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HIGH SCHOOL STRENGTH TRAINING

It is important to understand the differences between strength training, weight lifting, and power lifting. *Weight lifting* is a competitive sport in which the lifter tries to lift as much weight as possible during one exercise. *Power lifting* is a competitive sport in which the lifter tries to lift as much weight as possible in one repetition. **Strength training involves lifting weights, and using other resistance methods, to improve athletic performance and reduce the risk of injury.** When used properly strength training will help an athlete improve performance, reduce the risk of injury, and increase muscular size, muscular strength, and muscular endurance,.

The basic principles of strength training apply to male and female athletes and are similar regardless of the sport. Because they have lower testosterone levels than males, girls will not develop large, bulky muscles as a result of a strength training program. *Girls will improve coordination and performance, reduce the likelihood of osteoporosis later in life, and develop better muscle tone, muscular endurance, and muscle strength as a result of strength training.*

Strength training involves lifting weights, and using other resistance methods, to improve athletic performance and reduce the risk of injury.

BASIC PRINCIPLES OF STRENGTH TRAINING

There are two physiological principles which govern strength training. Those two principles are the Principle of Progressive Resistance and the Principle of Specific Adaptation to indivdual Demands.

The ***Principle of Progressive Resistance*****: in order to continue to gain strength you must increase the resistance and/or the repetitions as you get stronger**. *A double progressive system, in which repetitions and weight are increased at different times, seems to be the most beneficial for high school student-athletes wanting to improve functional strength and reduce the risk of injury.*

The ***Principle of Specific Adaptation to individual Demands*** **(SAID): you should train the way you are going to play**. *If you are training for power and speed, lift heavier weights using fewer repetitions.* Lifting sets of 1-3 repetitions in the strength exercises (squat, press, or pull) using 75-90% of one's 1 RM (repetition maximum, or the amount of weight that can be lifted one time but no more) will generate the greatest strength gains.

Lifting sets of 1-3 repetitions in the speed exercises (snatch, clean, or jerk) using 70-85% of one's 1 RM will generate the greatest speed of movement. Lifting sets of 7-10 RM (repetition maximum, or the amount of weight that can be lifted 7-10 times but no more), will generate the greatest gains in muscle size, but can cause losses in speed of movement and strength when used exclusively for more than 4-6 weeks.

If you are training for cardiovascular and muscular endurance, lift lighter weights for a greater number of repetitions. A good method to improve overall endurance is to perform 2-4 sets of 15-20 repetitions using a weight that causes muscle fatigue, but not muscle failure after the 20th repetition. These sets should be completed with very little rest in between.

1 RM lifts should only be used to assess a young athlete's strength after a good strength base has been established, never at the beginning of a strength training program. The purpose of 1 RM lifts is to determine what weight the athlete will be using for their strength training program. When performing 1 RM lifts it is essential the athlete be properly supervised, use proper technique, and have spotters who have been properly trained and are alert. ***The risk of injury is much greater in 1 RM lifts than in any other lifting situation, especially when those lifts are done over the head.*** If the coach, or the athlete, is uncomfortable with a 1 RM lift for testing, 3-5 RM lifts can be used to determine a "perceived maximum" and the training program can be designed using percentages of the perceived maximum.

When performing 1 RM lifts, it is safer to use machines than free weights, especially when completing over-the-head lifts. Spotting is not necessary and risk of injury is less. 1 RM lifts, and over-the-head lifts, are not recommended for young teenage student-athletes or student-athletes with no strength training experience.

WEIGHT MACHINES VERSUS FREE WEIGHTS

As long as the Principle of Progressive Resistance is adhered to, the use of free weights or weight machines, will produce strength gains. Increasing muscle size and strength does not depend as much on the type of equipment used, as on the intensity with which one trains.

Advocates of weight machines claim machines are safer than free weights, encourage joint movement through the complete range of motion, and promote good form and proper technique because the weight can only be moved through a predetermined plane and direction. Proponents of weight machines also point out the fact that athletes lifting via machines do not need to balance the weight while lifting it. This isolates the muscles that are the prime movers for each exercise and can create greater strength gains in those muscles.

Advocates of free weights claim free weights can also be used safely, if properly supervised and if proper technique is being used. Proper technique includes using good

form and going through the entire range of motion. Free weight advocates further claim that balancing the weight while lifting it requires the use of more muscles than just the prime movers creating a greater potential to develop functional strength.

As long as the Principle of Progressive Resistance is adhered to, the use of free weights or weight machines, will produce strength gains.

STRENGTH PLATEAUS

Athletes will experience several plateaus as they progress through strength training programs. **A plateau indicates some change is needed in the training program.** These changes might involve training frequency, training intensity, exercise selection, or the incorporation of other fitness activities.

Many athletes who reach a plateau choose to work harder to achieve greater strength. This seldom works. **Doing more of the same activity will usually cause one to maintain the plateau level or lose strength.** The following are alternatives which may produce better results:

1) *Reduce the number of workouts per week.* This will allow more recovery time between workouts and allow the muscles more time to repair and rebuild.

2) *Change the number of sets and/or repetitions being used.* Rather than lifting 3 sets of 5 repetitions, lift 3 sets of 10 repetitions using a lighter weight. Rather than lifting 3 sets of 10 repetitions, lift 2 sets of 15 repetitions using a lighter weight. A combination of multiple set repetitions and single set repetitions may be the best means of continually gaining strength and working through plateaus.

3) *Select different exercises for the same muscle group.* If you have a plateau in the bench press, change to the incline press, dumbbell press, or dips. Different exercises for the same muscle group put the muscles through a different lifting pattern and can stimulate strength.

4) If no success has been realized with numbers 1 - 3, it may be necessary to eliminate that muscle group from the strengthening program and incorporate other fitness activities. Running, cycling, swimming, and rope jumping are all excellent fitness activities. They may not directly increase an athlete's strength, but they will improve cardiovascular fitness levels and allow the muscles to fully recover.

A plateau indicates some change is needed in the training program.

DESIGN OF STRENGTH TRAINING PROGRAMS

The ideal strength training program should incorporate four different types of

"seasons." *The "post-season" is a period of active rest after the competitive season has been completed.* This period allows the body to restore itself. Participation in a variety of fitness activities should be performed 2 - 3 times per week for 30 -40 minutes per session.

The "off-season" begins after the "post-season" and lasts 4 - 6 weeks before the competitive season begins. *The "off-season" is the time when strength, size, and power are developed.* This period will involve the most intensive strength training. A model off-season strength training program will be discussed later.

The "pre-season" begins 4 -6 weeks before the competitive season and lasts until the competitive season begins. *During this "pre-season" period strength training should be continued, but increased sport-specific activities, increased cardiovascular activities, and exercises to improve flexibility should be added or increased.* A combination of strength, cardiovascular fitness, and flexibility will result in a high level of fitness which is needed for the competitive season.

The "in-season" is the period of time when the athlete is involved in a competitive sport. *It is impossible to maintain strength during a competitive season without being involved in strength training.* Through the use of an "in-season" strength training program, a large percent of the strength gained during the off season can be maintained. A model program for "in-season" strength training will be discussed later in this update.

High school student-athletes involved in more than one sport may not be able to follow the "seasonal" time lines suggested previously. Athletes involved in more than one sport, whose competitive seasons are not back-to-back, should allow 7-10 days of active rest following their competitive seasons. After this post-season period, the athlete may need to combine cardiovascular fitness activities and a strength training program. This will allow maintenance of cardiovascular fitness levels and gains in strength. **It is extremely important for multi-sport athletes to participate in an in-season strength training program.** Multi-sport athletes involved in "in-season" strength training may very well notice an increase in strength during their competitive season.

A MODEL PROGRAM FOR OFF-SEASON STRENGTH TRAINING

EXERCISE SELECTION

The legs, hips, and torso are the major muscle groups involved in athletics. The National Strength and Conditioning Association recommends **65% of all training time involve the muscles from the top of the chest to the knees**. Exercises that strengthen these areas are called "core exercises." The remaining 35% of training time should be concentrated on the neck, arms, lower legs, and shoulders. Exercises that strengthen these areas are called "supplemental exercises."

Emphasis should be placed on each major muscle group to ensure balanced muscle development. **Strength training programs should exercise large muscle groups first**

and smaller muscle groups last. A recommended training sequence is: hips and buttocks, upper legs (quadriceps and hamstrings), lower legs (calves and dorsiflexors), upper torso (chest, back, and shoulders), arms (biceps, triceps, and forearms), abdominals, and the lower back. The abdominals and lower back muscles are important stabilizers and should always be exercised at the end of a workout. For a balanced workout that builds functional strength perform multi-joint exercises first and single-joint exercises last.

EXERCISE FREQUENCY

A regular training schedule is necessary for sustained strength improvement. If core exercises and supplemental exercises are performed on the same day, three non-consecutive workouts per week produce the best results. If core exercises and supplemental exercises are performed on different days, a split routine should be used. A split routine would include doing chest, leg and stomach exercises on Monday and Thursday and doing hip, back, shoulder, and arm exercises on Tuesday and Friday.

Adequate rest is essential to strength development. Muscles do not get stronger during a workout, they get stronger during the recovery from a workout. 48 to 72 hours of rest should be allowed between strength training workouts for a particular body area to allow the muscle tissue to rebuild.

EXERCISE SPEED

All strength training exercises should be performed in a slow, controlled manner to increase muscle force production and decrease potential for injury. *Lifting the resistance should take approximately 2 seconds, while lowering should take approximately 4 seconds.* There should be a momentary pause in the fully contracted and fully extended positions. This causes not only an excellent strength stimulus in the target muscle group, but also an excellent stretch in the opposing group. Slow, controlled strength training will greatly reduce the risk of injury and produce excellent results.

EXERCISE INTENSITY & DURATION

There are multiple theories regarding the intensity of strength training programs. Some theories involve multiple sets of varying repetitions and some theories involve single sets of multiple repetitions. **All theories are based on The Principle of Progressive Resistance and will produce significant strength gains when applied on a regular basis over time.** Research indicates different muscles should be exercised for different amounts of time to increase muscle size and strength. Optimal training times are 90-120 seconds for the buttocks, 60-90 seconds for the rest of the lower body, and 40-70 seconds for the upper torso. In practical terms, *the buttocks should be exercised for 15-20 repetitions, the lower body for 10-15 repetitions, and the upper body for 6-12 repetitions*. This does not mean multiple sets cannot be used, but for optimal strength gains each set should last the recommended time.

Scientific research indicates the optimal length of a strength training session should be no more one hour. Your body has enough energy stored to work at a high level of intensity for about one hour. Workouts lasting longer than one hour will be performed at a lower level

of intensity due to low energy levels.

EXERCISE CONTINUITY

The amount of rest between successive exercises depends greatly on the type of activity being trained for. Remember the SAID principle, which states that one should train the way they will play the game. In football, where longer rest periods are permitted between plays, longer rest periods can be permitted between successive exercises. In sports which require more cardiovascular endurance without frequent rests one should train allowing little rest between sets. As the competitive season draws closer, it is a good idea to reduce the rest period between sets to increase cardiovascular endurance. This certainly does not take the place of cardiovascular fitness training, but it is an important adjunct to it.

EXERCISE RANGE

For best results, **each repetition should go through the full range of joint movement**. Moving a joint through a full range of motion means moving it from a completely extended position to a completely flexed position. Moving the joint through a full range of motion not only produces strength throughout the entire range of motion, but also helps to enhance flexibility.

EXERCISE PROGRESSION

Gradual increases in resistance are essential for developing strength. A program with emphasis on progressing slowly will result in greater muscle and tendon strength gains and less muscle soreness. **When increasing the weight being lifted, it is best to increase in approximately 5% increments.**

It is impossible to maintain strength during a competitive season without being involved in strength training.

A MODEL PROGRAM FOR IN-SEASON STRENGTH TRAINING

Strength training must be emphasized year-round. Strength can be developed during the off-season, but it must be maintained during the competitive season. Student-athletes who do not perform strength training during the season will lose strength. Losing strength during the season increases the athletes risk of injury, decreases their performance potential, and lowers the base at which they will start lifting when the season is over.

When planning in-season strength training programs, keep the following ideas in mind:

1) **Concentrate on the core exercises that strengthen the muscles from the top of the chest to the knees.** The muscle groups that should be concentrated on are the hips, back, upper legs, abdominals, and chest. *For football and wrestling, include exercises for the neck.* Remember to maintain muscular balance among muscle groups by exercising opposing groups.

2) **One or two, high intensity, 20-30 minute workouts a week are adequate. Don't train within 48 hours of competition.**

3) **Do one set of exercises for each muscle group you choose to exercise.** A set should consist of 8 - 13 repetitions at the maximum weight which can be lifted 8 - 13 times.

4) **Develop a program that best fits the needs of your sport.** Strength training can be performed before or after practice. Possibly some athletes can train before practice and others can train after practice. Allowing little time for rest between sets can also make strength training part of a cardiovascular fitness program. *If strength training and cardiovascular training are being performed on the same day, the order in which exercises will be performed depends upon the sport.* If the sport has a greater strength component, the strength workout should come first. If the sport has a greater cardiovascular endurance component, the cardiovascular workout should come first. If both components are of equal value, the endurance workout should come first.

The principles discussed in this chapter can be adapted to fit any desirable program and will result in a successful, safe strength training program. Strength training programs vary depending on the sport, the supervisor or coach, the equipment available, the time available, and the objectives of the program. The individual results gained will vary, but they will include gains in muscular strength, muscular endurance, muscular size, improved performance, and a reduced risk of injury.

Questions and comments about strength training or any other areas of student wellness are welcomed and encouraged. They should be directed to Alan Beste, Wellness Coordinator at the Iowa High School Athletic Association, PO Box 10, Boone, IA 50036. (515) 432-2011

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STRENGTH TRAINING TECHNIQUE FOR VARIOUS EXERCISES

BACK SQUAT

Back straight, head and neck in line with back, eyes forward
Feet flat and toes forward or slightly pointed out
Hands wider than shoulder width
Weight on shoulder blades, supported by arms
Pause slightly at fully flexed and extended positions
Back straight, leaning slightly forward
LOWER ONLY UNTIL THIGHS ARE PARALLEL TO GROUND, "CHAIR SIT"!
KNEES ONLY SLIGHTLY IN FRONT OF FEET AT DEEPEST SQUAT!
DO NOT HYPEREXTEND NECK OR BACK!
Raise by straightening the legs and concentrate on bringing hips forward and chest up, or push feet through the floor

BARBELL LUNGE

Hands slightly wider than shoulder width
Feet about shoulder width
Head up and in line with back
Back straight
Large step forward with one leg so knee of lead leg is approximately over ball of foot
Can be done holding dumbbells also, easier to keep back straight with dumbbells and no spotting is required

BENCH PRESS

Lie flat on bench with shoulder blades and buttocks touching bench
Back slightly arched
(Placing the feet flat on the bench will reduce stress on the low back)
Grip slightly wider than shoulders
Wider grip = chest muscles involved more, narrower grip = muscles on back of arms involved more
Bar should contact chest at nipple line
Upper arms at 45 degree angle to torso, not parallel
DO NOT BOUNCE!
DO NOT ARCH BACK EXCESSIVLEY!
Pause slightly at fully flexed and extended positions

BICEP CURL

Feet shoulder width apart, knees slightly bent
Hands shoulder width apart, or slightly more
Elbows close to the body
Back straight, but not hyperextended
Don't rock the hips forward when lifting
Don't move the elbows backward when lifting
Pause slightly at fully flexed and extended positions

OVERHEAD (MILITARY) PRESS

Back straight, head upright, eyes forward
Feet flat on floor about shoulder width or slightly more, staggered slightly one in front of the other for balance
Hands slightly wider than shoulder width
Back and legs straight, but knees not locked
Tilt the head back slightly, if necessary, to avoid hitting the chin - do not push bar forward to avoid hitting chin
Do not use legs to help lift bar
DO NOT ARCH BACK EXCESSIVELY!
Pause slightly at fully flexed and extended positions

LAT PULL DOWNS

Hands slightly wider than shoulder width
Position body under pulley so handle can be pulled straight down
Head and back in straight line with back straight
Pull behind head or in front of head
DO NOT EXCESSIVELY BEND HEAD FORWARD!
Pause slightly at fully flexed and extended positions

POWER CLEAN

Feet hip width
Hands slightly wider than shoulder width
Back arched, but not excessively, and tight
Thighs parallel to ground
Shoulders above or slightly in front of bar

Elbows straight
The lift is one smooth, continuous motion

POWER SNATCH

Grip - measure from AC joint of left shoulder to knuckles of right, extended arm
Back arched, not excessively - head, neck, back in line
Feet flat and hip width apart - toes forward or slightly out
Bar close to shins and body weight back on heels
Weight is lighter and moves faster than the power clean