Conditioning Strategies for Competitive Kickboxing

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LEAD SUMMARY

IN CONJUNCTION WITH SPORT-SPECIFIC SKILLS DEVELOPMENT, SUFFICIENT NUTRITION, REST, AND PSYCHOLOGICAL READINESS, A KICKBOXER'S SUCCESS IS CONTINGENT UPON HIS OR HER LEVEL OF CONDITIONING. ON THE BASIS OF THE METABOLIC DEMANDS OF COMPETITIVE KICKBOXING, TRAINING SHOULD TAX BOTH THE ANAEROBIC AND AEROBIC SYSTEMS EXTENSIVELY. IN TANDEM WITH PROPER CONDITIONING, INJURY MAY BE PREVENTED THROUGH PREHABILITATIVE EXERCISES AND ADHERENCE TO SAFETY MEASURES.

INTRODUCTION

The origin of competitive kickboxing is obscure (4). In addition, styles such as Muay Thai, American or European kickboxing, Chinese San Shou, and French Savate seem to have evolved independently and asynchronously from each other (4). Despite their differences, all styles are similar in that 2 combatants use a variety of full-contact punches and kicks against each other to score points. Depending on the rules of a particular kickboxing style, legal techniques may also include elbow strikes, knee strikes, clinching, takedowns, and throws. Matches are scored and decided via referee stoppage, knockout, or judged decision at the conclusion of the match. Kickboxing matches are usually divided into rounds of 2 to 4 minutes each with a rest of 1 to 2 minutes between rounds (4). Matches vary in duration, but typically consist of 3 to 12 rounds.

BIOENERGETICS

The bioenergetics of competition must be considered when designing a training program (4,15,21). By stressing the appropriate metabolic systems through training, the athlete can better prepare for the specific demands of competition (15). Adenosine triphosphate (ATP) is the primary source of energy for muscle contraction and is replenished through anaerobic and aerobic metabolism (21). Anaerobic metabolism may be divided into 2 systems: the phosphagen system and the anaerobic glycolysis system. During maximal intensity exercise, the phosphagen system provides the majority of ATP through the initial 10 seconds of the effort (21). Beyond 10 seconds to approximately 120 seconds of maximal intensity exercise, anaerobic glycolysis predominates. For efforts lasting greater than 3 minutes, aerobic metabolism serves as the cornerstone of ATP replenishment (21). Aerobic metabolism involves pyruvic acid-producing aerobic glycolysis, the Krebs cycle, and oxidative phosphorylation (4,21). As a point of clarification, aerobic metabolism occurs concomitantly with anaerobic metabolism even during short-duration, maximal-intensity exercise (4,21).

Karate is comparable with kickboxing in that both require the repetitive delivery of powerful punches and kicks. Because karate is considered an anaerobically demanding activity (9), one may deduce that kickboxing is as well. Wingate anaerobic power testing for the legs and arms of professional male kickboxers revealed mean anaerobic capacities of 10.5 $W{\cdot}kg^{-1}$ and 5.4 $W{\cdot}kg^{-1}$, respectively (34). Although these values were deemed comparable with those of elite freestyle wrestlers (34), further study is needed to quantify the anaerobic demands specific to kickboxing training or competition.

Rounds in kickboxing last between 2 and 4 minutes and a match may have up to 12 rounds, which suggests that, during a course of a match, a kickboxer could reasonably derive more than 50% of ATP from aerobic metabolism (4,21). Aerobic capacity among professional male kickboxers was measured via cycle ergometry, which revealed a mean maximal oxygen consumption (VO_{2max}) of 62.7 $mL{\cdot}kg^{-1}{\cdot}min^{-1}$ (34). This value was also comparable with that of elite freestyle wrestlers (34). Further study is needed to quantify the aerobic demands specific to kickboxing training or competition.

Because kickboxing stresses anaerobic and aerobic metabolism, both systems should be optimized to improve the

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kickboxer's chances for success (4,34). Furthermore, targeting the appropriate energy systems in training is also important from an injury prevention standpoint. Data suggest that one's level of conditioning and experience are likely inversely proportional to one's risk for sustaining injury (3,4).

Anaerobic and aerobic conditioning principles relevant to kickboxing are discussed in the following sections. Specific examples of anaerobic and aerobic training modes are provided in Table 1. A sample training template is provided in Table 2, which outlines 6 weeks of preparation leading up to a competitive match.

ANAEROBIC CONDITIONING

Anaerobic capacity may be honed via interval training, other methods of power training, and strength training (4,15,24,28–32), whereas aerobic capacity may be optimized through interval and endurance training (15,16,24,28–32). Because anaerobic and aerobic systems may be improved concomitantly through interval training (16), such intermittent-style exercises should be core to the kickboxer's training regimen (4).

Interval training involves high to maximal intensity efforts of short duration, usually with incomplete recovery between sets. Because many techniques in kickboxing require unilateral limb movements and generation of rotational forces, functional training should mimic these movements using pad work, medicine balls, cables and bands, dumbbells, and stability balls (Table 1) (24,28–32).

Interval intensity, duration, and rest periods should be periodized throughout the kickboxer's preparation for competition (Table 2). To emulate the most demanding of competitive situations, intervals should consist of a series of maximal intensity sets, each set lasts approximately 10 to 30 seconds, and minimal rest is allowed between sets (31,32). For example, a kickboxer may perform the sequence of four maximal intensity sets: 15 seconds of band punching, rest less than 5 seconds (a quick transition to the next set), 15 seconds of a medicine ball-resisted bob and weave technique, rest less than 5 seconds, 15 seconds of dumbbell uppercuts, rest less than 5 seconds, and 15 seconds of a hexagon fast-foot agility drill, followed by a rest of no more than 60 seconds before the next sequence of four sets begins. This sequence of 4 sets could then be repeated 2 to 4 times, depending on the scheduled duration of rounds planned in actual competition. Likewise, the number of training rounds and rest duration between training rounds should mirror the same number of rounds and rest duration scheduled for competition, respectively (31,32).

To periodize the training regimen with respect to the athlete's adaptive capabilities, level of conditioning, and proximity to competition (e.g., peaking versus taper phase), intensity and work:rest intervals should be manipulated throughout the kickboxer's preparation (Table 2). In addition to the maximal intensity example provided previously, intensity may vary from light to high, the duration of some sets may extend to 2 minutes to develop power endurance and/or muscular endurance, and rest periods between interval training rounds may extend to 4 minutes (Tables 1 and 2).

From a functional standpoint, interval training mirrors the intermittent nature of kickboxing. As the date of the competition nears, intervals should emulate the technical and physical demands anticipated for the upcoming match. However, because interval training can be demanding physiologically and psychologically, careful attention should be given to proper recovery. Field observations of several elite fight camps revealed that high and maximal intensity sessions should be limited to two to three times per week, tailored to the individual, and appropriately tapered during the final week or two prior to competition (4,19,20,31,32).

Power may be improved through a variety of training modalities, which may include Olympic-style lifts, plyometric training, agility drills, medicine ball exercises, elastic band training, and stability ball training (4,7,15,24–26,28–32). Weightlifting and related lifts such as the power clean and clean pulls develop general strength and power. These lifts promote type II muscle fiber recruitment and serve to improve the triple extension mechanism of the ankles, knees, and hips (13,15,18). A powerful triple extension mechanism is essential for optimizing maneuverability and delivering techniques forcefully. However, as in many sports, kickboxing often requires triple extension off a single leg. Shuffling, changes of direction, and driving off a single leg during a kick or a punch are examples of the unilateral leg drive and stability required in kickboxing. This functional requirement of kickboxing suggests the need for additional single leg training (25).

From a neuromuscular standpoint, speed and power cannot be maximized if anaerobic training is conducted in a fatigued state or with subpar effort (4,15). As such, a high degree of mental concentration should be devoted to each repetition in power training, the repetition should be performed with maximal force in the least amount of time, and interset rest periods should be sufficiently long to allow the kickboxer to recover for the next set (4). Although the overall intensity of a power training session may be relatively light as compared with interval training sessions, each movement during power training should be executed with utmost explosiveness (Table 2).

For weightlifting, the kickboxer should consider performing fewer than 6 repetitions per set of a given lift (i.e., approximately 30% to 75% of his or her one repetition maximum [1RM]), with several sets of the exercise done per session. The interset rest period should be greater than 2 minutes and no more than two sessions should be conducted per week (8).

Plyometrics training may involve approximately 100 contacts per session (Table 1). For example, one could divide the plyometrics workout into

Table 1
Training modes

Mode	Examples	Approximate parameters
Aerobic training (AT)	Running, cycling, swimming, shadow boxing, jumping rope	1 set × 15 min × 80–90% VO_{2max} or heart rate reserve. No more than 2 to 3 sessions per week
Interval training–functional strength and muscular endurance drills (IT-FS)	Alternating elastic band straight punches, medicine ball-resisted bobbing and weaving, dumbbell uppercuts, hexagon fast-foot agility drill. End with abdominal work (crunches, medicine ball drops)	4–12 maximal intensity sets for each scheduled round × 10–30 s per set (20–50 reps) × up to 60 s rest between sets. No more than 2 to 3 sessions per week. Periodize intensity, duration, rest, and frequency per Anaerobic Conditioning section*
Interval training–sport-specific power endurance drills (IT-PE)	Full contact punch-kick (jab punch high, round kick low), punch-punch (jab-cross-hook), and kick-kick (alternating front and round kick) combinations into pads or heavy bag. End with abdominal work (crunches, medicine ball drops)	4–12 maximal intensity sets for each scheduled round × 10–30 s per set × up to 60 s rest between sets. No more than 2 to 3 sessions per week. Periodize intensity, duration, rest, and frequency per Anaerobic Conditioning section*
Interval training–sprinting drills (IT-S)	Uphill sprints, stair running, assisted and resisted elastic band sprints, 50-meter dash while alternating jab-cross punches in air. End with abdominal work (crunches, medicine ball drops)	4–12 maximal intensity sets for each scheduled round × 10–30 s per set × up to 60 s rest between sets. No more than 2 to 3 sessions per week. Periodize intensity, duration, rest, and frequency per Anaerobic Conditioning section*
Power training (PT)	Olympic-style lifts (power clean), plyometrics (box jumps, hops), agility drills, other power drills (medicine ball throws)	Lifts: 3 sets per exercise × 3–5 reps (30–75% 1RM) per set × 3–5 min rest between each set. Plyometrics and agility drills: 5–10 sets × 5–10 contacts or movements per set, 30–120 s rest between sets. No more than 2 to 3 power training days per week
Rest	Safe, nondemanding recreational activities. Massage therapy, relaxation in sauna or steam room, analyzing fight videos of opponent	Focus on physical and mental recuperation, proper nutrition, and psychological preparation
Sparring and/or sport-specific tactical drills (S)	Sparring while wearing maximal protective equipment and minimizing head contact, defensive blocking drills, ring generalship, and footwork drills. May end with abdominal work (crunches, medicine ball drops)	Emulate anticipated competitive scenario as closely as possible (e.g., sparring 80–90% of full contact effort) with focus on injury prevention. No more than 2 high-intensity sessions per week
Strength training–muscular strength development (ST)	Squat, bench press, deadlift, calf raise, multidirectional neck exercises, abdominal exercise	3 sets per exercise × 2–6 reps (80–95% 1RM) per set × 2–5 minute rest between each set. No more than 2 sessions per week

VO_{2max}, Maximal rate of oxygen consumption; Reps, repetitions; RM, repetition maximum.

*May be performed as circuit training with minimal to no rest between sets to exceed the intensity of 100% effort sparring.

Table 2
Six-week sample training template (athlete begins with basic level of conditioning)

Week 1: Introduction						
Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**	**Sunday**
LI	MI	HI	MI	MI	HI	VLI
ST	PT	IT-PE	IT-FS	PT	S	Rest
	AT	IT-S	ST	AT	IT-PE	
Week 2: Progression						
Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**	**Sunday**
MI	MI	HI	MI	MI	VHI	VLI
ST	PT	IT-PE	ST	PT	S	Rest
	AT	IT-S	IT-FS	AT	IT-PE	
Week 3: Progression						
Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**	**Sunday**
LI	MI	VHI	MI	LI	VHI	VLI
ST	PT	S	IT-PE	PT	S	Rest
	IT-PE*	IT-S	ST		IT-FS*	
Week 4: Progression						
Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**	**Sunday**
HI	MI	HI	MI	LI	VHI	VLI
IT-PE*	PT	S	IT-PE	PT	S	Rest
ST	IT-S	IT-FS*	ST			
Week 5: Peaking						
Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**	**Sunday**
LI	MI	VHI	VLI	LI	VHI	VLI
ST	PT	S	Rest	PT	S	Rest
	IT-PE	IT-FS*				
Week 6: Taper and competition						
Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**	**Sunday**
MI	MI	VLI	LI	VLI	VHI	VLI
PT	S	Rest	IT-PE	Rest	Competition	Rest
IT-S	IT-FS					

Overall intensity of session (based on perceived exertion): VLI, very low intensity activities of daily living (recuperation/relaxation); LI, low intensity (40–59% max effort); MI, moderate intensity (60–84% max effort); HI, high intensity (85–95% max effort); VHI, very high intensity (>95% max effort).

Training modes (see Table 1 for examples and parameters): Each session is preceded by gradual yet thorough warm-up. AT, aerobic training; IT-FS, interval training via functional strength and muscular endurance exercises with medicine balls, elastic devices, and/or stability balls; IT-PE, interval training for sport-specific power endurance via striking pads and heavy bags with full contact punches, kicks, and other tactical techniques; IT-S, interval training via sprints; PT, power training to include Olympic-style lifts, plyometrics, agility drills, and/or functional power exercises (e.g., using medical balls, elastic devices, and/or stability balls); Rest, no training or very low intensity recreational activity to promote recovery. S, sparring and/or sport-specific tactical drills to emulate actual competition; ST, strength training.

*Performed as circuit training with minimal to no rest between sets; intensity exceeds that of 100% effort sparring.

10 sets, whereby 10 contacts could be performed for each set (4). For maximal intensity efforts, the work:rest ratio may be as much as 1:10. In addition, 48 to 72 hours should elapse before a given body part is trained again plyometrically and no more than 2 to 3 sessions should be conducted per week (6).

Along with promoting type II muscle fiber recruitment, plyometric training can serve to minimize the transition period between eccentric and concentric muscle contractions (4). Examples of relevant plyometric exercises include explosive push-ups, vertical jumps, tuck jumps, and box jumps. Although kickboxing-specific improvements have yet to be quantified through plyometrics research, these exercises could conceivably improve the fluidity and power of the various strikes used in kickboxing, improve reaction time, and enhance overall maneuverability (6).

Agility may be defined as the ability to change direction rapidly and then accelerate (4,19). Agility is therefore relevant to ring generalship and may be improved through speed-intensive footwork drills on equipment such as an agility ladder, 5-dot drill mat, low hurdles, and angled boxes (7,31).

Strength training provides a base for power training (8). Strength gains can increase one's force of maximal contraction and velocity of submaximal contraction, both of which are highly relevant to power development (21). In addition, strength training may decrease the risk of injury by fortifying the myotendinous structures that support joints (4).

Strength training should incorporate multijoint lifts that improve overall body strength (Table 1). For instance, the squat may be done to improve lower body strength, which in turn could translate to more forceful kicks and knee strikes. To improve strength, the kickboxer should focus on performing two to six repetitions per set (i.e., approximately 80% to 95% 1RM). This repetition range is associated with greater strength gains without significant gains in body weight (1,2). As such, this training protocol may be attractive to those who want strength gains without the need to move into a higher weight class. Two to 5 minutes is an appropriate interset rest period between strength exercises and about 48 hours should elapse before a body part is trained again (4,8). If the kickboxer wishes to use resistance training to enhance muscular endurance, he or she may decrease the duration of rest periods and perform more than 12 repetitions per set (4,8).

However, strength development should be subsidiary to power and endurance training for the kickboxer. Except for relatively isometric challenges, such as clinching in Muay Thai, most kickboxing techniques are delivered repetitively and powerfully over the course of a match. As such, the kickboxer should focus on interval training and kickboxing-specific drills rather than strength training exclusively (4).

Functional training equipment, such as medicine balls, elastic bands, and stability balls, has become increasingly popular with combat sport coaches and can serve as a sport-specific form of resistance training (28–31). Although combat athletes have traditionally used many of these modalities, it is only recently that they have been deemed effective means by which core stability and performance may be enhanced (22,23). The movement mechanics stressed by these exercises improve core stability by optimizing inter- and intramuscular coordination as well as specific metabolic conditioning (10,22,23,26,27,29–31).

The volume and intensity of medicine ball, elastic band, and stability ball exercises can follow that of traditional periodization models. Progression should be tailored to meet the training level and capabilities of the individual athlete. Depending on one's training focus, a workout with functional training modalities may be incorporated into traditional lifting programs or circuit training. This may consist of four to 10 functional exercises, each performed for 10 to 15 repetitions, with 30 seconds to several minutes of rest between sets (24,26).

AEROBIC CONDITIONING

Although aerobic exercise may improve an athlete's conditioning (20), excessive endurance training (jogging one hour daily) to build a base for anaerobic training is an unfounded practice (4,32). Such prolonged, lower-intensity endurance training may actually impair anaerobic development (15,17,21). For this reason and consistent with specificity of training, interval training has gained acceptance in the combat sports community because of its effectiveness in developing aerobic and anaerobic conditioning concomitantly (15,16,21,31,32). Interval training may further improve aerobic capacity if the athlete increases the duration of a set or decreases the rest period between sets (15,16,21).

Aerobic capacity may also be improved by training at 80% to 90% of one's VO_{2max} or heart rate reserve for approximately 15 minutes, with no more than two to three sessions conducted per week (Table 1) (4,14). This training may be periodized by altering its order with respect to other training modes for a given workout day (Table 2) and by incorporating Fartlek-type training variations (20).

Although full-contact sparring provides the highest specificity of training, it may increase one's risk for injury (3). The power, strength, and functional training methods described previously are suitable substitutes to full-contact sparring if they closely emulate the biomechanical and metabolic demands expected in actual competition (4,31,32). Nonetheless, judicious contact sparring using full protective equipment is recommended to optimize neuromuscular memory, psychological preparedness, and the bioenergetics that underlie competitive kickboxing (4).

FLEXIBILITY TRAINING

Kickboxing techniques, such as kicks to the head of a standing opponent, require an extensive range of motion

about multiple joints. However, our field observations indicate that the dynamic flexibility required in kickboxing may be acquired inherently through the normal practice of techniques. If a kickboxer wishes to follow a stretching regimen, he or she may benefit from a proprioceptive neuromuscular facilitation program (33). After warm-up or immediately after a training session, this could include 1 to 2 sets of a proprioceptive neuromuscular facilitation stretch sequence (e.g., hold slight passive stretch for 10 seconds, hold isometric contraction for 10 seconds, then relax to allow more extensive passive stretch for 30 seconds).

INJURY PREVENTION

The competitive kickboxer's primary goal is to score blows more frequently and decisively than his or her opponent (4,5). As a result, a variety of injuries may be expected. Several studies have elucidated that most injuries in kickboxing occur to the head and lower extremities (5,11,12,35). These findings were attributed to the lower extremities being used to both defend against and deliver forceful blows, while the head region was a primary target (4).

Joint integrity may be preserved by strengthening the surrounding myotendinous architecture and perhaps by also improving the joint's range of motion (4). Such prehabilitation may be afforded through the strength, functional, and flexibility training modalities discussed previously. In terms of preventing injuries caused by blunt trauma, frequency and severity may be decreased by supplanting full-contact sparring with sport-specific interval and circuit-based training (4,26). Limiting contact to the head region, mandating wear of protective equipment, and ensuring injured participants complete rehabilitation before returning to full training or competition are also strategies for decreasing the likelihood of injury (3,4).

DISCLAIMER

The information provided herein does not represent the views of the United States Air Force or Department of Defense.■

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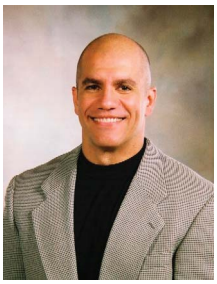

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