Preseason Performance Testing Battery for Men’s Lacrosse

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SUMMARY
DESPITE THE INCREASED PARTICIPATION IN THE SPORT OF MEN’S LACROSSE, THERE REMAINS A PAUCITY OF PHYSIOLOGICAL AND BIOMECHANICAL STRENGTH AND CONDITIONING DATA REGARDING THE CORPOREAL DEMANDS OF THE SPORT. THE PURPOSE OF THIS ARTICLE WAS TO PRESENT A PRESEASON TESTING BATTERY IMPLEMENTED TO TAX THE SPORT-SPECIFIC PHYSICAL RIGORS OF MEN’S LACROSSE. THE TESTING BATTERY PRESENTED HAS BEEN EMPLOYED ON A NATIONAL COLLEGIATE ATHLETIC ASSOCIATION DIVISION III MEN’S LACROSSE TEAM AND INCORPORATES THE ASSESSMENTS OF SPEED, AGILITY, STRENGTH, ENDURANCE, AND BODY COMPOSITION.

INTRODUCTION
THE SPORT OF MEN’S LACROSSE HAS DEVELOPED INCREASED ATTENTION IN THE PAST 7–8 YEARS IN THE UNITED STATES (16,18). THE GROWTH IN POPULARITY HAS RESULTED IN ELEVATED STUDENT AND PROFESSIONAL PARTICIPATION AND TRIGGERED ADVANCEMENTS IN THE EQUIPMENT USED FOR COMPETITION (10). HOWEVER, THE INCREASED PARTICIPATION HAS NEGLECTED TO ELICIT AN INCREASE IN LACROSSE SPECIFIC PUBLISHED LITERATURE. THEREFORE, A CHALLENGE ARISES WHEN COACHES AND PLAYERS SEEK OUT PHYSICAL TESTING BATTERIES TO IMPLEMENT INTO THEIR TRAINING PROGRAMS AND PRACTICES.

The purpose of this article is to present a preseason testing battery designed to assess the physiological and biomechanical strength and conditioning demands of men’s lacrosse. The physical rigor of lacrosse requires high-intensity, fast-paced, full-contact bouts of exertion produced by the player. Such highly stressed corporeal demands commonly elicit high injury rates associated with frequent participation in competition, practice, or training programs (10,16). Because of the aggressive nature of competitive play, the leading affliction responsible for player injury is physical collision contact (10,16). Player-to-player contact coalesced with stick and ball contact are associated with approximately 88.8% of game, and 50% of practice sustained injuries (10). Body checking is a permitted physical strategic game play skill used in defensive play. Investigators have reported that the probability for a player to sustain a head injury such as a concussion in player-to-player body checking is twice as common than a head injury sustained in stick and ball contact (9,18).

Despite the notoriously high-impact component of men’s lacrosse (with the majority of the recorded sport-related injuries reported as collision contact injuries), the sport is statistically held as reputedly safe (16,25). Over recent years, several rules and regulations have been updated in attempts to increase player safety and reduce injury-prone situations in the game.

An amendment to an offensive shooting rule was enforced in 2000, which disallows the offensive player from becoming airborne before shooting the ball and landing in the goal crease (10). The amendment is referred to as the “dive rule,” and the enforcement of the rule provides increased offensive-defensive player collision protection at the goal. The goal crease is a marked circle on the game field, which is measured 18 ft in diameter. The goal cage is centered in the crease at the goal line midpoint, therefore allowing more space in the front of the crease at the opening of the cage (where close to 25% of game injuries are sustained) (10).

With amendments in the rules of men’s lacrosse and advancements in the equipment (5), the continued progression of the sport needs innovative testing data revolving around the most effective strength and conditioning training. Such conditioning must objectively integrate the fundamental high physical intensity of lacrosse. The aggressive high-impact physical contact and high intensity of speed, coordinated with ball and stick handling skill, are defining physical rigors of men’s lacrosse (18).

The intensity of the sport elicits a feasible comparison of the sport’s physical demands to a combination of selective physical demands from...
Although there is a lack of data directly relating passive or active rest occurs (13). Men’s lacrosse can be highly associated with the intermittent characteristic of sports such as basketball and ice hockey (18,25). Overall, the physiological and biomechanical demands of men’s lacrosse impose a vast array of corporeal taxations, which delineate lacrosse from simulating any one sport. The game requires an intrinsic combination of muscular strength and endurance, the agile ability to explosively adjust directions, with the capability of frequently transitioning speed and motion from offensive to defensive mode (18).

The fundamental guidelines of men’s lacrosse have a field setup most closely structured to that of a soccer field. The field dimension of a collegiate lacrosse field is formatted at a length of 120 yd and a width of 60 yd (25). The game is played, within regulation time, in 60 minutes, which is broken into four 15-minute quarters. At the termination of each quarter, a specific amount of time is elicited for both teams for player rest and team strategizing. After the first quarter a 2 minute break is given. The end of the second quarter signifies half-time and a 10 minute break is allowed (25). In the event when regulation time ends in a tie, the game will be granted as 4-minute sudden-death overtime quarters until the point where one of the teams scores a goal to end to the game (25).

In comparison, the structure of the field of play and the positioning of players on the field in men’s lacrosse most closely relates to soccer. The similarity in game play format elicits in the aerobic conditioning of the male soccer athlete to the male lacrosse player. However, the explosive change of direction, which continually occurs throughout a lacrosse game, matches the impulsive agility displayed in the sports of basketball and ice hockey. Men’s lacrosse can be highly associated to the intermittent characteristic of basketball, suggesting that throughout a players shift in a game, there is time between bouts of exertion where passive or active rest occurs (13). Although there is a lack of data directly evaluating the work to rest ratio experienced in a men’s lacrosse game, the intermittent component of physical performance along with the greater size of the game field implies a balanced ratio between sprint/jog/walk movements in a game. In addition to the high demand for speed, agility, and stamina needed for peak lacrosse performance, the size of a player is an important physical attribute, which assists the player to withstand the high impact of checking in the game. The collision aspect of men’s lacrosse correlates strongly to tackle football and men’s ice hockey (16,25).

The overall high versatile athleticism of a male lacrosse player presents a strenuous demand upon the conditioning of the athlete. However, the demand of performance capability is subjected to differences between each position played on the field. Men’s lacrosse has 4 positions: attacker (offensive player), midfielder (transition player), defensemen, and goal tender (1).

The general anthropometric and physiological condition required at each position has many overlapping similarities. Conversely, because of the different responsibility each position has, particular alterations in performance demand arise. As an attacker, field position remains within the 60-yd offensive zone between the halfway line and the baseline of the field. The focal task of an attacker is to score goals, and therefore, speed, agility, and elite stick skills are needed (1).

The midfielder is the transitional player, who allows the position to be able to cross the halfway line between offensive and defensive ends of the field at any point in the game. The midfielder as a result is required to cover the most running distance while assisting ball movement from defense to offense and therefore needs speed and great stamina (1). The midfielder usually possesses the greatest fitness level out of all the positions (1,25).

Defensemen, like the attackers, remain within the realm of the defensive zone between the midway line and the defensive baseline. Defensemen are also quick and agile; however, the aggressive nature of the position requires greater strength outputs to defend the goal and repossess the ball (1). The goaltender is the final line of defense, positioned directly in front of the goal cage, with majority of game play spent within the surrounding goal crease. Although the goalie is involved in the least amount of running, the position requires quick agile hand-eye coordination and footwork (1).

This preseason testing battery is designed to tax sport-specific requirements. This testing battery can provide baseline data for coaches, staffs, and athletes. If implemented into fitness assessment programs, the physical condition of the team and athletes as individuals can be established. The accumulated data obtained can provide greater insight into the corporeal taxation of a male lacrosse athlete.

**TESTING BATTERY**

A lacrosse fitness testing battery must balance the many physical demands of this vigorous team sport. The testing battery is structured to simulate sport-specific skills and physiological game play demands. Lacrosse players need to possess an ultimate physicality that incorporates speed, agility, strength, endurance, and lean body composition (18).

The assessments of maximal aerobic power, muscular power, muscular strength, speed, and agility were measured. The testing battery requires 3 separate testing days. The setup of the testing battery was formatted with nonfatiguing tests performed first within each day. Day 2 and 3 incorporate the same concept. Day 2 begins with the 1 repetition maximum (1-RM) bench press, which is followed by the back squat, which is considered more of a full body exercise. Day 3 begins with the straight line running and progresses into sprint courses, which integrate agility, balance, and explosive change of direction.

**DAY 1**

Day 1 is performed in the laboratory setting. Anthropometric measurements...
are acquired and include data such as height, weight, and body fat percentage. Body fat percentage is obtained using skin fold caliper measurements with a 3-site measurement protocol at the chest, umbilicus, and thigh (12,13). A reasonable score in Division III male lacrosse players for body fat percentage is 12%. The correlation coefficient for skinfold measurement steadily ranges from 0.70 to 0.90 (1). In addition to demographics, day 1 testing in the laboratory includes an assessment of anaerobic vertical power and maximal aerobic power.

**VERTICAL JUMP.** Anaerobic vertical power is effectively measured with the vertical jump test using the Vertec Vertical Leap (Hilliard, OH). The standing reach height taken from the athlete’s dominant side of body determines the height that the shaft of the device is positioned. The reliability coefficient for the vertical jump test is in the high range of 0.93–0.99 (6,11). A familiarization trial is given through a visualization of the jump technique performed by the test administrator. The athlete is instructed to stand slightly back from the device. Three countermovement jump trials are elicited. The athlete performs the countermovement jump by simultaneously bending the knees and swinging the arms back while descending into the squat position. The results are determined by the highest vane touched after 3 jump trials (8,17,24). A reasonable peak jump height for the vertical jump test in this population is 22 inches. A 5-minute rest period is given between the conclusion of the vertical jump and the commencement of the maximal oxygen consumption test.

**MAXIMAL OXYGEN CONSUMPTION.** Maximal aerobic power is determined through the maximal oxygen consumption test (VO2max) in accordance with the Bruce protocol (4,19). The performance of the VO2max test on a treadmill simulates the critical cardiovascular component of lacrosse. The correlation coefficient for the VO2max test is high at 0.93 with a standard error ranging from 2.5–6% (14,21,22).

The standard Bruce protocol consists of nine 3-minute stages, and with progression to each new stage, the treadmill speed and grade increases (19). The first stages of the protocol elicit a slow walking pace, but the player was verbally encouraged that as the intensity of the test progressed to a running pace to continue to perform test to exhaustion. The player self-terminates the VO2max test at a voluntary point of exhaustion (19). The first 2 stages of the Bruce protocol are performed at a medium walking pace and therefore are considered the warm-up for the VO2max test. A reasonable score in a VO2max test in Division III male lacrosse players is approximately 55 mL·kg⁻¹·min⁻¹.

**DAY 2**

Testing day 2 assesses maximal strength using a 1-RM test. The sequence of test consists of the 1-RM bench press followed by the 1-RM back squat.

**ONE REPETITION MAXIMUM.** Athletes are allowed a warm-up that replicates the execution of the lift, which consists of 5 repetitions at 40–60% of estimated 1-RM before each test (15,26). Proper lifting technique of the bench press and back squat are monitored by the individual administering the tests to the athletes (strength and conditioning certification may increase reliability of test administration but is not mandatory). The reliability coefficient for the 1-RM bench press is 0.97 (3). However, despite the high reliability associated with the 1-RM test strength scores measured in the test can have variability change ranging from 2 to 12% (27). A maximum of 5 trials is allowed for an athlete to obtain their 1-RM (for both tests) to avoid significant potential effects of muscular fatigue (28).

To perform the bench press, athletes lie supine on a bench with hands positioned shoulder-width apart on the barbell. The movement criterion for the test begins with arms extended directly above the chest. The weight is lowered until the barbell is in contact with the chest and then returned to the preparatory extended position (15,26).

The movement criterion for the back squat starts in a standing position with a barbell positioned across the upper back. The athlete maintains a straight back while descending into the squat position. The squat is complete when the hamstring of the athlete is observed in a parallel line with the ground, and the athlete ascends back to the standing position (15,26,28). The results of the 1-RM bench press and back squat are determined by the highest weight recorded. A reasonable score for male Division III lacrosse athletes in the 1-RM bench press is 195 lbs and in the 1-RM back squat is 260 lbs.

**DAY 3**

Day 3 of the testing battery consists of timed field testing for the assessment of speed and agility. Handheld stop watches are operated by the test administrator for the timing of each trial. Field tests used are the 40-yd sprint, T-run, box run, and agility run. The athlete is allowed a 10-minute self-prescribed warm-up session before the commencement of the field tests. The athlete is instructed to perform a warm-up that would effectively produce a light sweat and increase the heart rate. Visual performance of the test is provided before each field test by the test administrator as a familiarization trial. A rest/recovery period of approximately 2–3 minutes separates each trial and test.

**FORTY-YARD SPRINT.** The 40-yd sprint is used to assess the athlete’s explosive sprinting power. The distance of the 40-yd sprint has been established as a universal sprinting distance in athletic testing (20). Although testing linear running speed can be accomplished in shorter testing distances, greater reliability has been determined in sprinting distances that are farther than 20 yd (2). The reliability coefficient
for the 40-yd sprint was calculated at a high value of 0.97 (7). The 40-yd sprint assessment displays the basic linear speed produced in an average sprint distance of the athlete on a lacrosse playing field. The 40-yd sprint test is self-started by the athlete who starts the sprint with both feet behind the start line (23). The sprint time begins at the first movement of the athlete and is terminated when the first part of the athlete’s body crosses the 40-yd distance marker. The fastest time of 2 trials is recorded. A reasonable score in the 40-yd sprint in this population of male lacrosse athletes is 5.5 seconds.

T-RUN. The T-run test is a timed assessment of the speed; explosion; and efficiency to accelerate, decelerate, and change directions. The T-run course is designed with 4 cones numbered 1–4 (8). Cones 2–4 are spaced 5 yd apart along a straight line with cone 2 positioned to serve as both the center point between cones 3 and 4 and the perpendicular point spaced 10 yd from cone 1, creating a T-shape (Figure 1). The athlete starts on either side of cone 1, and the test time begins with the athlete sprinting to the middle-top of the T-course to cone 2. Cone 2 is positioned slightly ahead of the T-run line, to avoid an obstructive object throughout the rest of the test. Once the athlete reaches the cone 2 marker, the athlete then shuffles sideways in a low squatting position to cone 3. At cone 3, the athlete must touch the cone before changing directions. From cone 3, the athlete shuffles sideways to cone 4 (bypassing cone 2) and touches cone 4. From cone 4, the athlete shuffles back to cone 2 and finishes by sprinting backward to cone 1. The time is stopped as the athlete passes through cone 1 (8). Two trials are performed with the fastest time recorded. A reasonable score for the T-run in this population is 9.5 seconds.

AGILITY RUN. The agility run is a test performed to assess the athlete’s ability to rapidly accelerate, decelerate, and change directions continuously in a localized area. Five cones are used with each cone spaced 5 yd apart. Cone 2 is in the middle of the sprint course, with cones 1, 3, 4, and 5 arranged around cone 2 (12 o’clock, 3 o’clock, 6 o’clock, and 9 o’clock). The athlete starts and ends the agility run at cone 1. The test begins on the right side of cone 1 and is a continuous sprint throughout the entire cone sequence. Each time the athlete approaches a cone, the athlete performs a left turn around the cone and reaccelerates into a sprint toward the next cone. The cone sequence for the agility run is (1-2-1-3-2-3-4-2-4-5-2-5-1) (Figure 2). The total distance covered in one trial of the agility run is approximately 60 yd. The second trial begins on the left side of cone 1, and the athlete completes a right turn around each cone approached. The cone sequence for trial 2 is (1-2-1-5-2-5-4-2-4-3-2-3-1) (Figure 3). The time is recorded for each
A reasonable score for the agility run in both the right and left turn is 20 seconds in this population.

**BOX RUN.** The box run is a timed agility test used to assess the ability to change directions with speed, balance, and coordination factored into the sprint. The box run uses 4 cones, each 10 yd apart (Figure 4). The test begins with a forward sprint from cone 1 to cone 2. At cone 2, in a continuous movement, the athlete spins counterclockwise and continues to cone 3. At cone 3, the athlete spins counterclockwise and continues to cone 4. At cone 4, the athlete spins counterclockwise and finishes the test by sprinting through cone 1. Two trials are performed for the box run. The second trial is completed in the opposite direction, starting at cone 1 and sprinting to cone 4, with the athlete spinning in a clockwise direction (Figure 5). The times(s) for both trials in each direction are recorded. A reasonable score for this population of lacrosse athletes is 8.5 seconds.

**CONCLUSIONS AND CONSIDERATIONS**

The importance of implementing a pre-season testing battery to a team’s strength and condition program is an essential component in monitoring the progression of individual and team fitness levels. The application of a testing battery must be designed to the sport’s specific physical demands. This lacrosse testing battery is provided to introduce a lacrosse-specific design, which was created to correlate the sports game play demands and simulate such physical demands in controlled laboratory and field fitness test environments. Each physical assessment chosen for the testing battery was selected to explicitly simulate a biomechanically stressed movement or sequenced physical exertions, which would commonly be performed on the field of play.

The sport of men’s lacrosse is in need for normative sport-specific testing values. Such values will give coaches and athletes data that will provide a definitive physical fitness tier, elicit player comparison to a researched lacrosse fitness status. The assessment of the taxing physical demands required to successfully perform in a lacrosse game will contribute to the progression of the individual athlete, the team, and the sport collectively. The accumulation of athlete’s physical condition data is necessary to begin to provide insight of the fitness parameters at the collegiate level of this growing sport. With the continuous growth in participation, an increase in the need for data must follow to...
progressively guide the physical, psychological, and safety demand of the lacrosse athlete. The demand of lacrosse-specific fitness data is inevitably increasing, and the importance of increasing the supply of such needed data will serve as a crucial determinant in the future success and progression of the sport.

**PRACTICAL APPLICATIONS**

The design of our lacrosse fitness testing battery is structured to promote the performance progression of the lacrosse athlete via the implementation of the testing battery in team and individual fitness conditioning. This testing battery provides a comprehensive sport-specific proposal of tests that tax cardiorespiratory endurance (aerobic fitness) and short-term high-intensity power (anaerobic fitness) and integrates speed, agility, and coordination components. Teams and individual athletes can establish a baseline analysis of their fitness level and track their progression within comparable intervals of fitness battery retesting.

**REFERENCES**


