. Return to starting position.



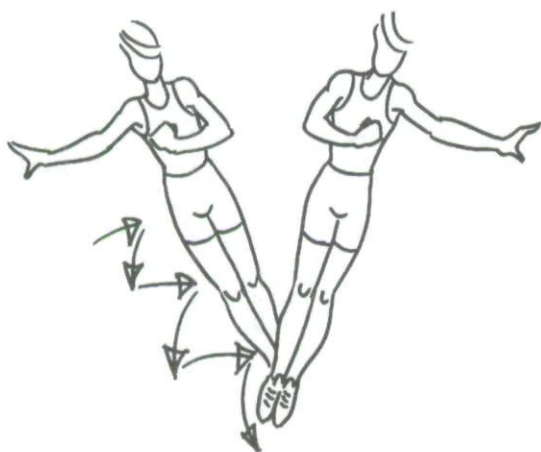
HALF SQUAT



Area worked: knee and hip extensors

1. Place shoulders squarely under the pads, hands grasping the bar. Place feet at shoulder width, knees bent, with the back straight.
2. Leading with head and shoulders upward, fully extend leg.
3. Return to starting position.

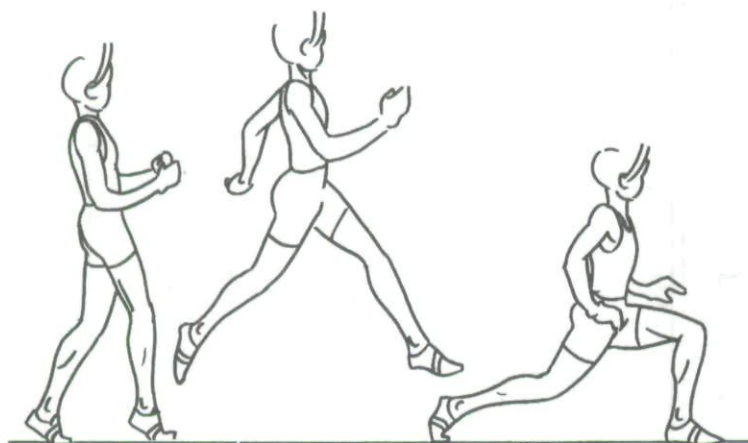
SLALOM JUMP



Area worked: calf and knee extensor muscles

1. Begin standing.
2. Use two feet to make continuous diagonal jumps, progressing forward in slalom fashion.

SCISSORS SPLITS



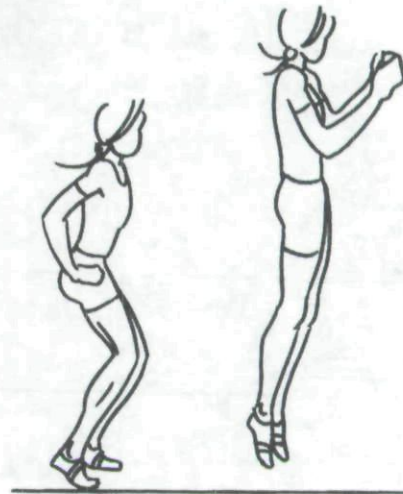
Area worked: calf and knee extensors

1. Stand, with one leg forward, the other behind.
2. Take off for a vertical jump and switch legs quickly in midair. Land and immediately jump again for continuous jumps.

VERTICAL HOP

Area worked: calf and knee extensors

1. Begin standing.
2. Swing the arms upward and press actively against the ground for a vertical spring.
3. Land, absorbing the shock, lowering the arms to hip level.
4. Repeat.



CONE JUMP

Area worked: calf, knee, and hip extensors

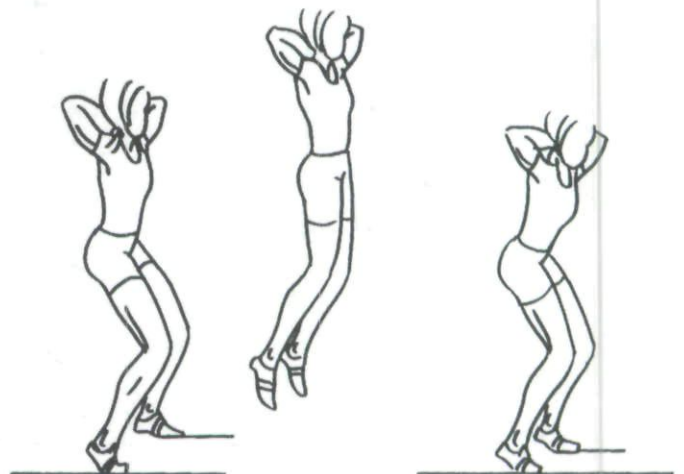
1. Begin standing in front of a row of cones two meters or yards apart.
2. Run and jump over each cone.
3. Return to the starting line.



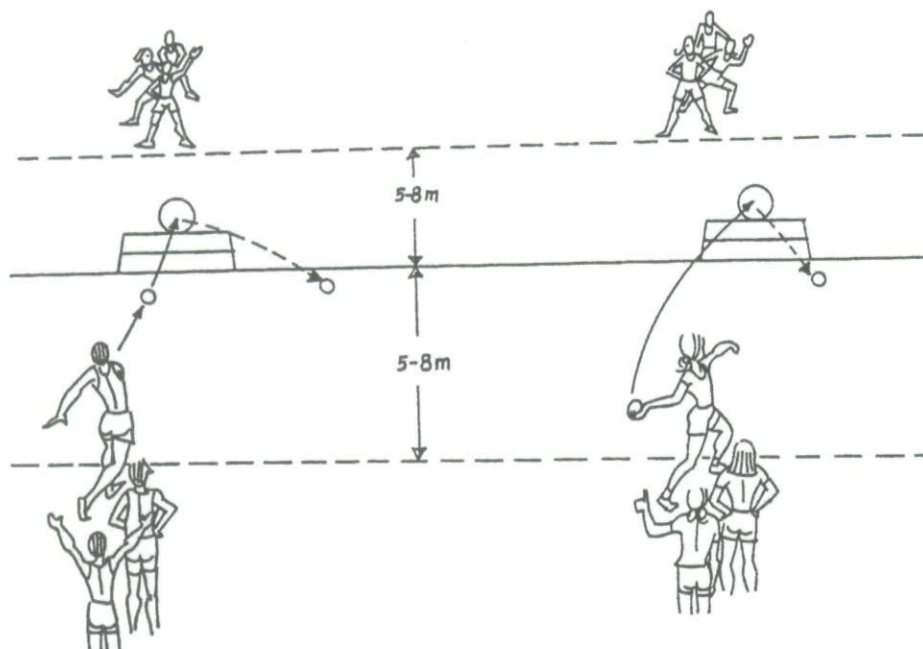
CONTINUOUS SQUAT JUMP

Area worked: calf, knee, and hip extensors

1. Stand, feet apart, hands behind the head.
2. Use active upward-forward movements. Land on toes, lower heels, and slightly bend the knees to absorb the shock.
3. Repeat the sequence.



BASEBALL OR TENNIS BALL THROW FOR ACCURACY



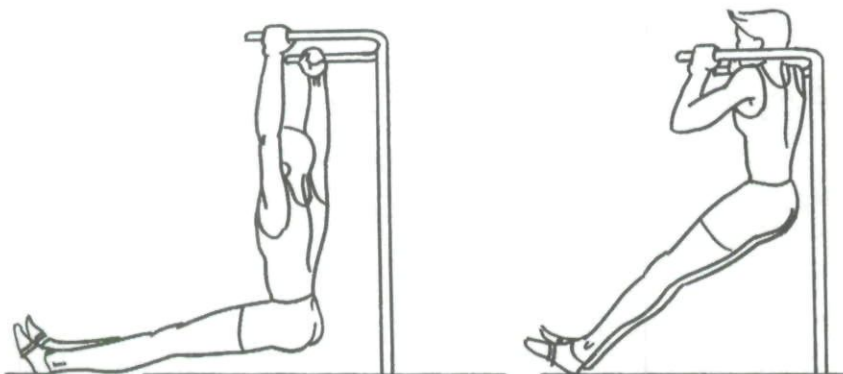
Area worked: shoulders

1. Two teams start, 10 to 15 meters or yards apart, on two lines.
2. In the middle of a gym or marked field, place two balls, bowling pins or upside-down cones so they fall easily when hit by a ball.
3. Each team or individual scores points for knocking over the cone.

Exercises for Late Postpuberty

The training program and exercises for late postpuberty are closer to the programs for high performance than those of early postpuberty. The exercises in this section are most sport-specific. In addition to the following exercises, you should also use some exercises from early postpuberty during this stage of athletic development, such as chest press (bench press), cable triceps extension, shoulder press, lats pull downs, and arm curls.

SEATED PULL-UP



Area worked: elbow flexors, chest, and lats

1. Grasp the handles or bar with feet resting on a bench or low box.
2. Pull up the body by flexing the arms.
3. Extend arms to return to starting position.

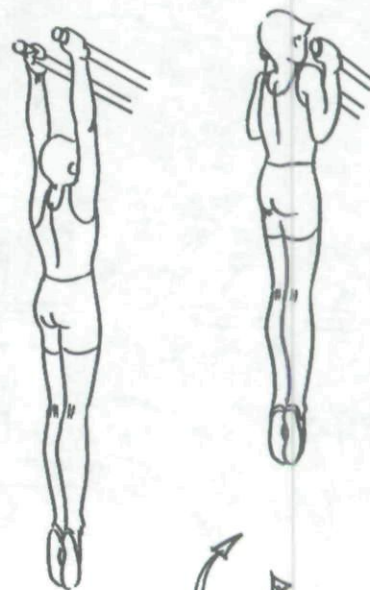
PULL-UP

Area worked: elbow flexors, chest, and lats

1. Grasp handles or bar, arms and body extended down, palms inward.
2. Pull up the body by flexing the arms.
3. Extend arms to return to starting position.

Variation

Grasp the handle, palms facing away.



ROPE CLIMB

Area worked: wrists, arms, and shoulder flexors

1. Using arms and legs
2. Using just the arms
3. Legs at horizontal
4. One hand for each rope
5. Same, holding a medicine ball between legs



CATERPILLAR PUSH-UP

Area worked: hands, elbow extensors, shoulders, and back muscles

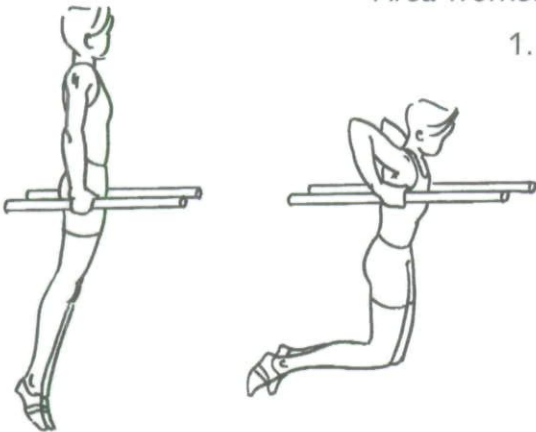
1. Bend hips, feet far apart, legs extended, hands at shoulder-width.
2. Bend elbows, lower shoulders toward the floor. Drive forward raising the head and extend arms straight.
3. Bring the feet close to the hands (as in the starting position) and repeat.



DIPPING

Area worked: elbow extensors and chest

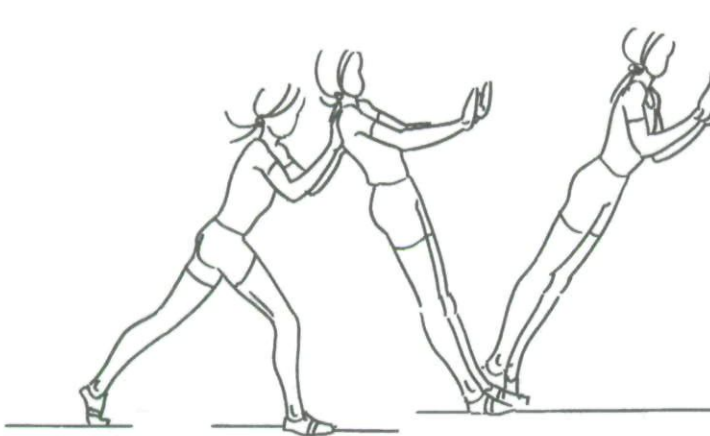
1. Grasp the handles of the machine, palms in.
2. Bend elbow, lower chest toward the bar.
3. Return to starting position.



WALL PUSH-UP

Area worked: elbow extensors, chest, and shoulders

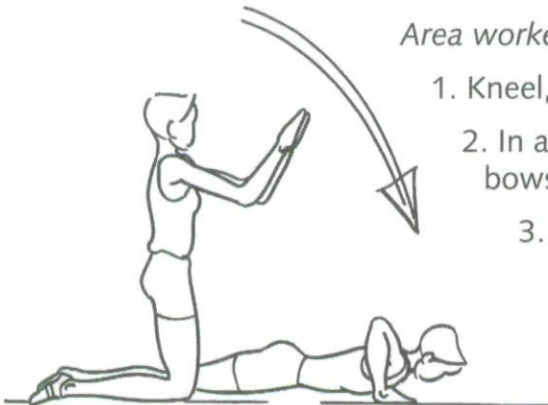
1. Partner A stands about 1 meter (2 or 3 feet) away from the wall, with partner B having palms on the upper back, and one leg placed behind the performer.
2. Partner B pushes partner A toward the wall. Partner A bends the elbows slightly to absorb the shock.
3. Immediately, in a dynamic action, partner A pushes against the wall to return to starting position. Continue the action without stopping for several push-ups.



DROP PUSH-UP

Area worked: arms flexors and extensors, chest, and back muscles

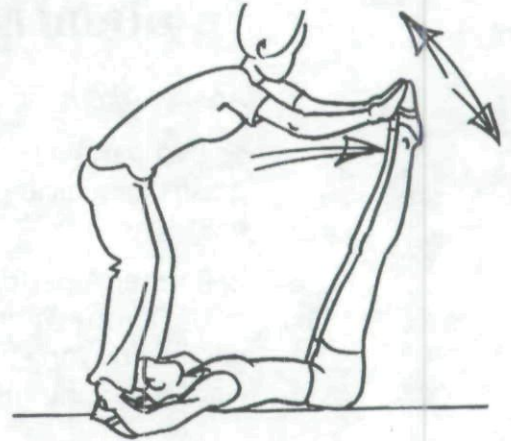
1. Kneel, with elbows bent at 90 degrees.
2. In a free fall, drop your body toward the floor, keeping elbows at 90 degrees.
3. Perform a dynamic push-up to return to starting position.



ABDOMINAL THRUST

Area worked: abdominals and obliques

1. Partner A lies on back with legs on the floor, holding partner B's ankles.
2. Partner A lifts legs toward the chest of partner B. Partner B pushes the legs down, or toward one side for a series of abdominal thrusts. This creates high tension at the abdominal level.
3. Lower legs to return to starting position. Alternate roles.



ABDOMINAL ARCH

Area worked: abdominals, hips, shoulders, and back

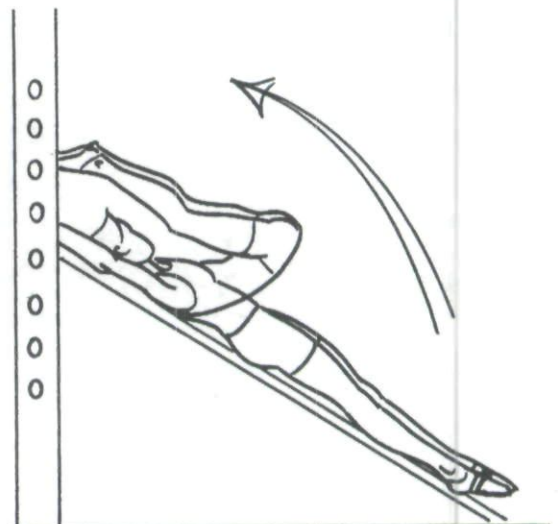
1. Sit with your back against the stall bars, arms above head, grasping the nearest rung.
2. Press the hips actively upward, arching the body (feet are on the ground, hands firmly gripping the rung).
3. Lower hips to starting position.



INCLINED OVERHEAD LEG LIFT

Area worked: abdominals

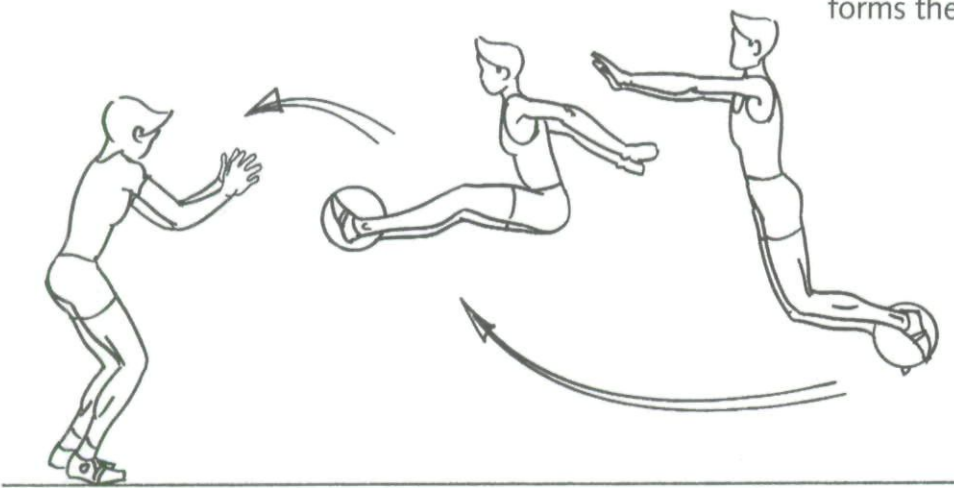
1. Lie on inclined bench holding a stall bar rung above the head.
2. Quickly lift the legs over the head.
3. Slowly return legs to starting position.



DOUBLE-LEG MEDICINE BALL FORWARD TOSS

Area worked: leg extensors and abdominal muscles

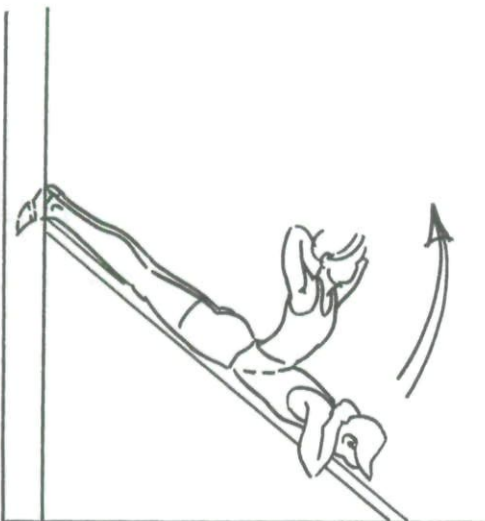
1. Two partners stand three meters (10 feet) apart facing each other. Partner A grasps a medicine ball between the feet and toes (toes are slightly under the ball).
2. Partner A performs a two-foot takeoff. At the approach to the highest point of the jump, slightly arch the hips, bringing the feet backward. As quickly as possible by forcefully contracting the abdominal muscles, bring the legs forward, releasing the ball toward the chest of partner B.
3. Partner B catches the ball and performs the same action.



TRUNK EXTENSION

Area worked: back muscles

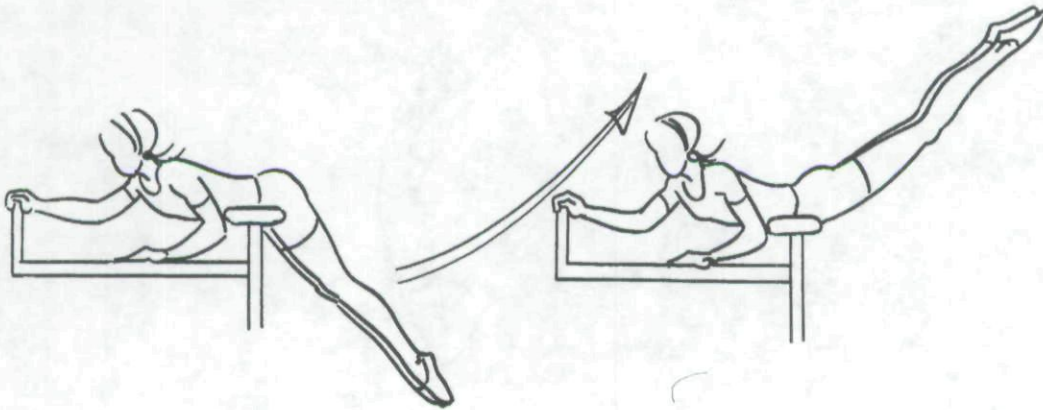
1. Lie on stomach on a diagonal bench, head down.
2. Arch upper body as high as possible.
3. Return to starting position and repeat.



THRUST LEGS UPWARD

Area worked: back and hip extensors

1. Lie on stomach, hips resting on a pad, arms holding a handle.
2. Thrust legs upward.
3. Lower legs to starting position and repeat.

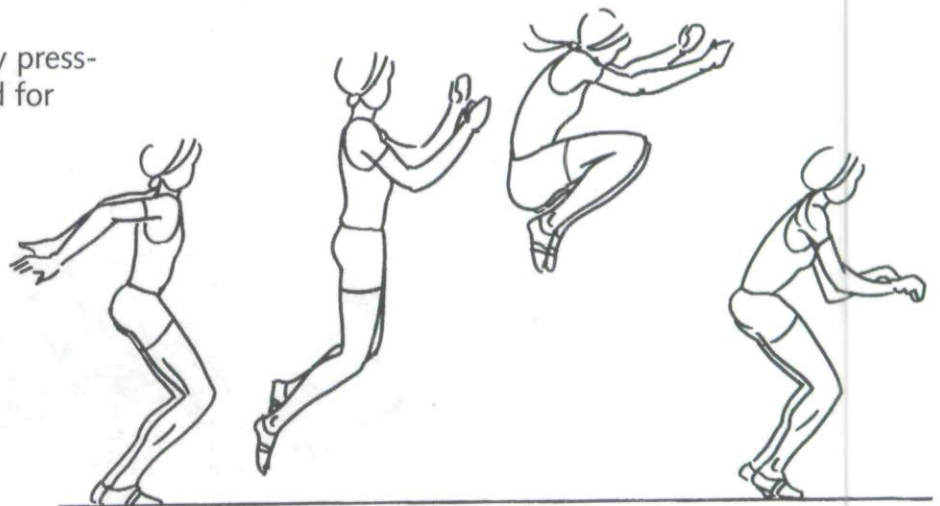


This section will focus mostly on exercises for leg power, which is often not well represented in athletic training. For leg strength, the instructor can also use exercises suggested for early postpuberty.

KNEE-TUCK JUMP

Area worked: calves, knees, and hip extensors

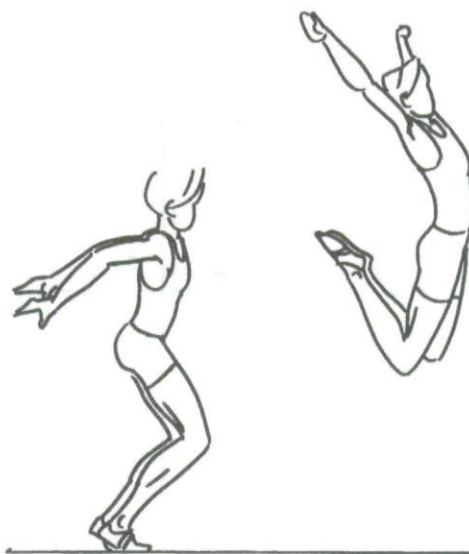
1. Begin standing.
2. Swing arms upward, actively pressing the feet against the ground for a vertical tuck jump.
3. Land on toes of both feet, lower arms; immediately drive arms up and spring upward again.
4. Land by flexing the knees to absorb shock and stop the jumps.



BACK KICK

Area worked: calves, knees, hip extensors

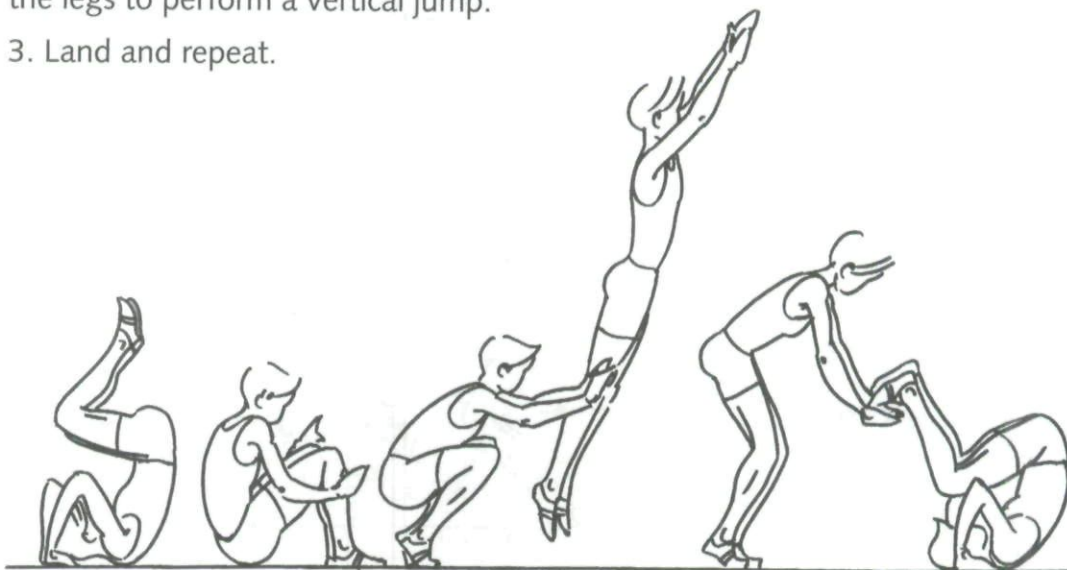
1. Begin standing.
2. Vertical jump bringing the heels to the buttocks.
3. Land on toes to absorb the shock; either continue or stop the jumps.



FORWARD ROLL AND VERTICAL JUMP

Area worked: calves, knees, hip extensors, and shoulders and arms

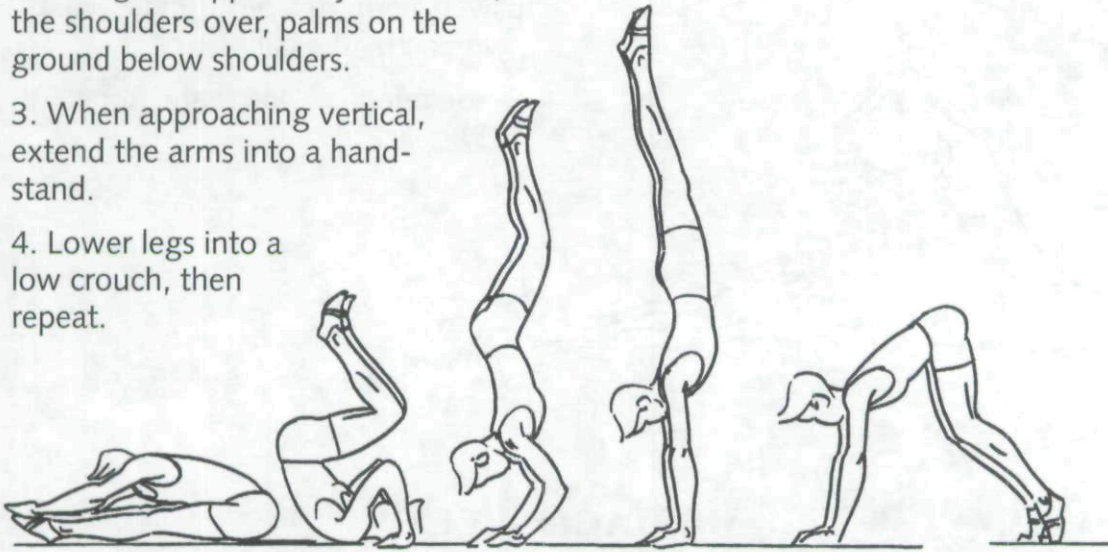
1. Low crouch, hands flexed at knee level.
2. Tuck the head under and roll over to a half-squat position, actively extend the legs to perform a vertical jump.
3. Land and repeat.



BACK ROLL INTO HANDSTAND

Area worked: arms and shoulders

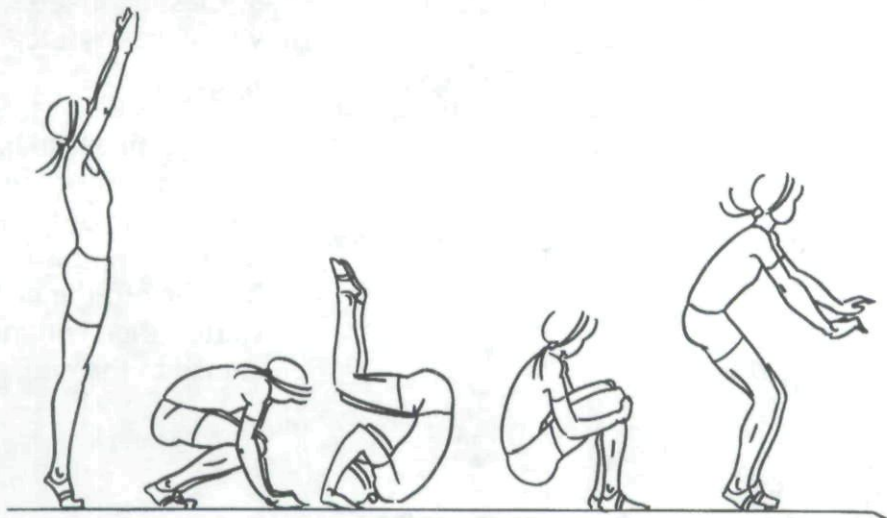
1. Sit with chest above knees.
2. Swing the upper body backward, roll the shoulders over, palms on the ground below shoulders.
3. When approaching vertical, extend the arms into a handstand.
4. Lower legs into a low crouch, then repeat.



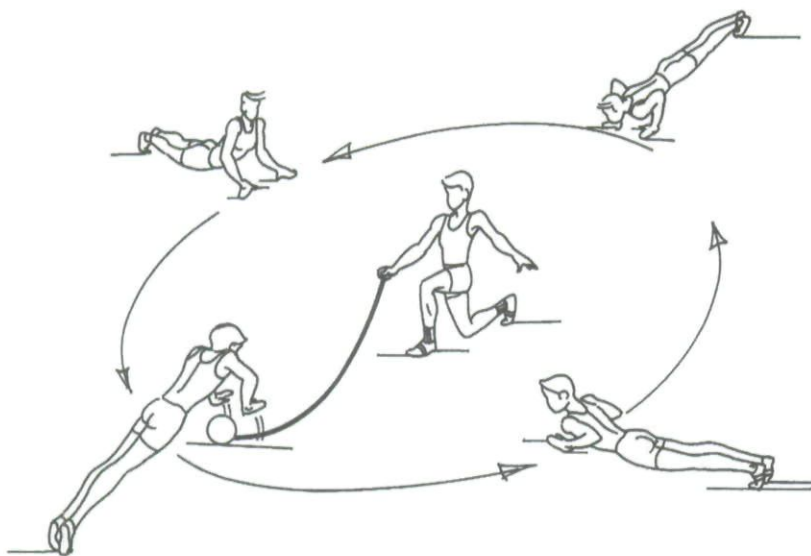
BACK ROLL INTO VERTICAL JUMP

Area worked: arms, shoulders, calves, knees, and hip extensors

1. Half squat.
2. Fully flex the knees, and roll backward into a full squat position. At that instant, perform an active vertical jump.
3. Land, then repeat the movement.



ROPE PUSH-UP

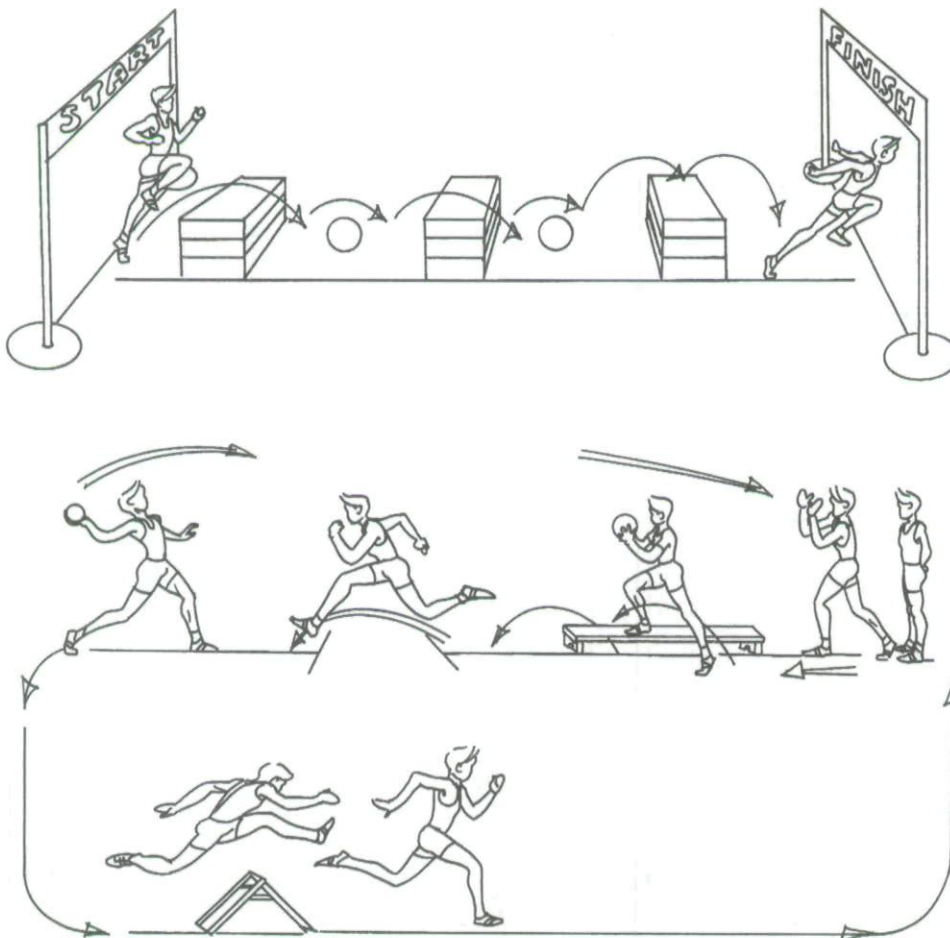


Area worked: elbow extensors, shoulders, and lower back

1. Same as previous exercise, except players perform a push-up to avoid being hit by the ball.

Please refer to "Dodge the Rope" (p. 123)

OBSTACLE RELAY



Area worked: ankle, knee, and hips extensors

1. Create an obstacle course of boxes, cones, or balls to jump over, with a short space between to run.

2. Time each athlete from start to finish.

3. Classify athletes individually or as a team.

Variation

Carry a medicine ball for the first part of the course, and at the end of the first line, throw the ball back to the next starter; then continue the course to the end.

MEDICINE BALL SPEED THROW

Area worked: shoulders and elbow extensors, and back muscles

1. Organize two rows of players in pairs, facing each other 5 meters (16 feet) apart.
2. Players from the right row have the ball.
3. The aim is to determine which pair can perform the most throws in 30 seconds (or 60, 90, 120 seconds).
4. The coach will determine the throwing technique.

Note: For between the legs forward and backward throws, increase the distance to 10 to 12 meters (33 to 39 feet).

MEDICINE BALL VOLLEYBALL GAME

Aim: To find which team is faster to score 15 points in two of three games.

Rules: Two teams of three players are in each court. Follow the rules from volleyball, except that the courts are smaller, 3 by 3 meters (10 by 10 feet), and instead of serving, players throw the ball over the net into the opposite court. The player who catches the ball passes to a teammate, who passes to another. On the third pass, the player throws the ball back over the net.

Net: Set the highest point of the net (rope, band, etc.) at the average shoulder height of the players.

Referee: The coach or a player.

Note: You can mark the court by tape or a small but visible object in each corner. Do not use balls as markers as they can cause injuries if a player steps on one. You can set a time limit for a set, for example, three sets of five minutes.

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