Differences in Player Metrics Between Lacrosse Games and Practices

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Differences in Player Metrics Between Lacrosse Games and Practices

Kinta Schott
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Abstract – This study was intended to better understand the physiological demands of the sport of lacrosse by analyzing and comparing player metrics during game and practice sessions. A team heart rate monitoring system with global positioning was utilized to measure player metrics during games, which were compared with metrics recorded during practice sessions. Participants in the study consisted of 13 male high school club lacrosse players (16.2 ± 1.5 yr; 175.3 ± 7.7 cm; 69.9 ± 13.6 kg). Game and practice data were compared utilizing paired samples t-tests, while individual position metrics were analyzed by independent samples t-tests. A standard p ≤ .05 and effect size (r) were used to determine significance and effect sizes. Results of game and practice comparison showed significant differences for average HR, total calories, and caloric expenditure (t ≥ 4.2, p ≤ .003, r ≥ .590). Significant differences were also found for duration, total distance covered, and number of sprints performed between game and practice sessions (t ≥ 2.32, p ≤ .049, r ≥ .253). Positional comparisons identified significant differences and large effect sizes between midfield and face off positions (t=2.411, p=.028, r=.525) and number of sprints (t = 3.242, p = .005, r = .745). Games showed lower total caloric expenditure, but duration of the sessions was significantly different. When session duration was normalized, players showed a higher caloric expenditure during games. As a result of these findings coaches may want to change their practice session intensities if they wish to emulate games.

Keywords: positional differences, heart rate monitor, global positioning, physiological outputs, field athletes

I. Introduction

There were 324,689 lacrosse players in the United States in 2017 according to US Lacrosse’s “2017 Participation Survey”. The sport of lacrosse has been one of the fastest growing sports in the US with boy’s programs increasing participation by 24 percent between 2012 and 2017. Lacrosse has been dubbed the “fastest sport on two feet” (“Making the Fastest Game on Two Feet Faster,” 2016) and it has a growth rate to match. The rise of participation in lacrosse has also led to an increase in research of the physiological demands of the sport. Current research, has been focused toward laboratory-based testing on lacrosse players, utilizing common maximal effort tests such as one repetition max, the Bruce Protocol (Enemark-Miller, Seegmiller, & Rana, 2009), and the Wingate test (Steinhagen, Meyers, Erickson, Noble, & Richardson, 1998). However, there is limited real-time data collected in field-based settings. Although laboratory methods are ideal for testing peak performance, they may not be accurate in predicting the actual demand of lacrosse players during competition. Research has been done comparing laboratory performance tests and in game measures for other sports and has shown discrepancies between laboratory measurements and actual playing abilities and player metrics in competitive events. Results from a study conducted by Bond, Bennett, and Noonan (2018) concentrated on hockey athletes and showed that the data resulting from the use of laboratory and functional movement tests are inconsistent and suggest that they may not reveal information about a player’s sport-specific skill or capability. Additionally, research on other sports has shown insight into player conditioning levels and the need for data following live play to understand the physiological requirements of athletes in their respective sports. Soccer, a widely studied sport, is very similar to lacrosse in the individual positions and playing surfaces. During game play,
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soccer players reach average heart rates of 70-85% of their maximum rate (HR max), they can spend 8.1-8.7 percent of their game in a high intensity run or sprint, and they cover an average of 10.8 km per match (Sapp et al., 2017). Because these demands have been studied for more than five decades, the research is able to provide the average distance covered and athlete’s average intensity as a percentage of maximal heart rate. Without real-time data collection during competition, it is difficult to elucidate the true performance demands existing in the sport of lacrosse. The use of data found during game situations for lacrosse players may help to better understand the true demands during game play. The opportunity to study lacrosse players in similar ways exists and is necessary to better understand the physiological and conditioning requirements for the players participating in this rapidly growing sport.

The sport of lacrosse is a team sport with four primary positions: attack, midfield, defense, and goalie. Each position has its own responsibilities and physiological requirements. Traditionally, the midfield covers the entire field, end to end, while the attackers and defenders cover their respective ends. The goalie guards the goal often with minimal movement. In the men’s game, there is also a specialized position, called a face off get off (FOGO). A FOGO begins play at the start of the game and after every goal. Men’s lacrosse is typically played on a natural grass or synthetic turf field. The dimensions for the field are 110 yards long by 60 yards wide. The mid-line of the field is also referred to as the restraining line which is to prevent defenders from going onto the attacking area and attackers from entering the defensive end. Midfielders, however, are free to roam end to end, provided no more than six total field players from each team are on the side of play (Smith, 2017). Goals are placed 80 yards apart to provide 15 yards behind the goal line extended for play (Scroggs, 2018).

![Figure 1: Field diagram showing total distances of the men’s US lacrosse regulation field (Field Diagrams, 2016).](image)

Lacrosse requires a high level of aerobic and anaerobic fitness, with quick starts, short bursts of sprints and longer distance runs with and without possession of the ball. Need for speed, quick direction change, and varying movements for individual positions, each add increased muscular and

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cardiovascular system endurance and power requirements (Sell et al., 2018). Utilization of in-game data collection can be used to gain insight to an athlete’s conditioning and readiness to perform in game situations. Analysis of player metrics can also be used to quantify an athlete’s performance demands in each session, whether it is a practice or game. The internal metrics and physiological output of individual members of a lacrosse team can be monitored utilizing a commercially available team system, such as the Polar Team Pro System (PTPS), which can also allow for the collection of external metrics and movement parameters. The PTPS records time spent in designated heart rate zones, caloric expenditure, and time in defined sprint zones. The PTPS also utilizes a global positioning system (GPS) connection to measure distance traveled, speed, and distance in defined speed zones (Conners, Whitehead, Shimizu, & Bailey, 2018).

The purpose of this study was to observe and quantify the internal and external demands of high school lacrosse players during tournament game play and practice sessions. The comparison of factors including time in sprint zones, distance traveled, and heart rate between positions may highlight a need for varied conditioning and training requirements for each specific player based on their type of session. Researchers anticipated seeing elevated distances and increased durations during practice sessions as compared with games. It was also hypothesized that games caused players to show higher HR averages. In addition to the game and practice comparisons, individual positions may show different demands as well. It was anticipated that midfield would show more completed sprints than defense and attack, and it was predicted to see values indicative of higher demands, such as elevated HR and greater distances traveled, for midfields players. Regarding the specialized position, FOGO, the position was predicted to show very short bursts of speed and have data numbers indicative of high intensity with low duration and a low sprint count. In response to the opposing team’s attackers, researchers expected to see defense show occasional shorter distance sprints at high speed but not for prolonged periods of time.

II. Methods

Experimental Approach to the Problem

Data were collected from a high school level team during two practices and one tournament game with a running clock. The practices lasted an average of 130.92 minutes, while the tournament game totaled 39.58 minutes. To compare for individual position demands, each player was classified as one of five positions: midfield, defense, attack, goalie, or FOGO to allow for a comparison of positional demands. The research team did not alter training or game plans, and participants were instructed to practice, scrimmage, and compete in games as they otherwise would.

Subjects

A total of thirteen male players (mean ± SD; 16.23 ± 1.54 years; 175.32 ± 7.72 cm; 69.89 ± 13.60 kg) from a high school, club lacrosse team participated in the study. Of the thirteen players, five defenders, two attackers, five midfielders, and a single FOGO were recorded. All subjects were volunteer participants and completed written informed consent or parental assent approved by The University of Alabama Huntsville Institutional Review Board, prior to participation.

Procedures

Internal and external factor data were recorded using the PTPS. Each subject’s height, body mass, sex, date of birth and training background (based on the number of hours spent training for lacrosse per week) were recorded and then used to make their online PTPS profile. Each monitor was specifically coded using the athlete’s information and assigned an identification number. Each player would keep this number for the duration of the study to ensure player metrics were accurately monitored and recorded. The monitors were placed directly on the skin of athletes’ chests via an elastic strap at the beginning of each practice and game. The sensors recorded all movement from the beginning of warmups to their cool down. All measured metrics were as follows: duration, total distance, distance rate, average speed, max speed, max HR %, minimum HR % average HR %, training load, training load rate, calorie expenditure, and calorie
rate. These rates (kcal/min) were hand calculated and not recorded by the PTPS to find a relative measure in order to compare total data found in games and practices.

Statistical Analyses
Data were recorded and analyzed as mean values and standard deviations (SD) utilizing the IBM Statistical Package for the Social Sciences (SPSS) Statistics 24 for Windows (IBM Corp., Armonk, NY, USA). The overall demand for all players during a game versus during practice were compared using a paired samples *t*-test, while positional demands between attacking, midfield, defensive, and FOGO players were compared using independent samples *t*-tests. Significance was set at \( p \leq .05 \), two-sided *a priori* for all analyses. Effect sizes \((r)\) were also calculated for each comparison (Becker, L.A. 2000.).

<table>
<thead>
<tr>
<th>Cohen's Standard</th>
<th>( d )</th>
<th>( r )</th>
<th>( r^* )</th>
</tr>
</thead>
<tbody>
<tr>
<td>LARGE</td>
<td>0.8</td>
<td>.371</td>
<td>.138</td>
</tr>
<tr>
<td>MEDIUM</td>
<td>0.5</td>
<td>.243</td>
<td>.059</td>
</tr>
<tr>
<td>SMALL</td>
<td>0.2</td>
<td>.100</td>
<td>.010</td>
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<tr>
<td></td>
<td>0.1</td>
<td>.050</td>
<td>.002</td>
</tr>
<tr>
<td></td>
<td>0.0</td>
<td>.000</td>
<td>.000</td>
</tr>
</tbody>
</table>

*Figure 2: Effect size \((r)\) comparison with Cohen’s \( d \) (Becker, L.A. 2000.)*
III. Results

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Practice mean ± SD</th>
<th>Game mean ± SD</th>
<th>p</th>
<th>t</th>
<th>Effect Size (r)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration (min)</td>
<td>130.92 ± 5.28</td>
<td>39.58 ± 00.00</td>
<td>&lt; .001</td>
<td>51.916</td>
<td>0.997 VL</td>
</tr>
<tr>
<td>Total Distance (m)</td>
<td>3957.43 ± 329.10</td>
<td>1848.00 ± 607.595</td>
<td>.024</td>
<td>12.599</td>
<td>0.907 VL</td>
</tr>
<tr>
<td>Distance Rate (m/min)</td>
<td>33.63 ± 7.45</td>
<td>46.69 ± 15.35</td>
<td>&lt; .001</td>
<td>-2.786</td>
<td>-0.476 M</td>
</tr>
<tr>
<td>Average Speed (km/hr)</td>
<td>2.05 ± .28</td>
<td>2.64 ± 1.03</td>
<td>.086</td>
<td>-1.955</td>
<td>-0.364 M</td>
</tr>
<tr>
<td>Max Speed (km/hr)</td>
<td>25.7315 ± 2.25</td>
<td>29.44 ± 5.81</td>
<td>.051</td>
<td>-2.299</td>
<td>-0.388 M</td>
</tr>
<tr>
<td>Sprints</td>
<td>9.09 ± 3.57</td>
<td>7.11 ± 3.98</td>
<td>.049</td>
<td>2.322</td>
<td>0.253 S</td>
</tr>
<tr>
<td>Average HR %</td>
<td>73.89 ± 5.21</td>
<td>84.56 ± 5.15</td>
<td>&lt; .001</td>
<td>-5.623</td>
<td>-0.717 VL</td>
</tr>
<tr>
<td>Max HR %</td>
<td>98.611 ± 2.988</td>
<td>101.52 ± 5.597</td>
<td>.087</td>
<td>-1.951</td>
<td>-0.308 M</td>
</tr>
<tr>
<td>Calories</td>
<td>1266.87 ± 232.21</td>
<td>539.333 ± 132.78</td>
<td>.003</td>
<td>10.753</td>
<td>0.887 VL</td>
</tr>
<tr>
<td>Calorie Rate</td>
<td>9.69 ± 1.81</td>
<td>13.63 ± 3.35</td>
<td>.003</td>
<td>-4.199</td>
<td>-0.590 L</td>
</tr>
</tbody>
</table>

Table 1: Metrics recorded for all players for game and practice. Results are presented as mean ± SD.

Significant differences between game and practice data were observed for the following external factors: duration, total distance, distance rate, and number of sprints ($t ≥ 2.32, p ≤ .049, r ≥ .253$). Significant differences between games and practices were also found for the following internal factors: average HR %, training load, training load rate, calories, and calorie rate ($t ≥ 4.2, p ≤ .003, r ≥ .590$). Games had a higher intensity and shorter duration than practices.

Positional comparisons between midfield and FOGO positions were found to have significant differences for max HR ($t = 2.411, p = .028, r =.525$) and number of sprints ($t = 3.242, p = .005, r = .745$). All other variables: total distance, distance rate, average speed, max speed, average HR %, training load, training load rate, calorie expenditure (kcal), and calorie rate (kcal/min) showed no other significant differences ($p > .137$). Although insignificant distance rate had a medium effect size ($r = .362$), max speed and average speed had medium effect sizes ($r ≥ .300$). The data found for average HR% ($r = .399$) and calorie rate ($r = .325$) also showed a medium effect size.

IV. Discussion

The purpose of the study was to quantify the differences in the physiological demand players experience between game and practice play in the sport of lacrosse as well as to analyze positional metric differences. It was hypothesized that midfield players would complete more sprints and cover greater distances than defense and attack positions as a result of their positional requirements. It also was hypothesized that the FOGO position would perform a high number of sprints but not as many as the midfield players. Attack players were expected to demonstrate consistent, fast, and powerful movements with high speed sprints in short bursts. Data was expected to show shorter distance sprints performed by defensive players.

During the game, players expended significantly fewer calories than during the practices, however the duration of the game was also significantly less. Because practices lasted 130.92 ±
5.28 and players expended 1266.87 ± 232.21 kcal, players presented a calorie rate of 9.69 ± 1.81 kcal/min. Alternatively, the game had a duration of 39.58 minutes with calories expended being 539.333 ± 132.78 kcal, resulting in a caloric expenditure rate of 13.63 ± 3.35 kcal/min. Thus, participation in games resulted in an elevated number of calories burned per minute rate compared to practices. Overall, players burned roughly half the number of calories during game competition compared to practices, which was shown to be a significant difference ($p = .003$) with a large effect size ($r = .590$). The elevated caloric expenditure rate shows that games are more physiologically demanding than practices, despite having shorter durations.

When comparing individual positions, significant differences were found between the FOGO and midfield positions for max HR and number of sprints performed. During practices and the game, midfield completed 9.5 ± 3.57 sprints while the FOGO position completed 3.50 ± 1.29 sprints. This data shows that midfield players tend to complete three times the number of sprints that the FOGO position does. This finding supported the hypothesis and was expected, since midfield players spend a greater amount of total time on the field during a game than FOGO. In another study comparing individual positions, midfielders were found to perform more sprinting when compared with attackers and defenders across all quarters (Polley, Cormack, Tim J. Gabbett, & Polglaze, 2015). The data recorded in this study showed significant differences in maximum heart rate percentage (max HR %) between positions. When taking all data into consideration, midfield data showed a mean of 99.79% of a player’s predicted max HR% on average between games and practices. In addition, although not statistically significant, midfield players had the highest calorie rate (11.55 ± 2.81) versus all three other positions by the data [defense (10.18 ± 2.77), attack (9.01 ± 3.599), FOGO (9.62 ± 2.80)]. This data, despite a lack of significance, can be useful information to coaches and players regarding fueling strategies, as midfield players may require greater amounts of calories to replenish what was lost during games or practices.

As a pilot study, this investigation had a limited sample size. At only 13 subjects, it is difficult to show population significance. The limited n-size was further conflicted with inconsistent practice attendance and inclement weather, resulting in limited game data. Further, the game data was collected during a tournament, rather than a regulation game and featured a running clock, which reduced the overall playing duration that occurred.

To our knowledge, there is little research done on positional comparisons in men’s lacrosse. Continued research on both men’s and women’s lacrosse athletes at the high school and collegiate level may lead to better knowledge of player metrics and will help athletes and coaches to better understand what conditioning levels are required for individual players at each level for games and practices. Future studies can be directed towards the expanse of knowledge of lacrosse physiological metrics and research may benefit from continued studies on male lacrosse athletes as well as the inclusion of the female athletes of the sport.

V. Practical Application

This data can be utilized to improve player performance by creating a training regimen reflecting game demands. Based on data recorded, the internal physiological metrics and the external movement metrics between game and practice can be significantly different. During the games, players show higher average HR and more sprints at faster speeds. It was shown by our data that players show a higher intensity, on average, for games than practice, encouraging a high intensity, low duration practice if coaches wish to train with close relation to games. These data also help coaches and players understand the possible variances between positional nutrition necessities showing the approximate calorie needs per player.
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References


