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Prevention of Common Wrestling Injuries

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summary

Wrestling, both a contact and collision sport, places extreme demands on the entire body. These demands all too often result in injury. With injury rates second only to football (41), strength and conditioning professionals must understand not only injuries common to wrestling but also how a properly designed, well-planned strength training and conditioning program may help to decrease this high injury rate. The sections that follow provide a brief overview of wrestling, including its muscular and physiological demands, and suggestions for exercises intended to reduce the risk of common injuries while improving performance.

Background

Wrestling is one of the oldest sports in the world, with its roots embedded in the first Olympic Games in 776 B.C. Three common styles of wrestling exist in the United States: collegiate, freestyle, and Greco-Roman, all with a common goal of pinning the opponent (holding both shoulders of an opponent to the mat to determine control). All wrestling matches begin in the standing or neutral position with the wrestlers facing each other. From the neutral position, the wrestler attempts to take the opponent to the mat and gain control. Collegiate matches run 7 minutes, whereas freestyle and Greco-Roman, which are the international and Olympic styles, last 6 minutes.

Besides time allotments, collegiate wrestling differs from freestyle and Greco-Roman in that the latter 2 styles place more emphasis on wrestling in the neutral position and award additional points for taking the opponent from the standing position to the mat (i.e., throwing) with the back and posterior shoulders exposed to the mat. Differentiating further between the styles, Greco-Roman only allows holds above the waist and forbids the use of the legs to gain advantage over an opponent, whereas freestyle more closely resembles collegiate wrestling and the use of legs is permitted.

Physiology

Regardless of the style, wrestling is a highly anaerobic sport (32), requiring maximal power and strength for explosive attacks during each match. If overtime is required, the match may last up to 10 minutes. Further, because practices may require up to 2 hours of anaerobic efforts, wrestling has a significant aerobic component as well. Obviously, the development of these metabolic systems plays a key role in the wrestler's success (32, 54). For additional information about the physiological requirements for wrestling, see Kraemer et al. (33).

Nutritional Concerns

Adequate nutrition plays an essential role in the sport of wrestling, and much has been written regarding the nutritional habits and weight loss techniques employed by wrestlers (1, 12, 13, 31). Fasting (reduced caloric intake) and various methods of reaching a hypohydrated state, such as excessive running and use of a sauna either with or without rubber or plastic suits, are common but dangerous rapid weight loss methods (1, 31). As a result of the deaths of 3 colle-

giate wrestlers in 1997, the National Collegiate Athletic Association (NCAA) and State High School Athletic Associations have taken steps to create a safer wrestling environment in regard to weight loss. Weight class certification, assessment of body composition, moving weigh-in times closer to competition, and banning the use of saunas and rubber or plastic suits are measures intended to discourage rapid weight loss.

The aforementioned rapid weight loss techniques employed by wrestlers to make weight have been said to resemble bulimic tendencies (12). Because concerns with weight loss were specifically related to wrestling, these behaviors did not meet the classification requirements for a clinical diagnosis of bulimia nervosa and are best described as disordered eating (12).

The harmful effects of rapid weight loss via caloric restriction and hypohydration are well documented (Table 1) and can adversely affect performance (10, 22, 32, 57). After a 5% rapid decrease in body weight via caloric restriction and hypohydration, wrestlers demonstrated decreased strength, anaerobic power, anaerobic capacity, lactate threshold, and aerobic power when tested with common exercise physiology testing modalities (57). During simulated tournament wrestling, following weight loss of 6% body weight via similar methods as described above, wrestlers showed decreased testosterone levels and isometric strength and increased norepinephrine concentrations after the tournament (32). During this experimental wrestling tournament, at least 4 hours was allowed between wrestling matches, which is greater than the minimum requirement of 45 minutes in high school and collegiate tournaments. Most of the physiological changes were thought to be related to rapid weight loss methods and inadequate recovery between matches (32, 57). Although not directly studied, these physiological changes due to rapid weight loss techniques and hypohydration are thought to potentially increase injury rates (32).

Table 1
Effects of Rapid Weight Loss via Caloric Restriction and Hypohydration

Increased	Decreased
Core temperature	Strength
Rate of glycogen degradation	Anaerobic and aerobic power
Lactate levels	Lactate threshold
Norepinephrine concentrations	Testosterone levels
Heart rate	Cardiac output and stoke volume

Musculoskeletal Injuries

Injury rates for wrestling remain relatively high when compared with other NCAA sports. During the 2003–2004 academic year, per 1,000 athlete exposures, 5.7 injuries during practice and 25.8 injuries during matches occurred. Both ranked second behind spring football practice and football games (41).

High school wrestling holds a comparable injury rate of 6.0 injuries per 1,000 exposures (43). At both the collegiate and high school levels, most injuries occur in the neutral position during takedown-type activities (3, 26, 41, 43). In the neutral position, the defensive wrestler (not initiating takedown) has been shown to be more frequently injured (3, 43, 60). Common injury sites (Table 2) are the knee, face, shoulder, ankle, and neck (26, 41, 43). The most prevalent types of injuries are sprains, strains, cartilage tears, and contusions (26, 41, 43). Most injuries occur as a result of contact with a competitor or mat or twisting forces (41, 43). It is thought that injury prevention programs develop an individual's ability to decrease landing forces.

Less common are catastrophic injuries, which have been reported as 1 per 100,000 participants studied between 1981 and 1999 (3). Catastrophic injuries included cervical fractures, severe head injuries, spinal cord contusions, and spinal cord injuries. Most catastrophic injuries involved the cervical region (88.6%). Injuries typically occurred during matches (80%) while wrestlers were in the neutral position during takedowns (74%; 3). The majority of catastrophic injuries occurred during periods of high intensity and competitive situations. Injuries were thought to be related to higher forces involved when the opponent lifts the wrestler from the mat and the wrestler returns to the mat in an unbalanced position with one or both arms restrained (3).

Table 2
Five Common Wrestling Injuries

Ankle sprain
Rotator cuff strain
Knee collateral ligament sprain
Neck strain
Contusions

Injury Prevention

A wrestling match takes place on a slightly unstable surface (i.e., a cushioned mat). Additionally, match situations may require single limb stance (Figure 1a) or that the athletes support some of their body weight with 1 or 2 hands for a prolonged period (Figure 2a). Because of these precarious positions and unstable environments, there is an inherent risk of injury, with previous joint injury only compounding this risk (7, 28, 34, 39, 49, 51, 55). Additionally, individuals with decreased strength, balance, proprioception, and neuromuscular control are also at greater risk for injury (21, 36, 59). To combat this risk, athletic injury preven-

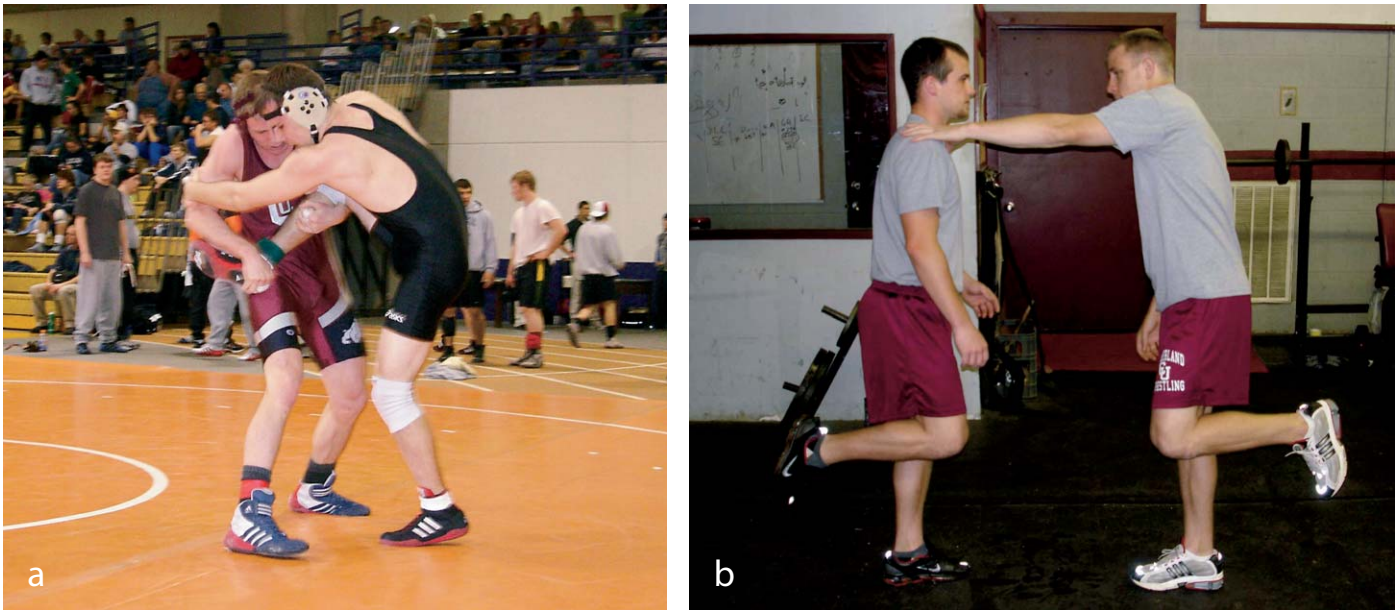

Figure 1. (a) Single leg takedown; (b) single limb stance partner perturbations.

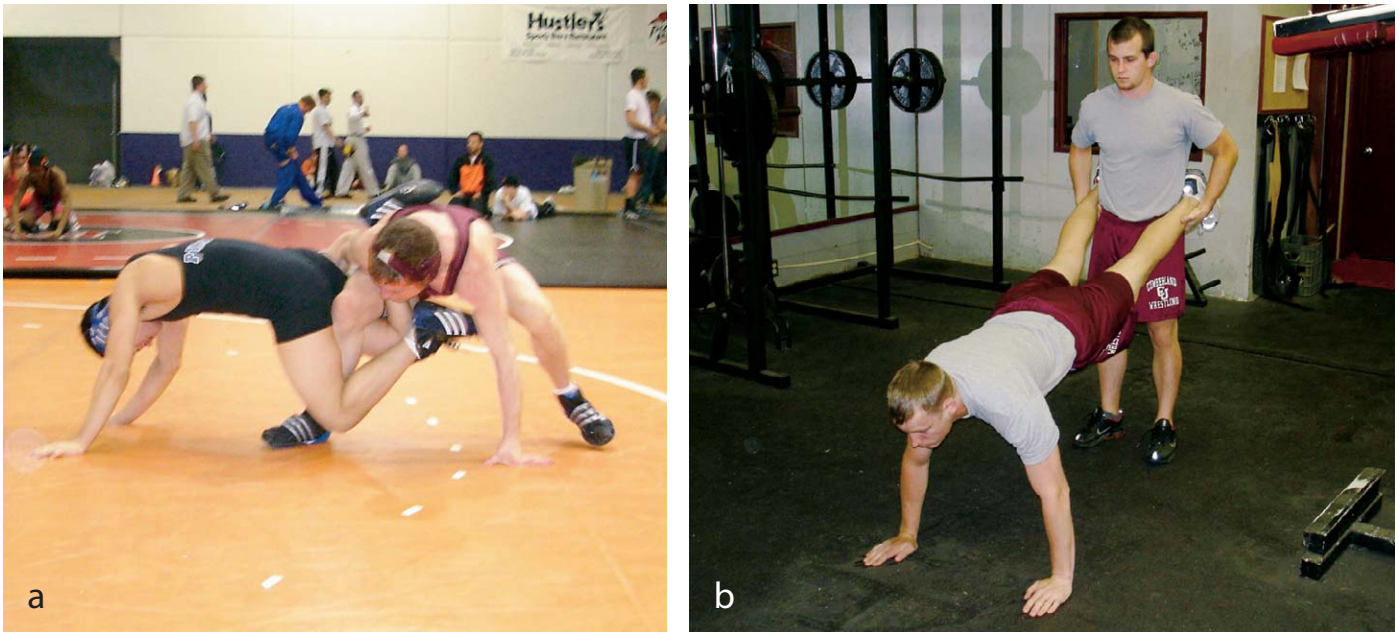

Figure 2. (a) Support of body weight with upper extremities; (b) wheelbarrow.

tion programs should contain the following components: resistance, plyometric, and balance training exercises (11, 16, 18-21, 33, 37, 40, 44, 45, 47, 52, 53).

Participants of programs that incorporate balance and plyometric training demonstrate increased strength, power, proprioception, and neuromuscular control (18, 38, 50, 56), as well as reduced voluntary muscle activation timing, time to peak torque (37), and risk of reinjury (18). Less than 25% of all injuries during collegiate matches studied between 2003 and 2004 occurred in the first period of a match (41), suggesting that fatigue may contribute to increased risk of injury (30). Central and neuromuscular fatigue potentially decreases motor control, balance, and proprioception and may also alter joint mechanics (9, 17, 27, 48). Therefore, injury prevention programs should also address the needs for maximal power and power endurance over the course of a match or practice session (29, 33, 35). Power endurance can be described as the ability to maintain power

Figure 3. Rotating push-ups: (a) start; (b) finish.

output over an extended period. This is typically accomplished using interval training with periods of high intensity interspersed with shorter rest periods.

When evaluating injury prevention programs, the contribution of trunk or core neuromuscular control demands attention. In some instances, knee and ankle injuries are associated with proximal pelvic and hip weakness (2, 5, 6, 23–25, 38). Although low back injuries are not common in wrestling (4%), preliminary evidence suggests that neuromuscular training programs incorporating exercises targeting weak core musculature decrease risk of injury and improve biomechanics and neuromuscular control (36, 38, 46). For more information about lumbar spine injury risk reduction, see Durall and Manske (15).

When designing an injury prevention program, selection of exercises should focus on situations specific to actual wrestling demands. Programs should also follow a logical order of progression. For example, using perturbations in single limb stance on stable or unstable surfaces (Figure 1b) mimics a common takedown position, whereas a wheelbarrow (Figure 2b) mimics upper extremity support. Components of traditional conditioning programs usually address some aspects of injury prevention, but additional wrestling-specific exercises should further decrease wrestling injury rates while possibly improving performance. It is important to remember that injury prevention programs may help decrease injury rates, but no exercise program completely eliminates the risk.

Wrestling-Specific Injuries

Because of the many demands wrestling places on its participants, the injuries suffered are both numerous and varied. Because of this diversity, it is difficult to adequately identify all injuries seen in wrestlers. The sections that follow serve to introduce and highlight common injuries wrestlers may experience.

Shoulder Injuries

In many instances, wrestling requires an extended period of upper-extremity weight bearing, which places a great demand on the muscles and joints of the shoulder. This distinguishes wrestling from most other sports. Rotator cuff strains account for 62% of all shoulder injures, followed by acromioclavicular joint sprains (19%) and shoulder subluxation and dislocation (13%; 43).

A study examining high school wrestling injuries noted that wrestlers with general ligamentous laxity suffered fewer shoulder injuries than did the other wrestlers (43). Therefore, shoulder flexibility should be an essential component of injury prevention programs. In addition to flexibility, rotator cuff strength, endurance, shoulder stability, and proper muscle balance should be addressed. Wrestling-specific exercises for the shoulder should involve both weight-bearing and non–weight-bearing positions. Weight-bearing exercises, such as push-up variations (Figure 3), produce muscle co-contraction, resulting in increased joint stabilization and proprioception (45, 52, 53). Plyometric exercises should also be incorporated to increase shoulder strength, power, and proprioception (50, 56).

Specific Exercises

Wrestling-specific shoulder exercises should be multiplanar, involve both

Figure 4. Bear crawl.

double- and single-extremity movements, and be designed with proprioception in mind. These exercises should include:

A. Push-up variations (rotating, cross-over, and plyometric) (Figure 3), wheelbarrow (Figure 2b), and bear crawl (Figure 4).
B. Single-arm power exercises, such as dumbbell cleans, snatch, and push press, which emphasize unilateral limb movement (common in wrestling).
C. Plyometric exercises, such as push-up depth jumps and cross-over push-ups with a medicine ball, which improve the ability of the upper extremity to control forces when landing. This ability proves invaluable when attempting to brace oneself during a fall to the mat (i.e., from the previously mentioned neutral position) and is thought to reduce the risk of subluxation-dislocation.
D. Exercises incorporating a stability ball, including push-ups (feet on ball or hands on ball), walk outs, and supine row (Figure 5).

Neck Injuries

Wrestling is also unique because the head and neck may bear weight for periods of time. This requires an increased demand on stabilizing muscles of the neck to maintain stability of the cervical spine. Muscle imbalance and muscle weakness are thought to be a risk factor for neck injuries (61).

Ylinen et al. (61) conducted a study of neck strength in elite Finnish wrestlers who were not currently participating in a neck-strengthening program. With regard to participants in the study, senior (22- to 27-year-old) wrestlers had stronger flexion and rotation strength than did junior (18- to 20-year-old) wrestlers but had almost equal neck extensor strength. Senior and junior wrestlers both had stronger neck strength in all planes when compared with the control group (22- to 27-year-old wrestlers). The following conclusions were drawn from the results of the study: normal activities related to practice and competition situations, such as pulling, pushing, and neck bridging (Figure 6), improve neck strength; upper-extremity resistance training did not increase neck muscle strength (61).

Specific Exercises

Neck strengthening programs should focus on combinations of all 3 cardinal planes of motion: rotation (transverse plane), flexion-extension (sagittal plane), side bending (frontal plane). In addition, the exercises should be both dynamic and static to mimic common wrestling situations. Classic neck strengthening methods include:

A. Front and back neck bridging in all planes of motion (Figure 6). Varying amounts of flexion-extension may be combined with side bending and rotation to strengthen muscles in all planes of motion.
B. Manual resistance in all planes of motion. This may be performed both with and without movement.
C. A 4-way neck machine, which may be used to increase uniplanar flexion, extension, and side-bending strength.

Knee and Ankle Injuries

Knee injury, with multifactorial etiologies, remains the most common injury in wrestling (26, 41). Injuries usually occur during the takedown or bottom positions (3, 26, 41, 43, 60), most often resulting in damage to collateral ligaments (30-52%), the meniscus (15-24%), the patella (6%), and the anterior cruciate ligament (2-5%) (26, 41).

In wrestling, the ankle is the most frequent site for joint sprains (38%; 43). Classic etiology is most often an inversion ankle sprain or forced hyper-plantarflexion with anterior and lateal ankle structures typically injured. Previous history of

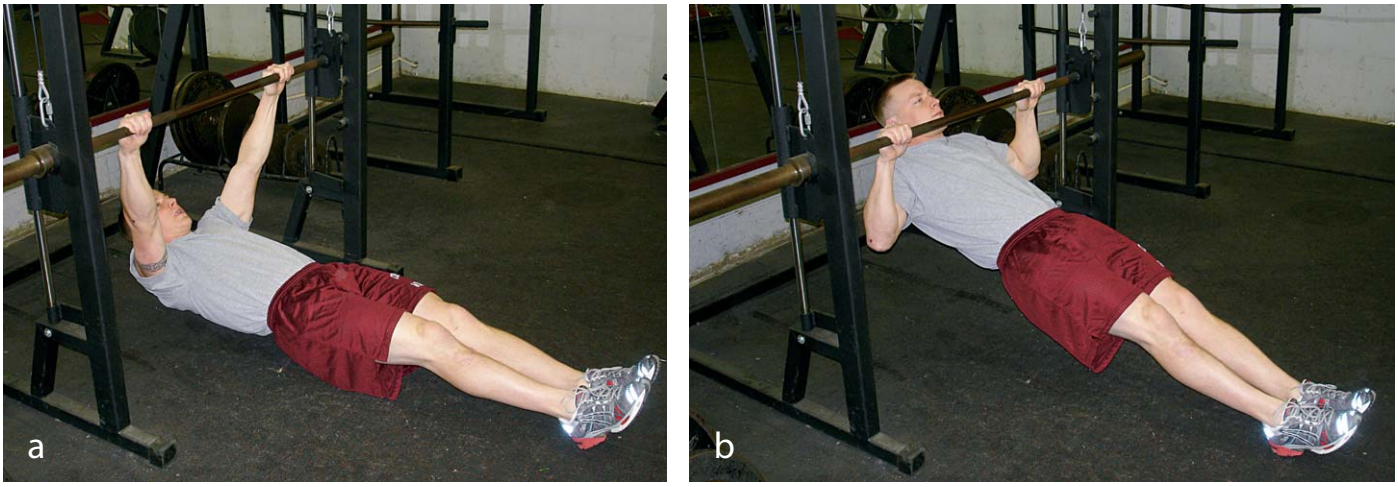

Figure 5. Supine row: (a) start; (b) finish.

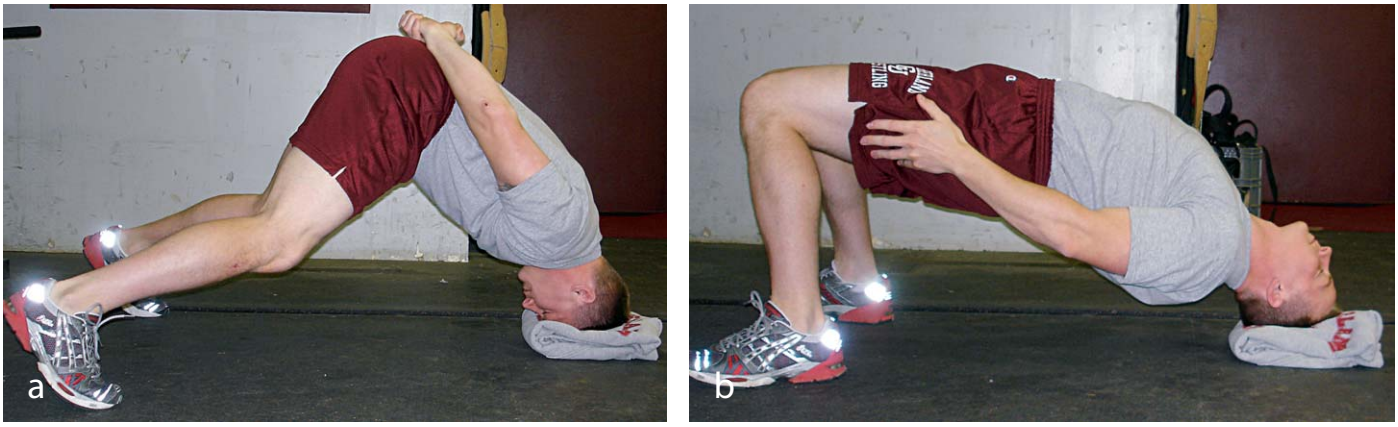

Figure 6. Neck bridging: (a) front; (b) back.

ankle sprain is the number one risk factor for subsequent ankle sprains (28, 39, 49, 51, 55). Other risk factors include decreased cardiorespiratory endurance and balance (59). Therefore, injury prevention programs to prevent future ankle injuries should include all individuals with a previous history of ankle sprain.

Due to the close relationship of knee and ankle and crossover effects of training programs for the individual joints, injury prevention programs may address both joints simultaneously. Numerous programs incorporating lower-extremity resistance training, balance, proprioception, and plyometric exercises have demonstrated success in decreasing injury rates and improving performance (11, 16, 18–21, 37, 40, 44, 46, 47, 51). Specific exercises targeting improvement of ankle proprioception and neuromuscular control have been shown to improve proprioception (16) and decrease muscle reaction times (37, 42, 47) and are thought to reduce the recurrence of ankle sprains and other lower-extremity injuries (11, 55, 58).

Specific Exercises

Such variables as support surface, eyes open or closed, and stance (e.g., single versus double support) may be manipulated for common upper- and lower-extremity exercises, such as arm curls, shoulder press, squats, and Romanian deadlifts.

A. Performing any of these exercises in single limb stance mimics takedown activities.
B. Adding an unstable surface (e.g., stability disks) further challenges balance and proprioception.
C. Plyometric exercises, such as squat jumps and split squats with cycle, serve an important role in developing explosive power necessary for takedowns.
D. Other exercises to improve balance and strength include partner perturbations (Figure 1b), standing medicine ball side toss, and ski jumps.

Conditioning

Due to the previously discussed increased risk of injury during periods of fatigue (30), designing the injury prevention program to incorporate metabolic system training proves essential. Specific to wrestling are activities that re-

Table 3
Sampling Conditioning Programs

Practice (30 min)	Competition (9 min; repeat 6 times)
Jump rope: 4 min	Sprint: 10 s
Run: 5 min	Relative rest: 15 s
Bike sprint: 3 min	Sprint: 20 s
Elliptical: 5 min	Relative rest: 10 s
Jump rope: 3 min	Sprint: 15 s
Bike: 5 min	Relative rest: 20 s

quire high levels of anaerobic power and muscular endurance (8, 22, 54). Over the course of a 2-minute period, an explosive attack occurs approximately every 6 to 10 seconds (35). Simulating the metabolic needs of practice and competition is best accomplished through interval training (33).

Intervals involving periods of intense resistance exercise, running, or biking interspersed with periods of relative rest should be considered the ideal training method to achieve physiological responses similar to wrestling. If possible, injured athletes should continue conditioning programs that also mimic the physiological needs of practice and competition (Table 3) to prepare for return to competition after adequate healing occurs.

Compliance

Compliance with athletic rehabilitation programs has been shown to correlate with decreased recurrence of knee injuries (60); compliance would likely reduce the recurrence of other injuries as well. Although highly motivated to return to competition, less than 50% of collegiate wrestlers over the course of a 6-year study were compliant with rehabilitation programs (60). A more recent study of high school wrestlers rated compliance levels between 4 and 54% (43). When compared with athletes in other sport injury rehabilitation programs (40-91%), wrestlers are less likely to be compliant or adhere to prescribed injury rehabilitation programs (4). An important aspect of returning to competition without successful rehabilitation is the result of inadequate healing and associated deficits in strength and proprioception. These deficits have been previously discussed as risk factors for injury.

Factors that have been associated with adherence are perceived value of treatment, degree of self-motivation, internal locus of control regarding health, social support, clinical environment, scheduling, and expectations of health care providers (4, 14). Building a rapport with athletes and helping them understand the need for preventing injury and following the steps to achieve adequate recovery from an injury help to ensure compliance. Because wrestlers struggle with rehabilitation compliance, the need to incorporate injury prevention strategies into an overall strength training and conditioning program is all the more important.

Summary

Wrestling is a challenging sport with regard to designing a strength training and conditioning program. Not only are the physiological demands diverse, the awkward positioning and unstable surfaces bring the need to prevent injuries to the forefront. A multifaceted, well-designed conditioning program incorporating resistance training, plyometrics, proprioceptive, and balance exercises will certainly improve athletic performance. Perhaps as important, these exercises—in concert with an awareness of common injuries, an emphasis on proper technique, and the development of multiple metabolic systems—will concurrently decrease injury rates. ♦

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