

The Team Physician and Conditioning of Athletes for Sports: A Consensus Statement

DEFINITION

Conditioning is a process in which stimuli are created by an exercise program performed by the athlete to produce a higher level of function.

GOAL

The goal of conditioning is to optimize the performance of the athlete and minimize the risk of injury and illness.

To accomplish this goal, the team physician should have knowledge of and be involved with:

- General conditioning principles
- Preseason issues
- In-season issues
- Off-season issues
- Available resources

SUMMARY

The objective of this Consensus Statement is to provide physicians who are responsible for the healthcare of teams with guidelines regarding conditioning for sports. This statement specifically addresses the role of exercise in conditioning. Nutrition and supplements are outside the scope of this statement. It is not intended as a standard of care, and should not be interpreted as such. This statement is only a guide, and as such, is of a general nature, consistent with reasonable, objective practice of the healthcare professional. Individual conditioning issues will depend on the specific facts and circumstances presented to the physician.

Adequate insurance should be in place to help protect the athlete, the sponsoring organization, and the physician.

This Statement was developed by a collaboration of six major professional associations concerned with clinical sports medicine issues; they have committed to forming an ongoing project-based alliance to “bring together sports medicine organizations to best serve active people and athletes.” The organizations are: American Academy of Family Physicians, American Academy of Orthopaedic Surgeons, American College of Sports Medicine, American Medical Society for Sports Medicine, American Orthopaedic Society for Sports Medicine, and the American Osteopathic Academy of Sports Medicine.

EXPERT PANEL

Stanley A. Herring, M.D., Chair, Seattle, Washington
John A. Bergfeld, M.D., Cleveland, Ohio
Joel L. Boyd, M.D., Edina, Minnesota
Per Gunnar Brolinson, D.O., Toledo, Ohio
Cindy J. Chang, M.D., Berkeley, California
David W. Glover, M.D., Warrensburg, Missouri
William A. Grana, M.D., Tucson, Arizona
Peter Indelicato, M.D., Gainesville, Florida
Robert J. Johnson, M.D., Minneapolis, Minnesota
W. Ben Kibler, M.D., Lexington, Kentucky

William J. Kraemer, Ph.D., CSCS, Muncie, Indiana
Joseph P. McNerney, D.O., Vallejo, California
Robert M. Pally, M.D., Hillsborough, New Jersey
Jeffrey L. Tanji, M.D., Sacramento, California

GENERAL CONDITIONING PRINCIPLES

Specificity

Training adaptations are specific to the nature of the exercise stimulus (*e.g.*, muscle contraction type, mechanics, metabolic demand). Athletes are subject to specific demands in the performance of sport. Therefore, performance is dependent upon the individual athlete’s ability to meet those demands.

Progressive Overload

A conditioning program should begin at a tolerable level of exercise and progress in intensity and volume toward a targeted goal for the individual athlete.

- **Intensity** is the percent of the maximal functional capacity of the exercise mode (*e.g.*, percent of maximal heart rate, percent of one repetition maximum).
- **Volume** is the total amount of exercise performed in specific periods of time (*e.g.*, total distance run, total amount of weight lifted).

Prioritization

Priorities should be developed according to the individual’s capabilities and sport-specific demands, because not all elements of a conditioning program can be optimized at the same time, rate, or magnitude.

Periodization

Periodized training is planned variation in the total amount of exercise performed in a given period of time (intensity and volume of exercise.) All periodization terminology describes either a certain type of training, a certain portion of a training cycle, or a certain length of time within a training cycle. Research supports periodization as an important corollary to the principle of progressive overload, as this type of planned variation is key to optimal physical development. Periodized training has shown greater improvements compared to low-volume, single-set training. Such training programs have been shown to be very effective during both short- and long-term training cycles, while

reducing the risk of overtraining. Several combinations of variables may be manipulated in order to produce an adaptation specific to training goals.

Periodization Cycles

- **Macrocycle:** an entire training year. For athletes it is normally thought of as beginning and ending after the last competition of a season.
- **Mesocycle:** a training period lasting three to six months
- **Microcycle:** a training period lasting one week or seven days (can also relate to a training cycle of up to four weeks in length depending upon the program design).

Types of Periodization Programs

Strength Training

- **Linear Programs:** Linear programs address conditioning for sports with a limited number of competitions in-season and a well-defined off-season. Classic periodization methods utilize a progressive increase in the intensity and a decrease in the volume of exercise with small variations in each microcycle. The linear method is based on developing neuromuscular function and muscle hypertrophy with concomitant improvements in strength and power. The linear method is repeated with each mesocycle as progress is made in the program. Rest between the training cycles (active recovery phase) allows for the needed recovery so that overtraining problems are reduced.
- **Non-linear (Undulating) Periodized Programs:** Nonlinear programs address conditioning for sports with long competitive seasons, multiple competitions, and year-round practice. The non-linear program allows for variation in the intensity and volume within each seven-to-ten-day cycle by rotating different protocols over the course of the training program. Typically, three-month cycles are used before an active recovery phase. Non-linear methods attempt to train the various components of the neuromuscular system within the same seven-to-ten-day cycle. However, during a single workout only one feature is trained on that day (*e.g.*, high-force strength, power, local muscular endurance).
- Linear and non-linear programs have been shown to accomplish similar training effects. Both are superior to constant intensity and volume training programs. The key to workout success is variation. Different approaches can be used during the macrocycle to accomplish this training need.

Program Variables

Several variables may be periodized in order to alter the resistance-training stimulus to achieve the conditioning goal. Different combinations of these variables will create different workouts.

- **Exercise Order:** the sequence in which exercises are performed during a training session (*e.g.*, large mus-

cles before smaller ones and multi-joint exercises performed before single-joint exercises).

- **Exercise Selection:** (*e.g.*, open- and closed-chain exercises, free weights, machines).
- **Frequency:** the number of training sessions performed during a specific period of time.
- **Intensity:** the percent of the maximal functional capacity of the exercise as it relates to strength training.
- **Load:** the amount of weight lifted per repetition or set as it relates to strength training.
- **Muscle Action:** (*i.e.*, concentric, eccentric, and isometric).
- **Repetition Speed:** varying resistive training speed from slow (strength development) to fast (power development) while utilizing the appropriate load.
- **Rest Periods:** the amount of rest taken between sets, exercises, and/or repetitions.
- **Volume:** the total number of repetitions performed during a training session as it relates to strength training.

Aerobic Conditioning

Aerobic conditioning can be achieved with a multitude of programs (*e.g.*, interval training, continuous training) and modes of exercise (*e.g.*, running, cycling, swimming). It is important that the aerobic conditioning be specific to the sport. Conditioning should be progressive, periodized, prioritized, and compatible with other elements of the conditioning program and the practice sessions.

Sport-Specific Conditioning

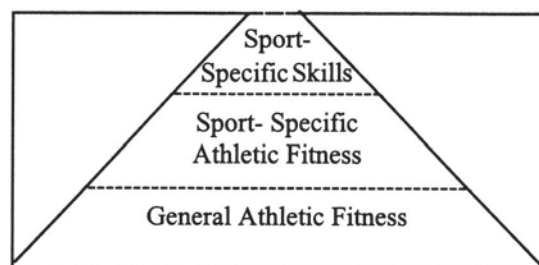
Sport-specific conditioning is the preparation of the athlete for unique physiological and biomechanical demands and the injury risks inherent in each sport.

- Physiological demands (*e.g.*, anaerobic/aerobic, environmental).
- Biomechanical demands (*e.g.*, throwing, running)
- Injury risks (*e.g.*, site-specific, traumatic, overload, age- and gender-specific).

Objectives of a Sport-Specific Conditioning Program: Performance

Sports conditioning can be described as a pyramid of fitness and skills (see Fig. 1).

- **General athletic fitness** serves as a base for sport-specific fitness and includes total body flexibility, total



body muscular strength and power, cardiorespiratory endurance, and body type, size and structure.

- **Sport-specific athletic fitness** addresses physiological parameters, biomechanical actions, anatomical sites, and muscle activation patterns common or essential to the individual sport. These components are addressed through specific flexibility, strength balance, power/work, and aerobic/concentric training.
- **Sport-specific skill** is the ultimate goal. Optimal performance demands a refinement of unique training and skill acquisition.

Injury and Illness Prevention

Conditioning may decrease injury and illness by influencing sport-specific risk parameters (*e.g.*, acclimatization, site-specific flexibility, strength, balance, force production of muscle).

Components of a sport-specific conditioning program:

- An individualized **preconditioning evaluation** to determine a fitness profile for the purpose of entering a conditioning program. This includes both a general and a sport-specific athletic fitness evaluation.
- A **periodized protocol** for the individual athlete that addresses the unique demands of that sport.
- An **evaluation process** to determine efficacy of the conditioning program.

Conditioning Modifications

In certain populations, conditioning programs may need to be modified to optimize performance and minimize the risk of injury.

Youth: Physiological and biomechanical capabilities in young athletes are different from those of adults. Conditioning injuries in this population include physeal, apophyseal, joint injury, overload tendinitis and unique susceptibility to environmental stressors.

Strength: Strength training programs are important for the young athlete. Strength gains in this population will be due to increases in recruitment and synchronization of muscle activation patterns. Strength training modifications for youth focus on proper supervision, and lower intensity and volume, particularly during periods of rapid growth. As the athlete matures, gains in muscle mass will play a more significant role in strength increases.

Flexibility: Flexibility is traditionally included as a component of conditioning for youth; however, its benefit is unclear in this population.

Aerobics: Aerobic gains in this population are obtainable, but young athletes do not respond so effectively as adults.

Female Athletes: There are gender-related differences in muscle performance, particularly in the upper body. However, female athletes can obtain strength gains and aerobic gains in the same proportion as male athletes in a comparable training program. All female athletes should participate in a total body conditioning program. The lower extremity and shoulder are frequent areas of

injury in the female athlete. Strength deficits in these areas are more closely associated with injury in females than in males. In the female athlete's total body resistance conditioning program, the upper body should always be emphasized. In addition, the female athlete at risk of unique sport-related injuries (*e.g.*, anterior cruciate ligament (ACL), ankle sprains) should participate in specific resistance conditioning programs. Proper conditioning programs to decrease ACL injuries particularly demonstrate these principles.

Multi-Sport Athletes: With overlapping seasons, multi-sport athletes have unique conditioning challenges. Multi-sport athletes need to maintain their general athletic fitness base and focus their sport-specific conditioning toward their current sport. There is a distinct need for recovery between seasons; therefore, including an active recovery phase into the athletic participation and conditioning cycle is of particular importance to multi-sport athletes. Conditioning injuries may occur when an athlete tries to prepare simultaneously for two different sports.

Athletes Who are Physically Challenged: Athletes who are physically challenged benefit from a conditioning program. Their program should be modified depending on the specific type of impairment and associated disability. Medical conditions in this population such as temperature regulation, skin problems, cardiovascular function, and entrapment neuropathies can affect or be affected by the conditioning process. A conditioning program for this population must also accommodate such unique concerns as access and equipment.

PRESEASON ISSUES

Network

The team physician should be involved in the network that integrates expertise regarding conditioning matters with certified strength and conditioning specialists (CSCS), the coaches, and other healthcare providers (which may include certified athletic trainers (ATC), physical therapists (PT), and medical specialists).

Education

Education of athletes and coaches about conditioning provides a framework for understanding the importance of such training for sports, and will optimize sports performance and minimize the risk of injury and illness.

It is essential that the education furnished through the network provide athletes and coaches with:

- Instruction about the goals and content of the periodized preseason, in-season, and off-season conditioning programs.
- Instruction about needs for modification of the conditioning program.
- Medical information that affects the conditioning program.

In addition, it is desirable for:

- The entire network, including the team physician, to understand the goals and content of the periodized conditioning program.
- The entire network, including the team physician, to be involved in the educational process.

Conditioning Programs

It is essential for:

- The network to implement the proper periodized sport-specific conditioning programs.
- Medical information that affects the conditioning program to be made available to allow for appropriate program modification.

It is desirable for:

- The entire network, including the team physician, to monitor the conditioning program.
- The entire network, including the team physician, to be available to address concerns about the conditioning program.
- There to be an adequate facility for the conditioning program.
- The network to provide for proper documentation of individual conditioning programs.

IN-SEASON ISSUES

Network

The network should continue to integrate expertise regarding the conditioning program during the in-season.

Implementation of the In-Season Conditioning Program

It is essential for:

- The network to implement the periodized in-season sport-specific conditioning program.

In addition, it is desirable for:

- The entire network, including the team physician, to monitor the in-season conditioning program.
- The entire network, including the team physician, to be available to address concerns about the in-season conditioning program.
- There to be an adequate facility for the in-season conditioning program.
- The network to provide proper documentation of individual conditioning programs.
- The team physician to observe the conditioning program.

Management and Rehabilitation of Injuries That Impact or Are a Result of Conditioning

The coordination of management and rehabilitation of injuries affecting conditioning is the duty of the team physician (as detailed in the Team Physician Consensus Statement, ©2000):

It is essential for the team physician to:

- Be familiar with conditioning matters and the injuries that occur with conditioning.
- Coordinate the modification or cessation of a high risk activity once identified.
- Coordinate the medical management of injury and illness.
- Coordinate rehabilitation of any conditioning injury or illness, focusing on return to conditioning with any modifications and return to play.

In addition, it is desirable for:

- The entire network, including the team physician, to be available to review conditioning matters.
- The entire network, including the team physician, to participate in the design of the reporting system for conditioning injuries.
- The entire network, including the team physician, to participate in injury surveillance to help identify practices that may be leading to increased rates of injury.
- The entire network, including the team physician, to develop proper documentation to identify and report conditioning injuries.

OFF-SEASON ISSUES

Review of Network and Conditioning Program

Off-season evaluation of the network and conditioning program established in the preseason promotes continued effectiveness. A timely meeting of the network should be held to review and modify the network and the conditioning program.

It is essential for the team physician to:

- Coordinate the evaluation of the possible role of the conditioning program in prevention or production of injuries.

In addition, it is desirable for the network to:

- Determine whether the conditioning program met the network's goals.
- Coordinate the development of an off-season conditioning program.
- Document and evaluate the sport-specific fitness level of each athlete.

Implementation of the Off-Season Conditioning Program

The network should implement an active recovery phase followed by the proper, periodized, sport-specific off-season conditioning program.

AVAILABLE RESOURCES

Ongoing education pertinent to the team physician is essential. Information regarding team physician-specific educational opportunities is available from the six participating organizations:



- American Academy of Family Physicians (AAFP)
11400 Tomahawk Creek Pkwy
Leawood, KS 66211
800-274-2237
www.aafp.org.



- American Orthopaedic Society for Sports Medicine (AOSSM)
6300 N River Rd Suite 200
Rosemont, IL 60018
847-292-4900
www.sportsmed.org



- American Academy of Orthopaedic Surgeons (AAOS)
6300 N River Rd
Rosemont, IL 60018
800-346-AAOS
www.aaos.org



- American Osteopathic Academy of Sports Medicine (AOASM)
7611 Elmwood Ave Suite 201
Middleton, WI 53562
608-831-4400
www.aoasm.org



AMERICAN COLLEGE
of SPORTS MEDICINE

- American College of Sports Medicine (ACSM)
401 W Michigan St
Indianapolis, IN 46202
317-637-9200
www.acsm.org



- American Medical Society for Sports Medicine (AMSSM)
11639 Earnshaw
Overland Park, KS 66210
913-327-1415
www.amssm.org

Also, specific information and education regarding conditioning issues is available from:

National Strength and Conditioning Association
PO Box 9908
Colorado Springs, CO 80932
Tel.: 800-815-6826
www.nasca-lift.org

Suggested Journal Resources

Strength and Conditioning Journal. National Strength and Conditioning Association, Colorado Springs, CO (bimonthly)

Journal of Strength and Conditioning Research. National Strength and Conditioning Association, Colorado Springs, CO (quarterly)

REFERENCES

- BAECHLE, T. R., and R. W. EARLE (Eds.). *Essentials of Strength Training and Conditioning*, 2nd Ed. Champaign, IL: Human Kinetics, 2000.
- CHANDLER, T. J., and W. B. KIBLER. *Muscle Training in Injury Prevention*. IOC Encyclopedia of Sports Med. - Sports Injuries. London: Blackwell, 1993, pp. 252–261.
- FAIGENBAUM, A. D., W. J. KRAEMER, B. CAHIL, J. CHANDLER, J. DZIADOS, L. D. EFRINK, E. FORMAN, M. GAUDIOSE, L. MICHELI, M. NITKA, S. ROBERTS. Youth resistance training: position statement paper and literature review. (NSCA). *Strength and Conditioning* 18(6):62–75, 1996.
- FLECK, S. J., and W. J. KRAEMER. *Designing Resistance Training Programs*, 2nd Ed. Champaign, IL: Human Kinetics, 1997.
- KIBLER, W. B., and J. CHANDLER. Sport-specific conditioning. *Am. J. Sports Med.* 22(3):424–432, 1994.
- KIBLER, W. B., J. MCMULLEN, and T. L. UHL. Closed-chain rehabilitation for upper and lower extremity. *J. Am. Acad. Orthop. Surg.* (in press).
- KOMI, P. V. *Strength and Power and Sport*. Oxford: Blackwell Scientific Publications, 1992.
- KRAEMER, W. J., A. D. FAIGENBAUM, J. A. BUSH, and B. C. NINDL. Resistance training and youth: enhancing muscle fitness. In: *Lifestyle Medicine*, J. M. Rippe (Ed.). Boston: Blackwell Science, 2000, pp. 626–637.
- KRAEMER, W. J., and S. J. FLECK. *Strength Training for Young Athletes*. Champaign, IL: Human Kinetics, 1993.
- KRAEMER, W. J., and K. HAKKINEN (Eds.). *Strength Training for Athletes*. IOC Medical Commission. Oxford: Blackwell Publishers (in press).
- KRAEMER, W. J., and R. U. NEWTON. *Training for Muscular Power: Clinics in Sports Medicine*, J. Young (Ed.). Philadelphia: W. B. Saunders Company, 2000, pp. 341–368.
- KRAEMER, W. J., and N. A. RATAMESS. *Physiology of Resistance Training: Current Issues*. Orthopaedic Physical Therapy Clinics of North America. C. Hughes (Ed.). Philadelphia: W. B. Saunders Company, 2000, pp. 467–513.
- KRAEMER, W. J., N. A. RATAMESS, and M. R. RUBIN. *Basic Principles of Resistance Training. Nutrition and the Strength Athlete*. Boca Raton, FL: CRC Press, 2000, pp. 1–29.
- KREIDER, R., M. O'TOOLE, and A. C. FRY. *Overtraining in Sport*. Champaign, IL: Human Kinetics, 1998.
- ZATSORSKY, V. *Science and Practice of Strength Training*. Champaign, IL: Human Kinetics, 1995.