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# A Comparison of External Loads in Division III Men's Lacrosse Between High Competition Matches and Low Competition Matches

Patrick Moore
*University of Lynchburg*, moorep259@lynchburg.edu

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Patrick Moore

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Sean M. Collins, PhD

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Thomas G. Bowman, PhD

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Price S. Blair, PhD

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**Title:** A Comparison of External Loads in Division III Men's Lacrosse Between High Competition Matches and Low Competition Matches

**Authors:** PATRICK M. MOORE*[1], THOMAS G. BOWMAN‡[3], YASMINE I. JONES†[3], PRICE BLAIR[2], and SEAN M. COLLINS*[1]

**Affiliation:** [1] Department of Exercise Physiology, University of Lynchburg, Lynchburg VA.; [2] Westover Honors College, University of Lynchburg, Lynchburg, VA. [3]Department of Athletic Training, University of Lynchburg, Lynchburg, VA.

**Student/Professional Status:** *Denotes undergraduate student author, †Denotes graduate student author, ‡Denotes professional author

**ABSTRACT**

Lacrosse is an open field sport with limited knowledge of the physiological demands of gameplay at the Division III level. The purpose of this study was to investigate the external loads of Division III men's lacrosse players during NCAA season games. Comparisons were made between the external loads placed on the athletes in high competition versus external loads placed on the athletes in low competition matches. Top competition matches were defined as matches against teams that qualified for the NCAA tournament whereas low competition matches included teams that did not meet top competition requirements. The dependent variables measured included total distance, work rate, intensity, 2D load, and 3D load. Defensive players were found to have significantly higher external load values for total distance (m; $p$=0.003), work rate (m/min; $p$=0.006 ), 2D load (AU; $p$= 0.039 ) and 3D load (AU; $p$=0.022), while there were no significant differences ($p>0.05$) for other positions between competition level. Competition level exerts a higher external load for defensive players, but not attack, midfield, or specialists (goalie, face-off), which may indicate the need for specialized conditioning or active load management to deal with potential fatigue.

KEY WORDS: 2D Load, 3D Load, GPS, Work Rate, Accelerometer,

**INTRODUCTION**

The sport of lacrosse is an ancient sport developed by Native American tribes mostly in the northeastern portion of North America, but versions of the game spread throughout the entirety of what is now the United States and Canada (13). Over time, the game was introduced to Europeans who ventured into the New World, and from there the game began to grow in popularity amongst these new populations. The evolution of the game has been vast, and the style of play has changed to include a shot clock, continuous substitutions, and relatively violent physical contact. At the NCAA Division III level, there are 247 institutions that sponsor men's lacrosse as a varsity NCAA sport.

Amongst these schools, there are a total of 8,901 student athletes participating in Division III men's lacrosse (15).
The introduction of Global Positioning Systems (GPS) devices has made it simpler to track more detailed on-field movements of athletes during outdoor sports. These technologies have been implemented, tested, and improved primarily in European soccer and rugby settings, but the knowledge gained from these devices has brought the attention of sports in the United States, including collegiate and professional lacrosse (11). These devices combine the use of accelerometers and GPS signals to record data about an athletes' movements on the field of play (4,11). As the technology has increased tremendously over the recent years, the validity and reliability of these types of devices has been reported as highly positive (10). The development of these devices and the understanding of what they are reporting has led to the rise in external load research and its application to athletics.

The physiological demands of lacrosse vary from position to position, but as a whole, the sport of lacrosse requires varying degrees of endurance, strength, speed, power, and agility. Positional differences have been noted within men's lacrosse (5). Goalies must have great lower extremity strength and power, hand eye coordination, and reaction speed in order to keep the ball from going into the goal. Defenders must have size and strength in order to be physical with offensive players, but they must also be agile enough to navigate around the goal. Attackmen have the opposite task, and they typically do their work in close proximity to the goal. There is a smaller time frame for them to operate. On the offensive side, midfielders must have the ability to run past defenders while also maintaining their direction and shooting the ball accurately. Some midfielders are specialized in defense, and their job is to keep the offense from scoring and to generate transition from defense to offense. All of these activities involve layers of physiological demand, but the quantitative extent to which the body is stressed is still largely unknown. A call to action by Vescovi implored researchers to look into the different levels of physical demand involved in lacrosse (12).

The loads experienced by different players can vary based on the position they play. Goalies will typically experience the least amount of total distance covered as they remain in the goal crease for the majority of the game. It is common in lacrosse matches for certain players to record more time on the field than others. Lacrosse does not have a limit on how many players can be substituted in, but it is common for certain positional players to remain on the field for the entirety of the game. Attackmen and defensemen will accumulate high total distance as they do not typically substitute, but they are inactive when the ball is on the opposite end of the field. Typically, several lines (groups of three) midfielders are rotated, with certain midfield lines being used for offense and others for defense. The substitution patterns for lacrosse are similar to those of hockey; players are able to substitute in and out constantly through a ten yard substitution area on one sideline. The differences between playing time in high competition (HC) and low competition (LC) has not yet been reported.

Research performed in other sports has shown that different competition levels result in different intensities in external load measures (1). These differences can stem from the timing of higher competition matches as players are less fatigued earlier in the season (1). Comparing the differences in competition level is essential, as both players and coaches can use such information to better prepare themselves for certain matches and stronger parts of a season's schedule. This can also influence how coaches may try to manipulate their practice plans and schedule as they want to maximize the number of healthy players for the strongest competition.

A study performed in amateur soccer players focused on the differences in external loads on certain positions throughout different phases of the season (7). The results indicated that the level of the opponent throughout the secondary phase, or championship phase, was higher than that of the primary phase of the season. The researchers reported that this could be due to "the confrontation with opponents of a higher qualitative level could cause a greater physical demand" (7). Our study aims to describe a similar phenomenon between HC and LC matches.

Another reason coaches and athletes are interested in external load data is because of the growing data surrounding injury incidence. A study done in men's soccer showed that both match days and high intensity practice days appeared to report the highest incidence of injury (4). Another similar study looked at male field hockey players, and their findings reported that players who spent more time playing at high speeds were more likely to be injured (6). Lacrosse is often characterized by being a fast paced sport, so becoming aware of instances where athletes are playing and practicing close to their top speed for prolonged periods of time could be an important marker for injury risk. Also of importance is the need for increased attention on high intensity practices and matches and including injury prevention practices in place.

It is common in lacrosse matches for certain players to record more time on the field than others. Lacrosse does not have a limit on how many players can be substituted in and out, but it is common for certain positional players to remain on the field for the entirety of the game. Typically, several lines (groups of three) midfielders are rotated, with certain midfield lines being used for offense and others for defense. The differences between playing time in HC and LC matches has not yet been reported.

The present study aims to use GPS devices to track on-field movement of Division III lacrosse players in matches against both high and low level competition. The researchers hypothesize that there will be a significant difference in external loads on certain positions between the high and low competition matches. These players will experience high loads in top competition, and they will experience significantly lower loads in low competition. However, the overall load on the team is predicted to be greater in lower competition games because reserve players will see more time on the field.

## METHODS

### *Participants*

The participants of this study were 54 male NCAA Division III lacrosse athletes (age: 20.6±1.4 years, 85.0±7.5 kg, 181.7±6.0 cm) who wore GPS devices (Sports Performance Tracking (SPT), Victoria, Australia) over the course of the 2022 spring season. In the final data analysis, 21 individual players' data were analyzed as some of the athletes who were equipped with GPS units did not compete in at least 50% of game action, so their data was not included in our study. This reduced the participants to starting players predominantly. Informed consent was collected prior to the start of the season and included an information session about the data that would be collected.

**Table 1.** Averages and Standard Deviations of Heights and Masses of Positions

| | Height (cm) | Mass (kg) | Age (years) |
|---|---|---|---|
| Attack | 178.8 ± 4.8 | 83.4 ± 4.1 | 20.4±1.78 |
| Offensive Midfield | 181.5 ± 5.8 | 82.1 ± 9.8 | 20.93±1.38 |
| Defensive Midfielder | 181.2 ± 4.4 | 83.7 ± 3.9 | 20.83±1.47 |
| Defense | 186.3 ± 4.0 | 90.8 ± 3.5 | 20.18±1.25 |
| Long stick Midfield | 182.9 ± 8.0 | 81.8 ± 6.0 | 20.25±0.96 |
| Face-off | 175.7 ± 4.4 | 87.4 ± 11.8 | 20.2±1.64 |
| Goalie | 187.3 ± 4.3 | 85.6 ± 9.9 | 20.25±0.96 |

### *Protocol*

Prior to each practice or game session, the GPS unit would be powered on and the athlete would confirm that it was activated by waiting for the unit's lights to turn on. The unit would then be placed in the sports vest and worn for the duration of the session. The GameTraka devices record information at 10 Hz, or 10 data points per second. The athletes used the same device each time in order to maximize inter-unit reliability. The validity of 10 Hz devices has been reported as mostly positive (10).

Once the session was complete, the devices were plugged into a charging hub and the data was uploaded to the GameTraka website hub. Over the course of the season, the data was compiled and the GameTraka website was able to calculate averages for different metrics.

The collected data was evaluated using Google Sheets. Players were included in the analysis if they competed in an estimated 50% or more of the match, so this limited the included players to mostly starters.

**PROCEDURES**

The twenty games of data were compiled into one comprehensive spreadsheet. Practice data was not analyzed for the purposes of this study. Each game included player information, the date of competition, the weather conditions, and the result of the game. The external load data included competition duration, total distance, segmented distances by speed, work rate, top speed, intensity, number of impacts, and 2D and 3D loads. 2D load involves the movement of an athlete along the X and Y axis. This would include forward, backward, and side to side movements. The 3D load metric involves the X, Y, and Z axis. This includes the movement of the athlete up and down as they are changing directions. Sums of the distances and impacts were calculated for the entirety of the matches, and the work rates, intensities, and loads were averaged. Each player's position was also labeled. A total of 330 data points were collected and analyzed.

A marker of national success is the NCAA Tournament. The tournament is played following the spring regular season, and teams are selected based on their conference tournament results as well as their regular season schedules. Selection to the NCAA Tournament is typically an indicator of competitive ability on the national stage, and teams are given the opportunity to compete for a National Championship on this stage. Bids are given to teams based on Automatic Qualification (AQ) or At-Large qualification. Teams that win their conference tournament typically are given AQ bids; teams that do not win but have a strong out of conference performance throughout the season are considered for At-Large bids. The participants' team received an AQ bid, while 2 other teams within the conference received At-Large bids into the NCAA Tournament. Using NCAA tournament status as the marker for competition status allowed for unbiased stratification of the opponent's for the purpose of this study. Of the twenty games, the participants' team competed against eight teams that qualified for the NCAA Tournament, and the remaining ten opponents did not qualify for the tournament.

*Statistical Analysis*

Using JASP 17.1 (University of Amsterdam, Amsterdam, Netherlands), five 2 x 7 analyses of variance (ANOVAs) were run for the following dependent variables; total distance (m), work rate (m/min), intensity (AU), 2D Load (AU), and 3D Load (AU). Bonferroni post hoc analyses were used to determine pairwise differences if significance interactions were found. The significance level was determined to be $p < 0.05$ *a priori*. A power analysis revealed that the number of participants used may be underpowered, however, roster sizes are limited but 330 GPS data points were assessed over the season which is similar to other studies (3).

## RESULTS

Significant interactions were found between Competition Level and Position for total distance ($F(1,6) = 3.39$, $p<0.05$, $\eta^2=0.03$), work rate ($F(1,6) = 3.09$, $p<0.05$, $\eta^2=0.03$), but no significant interaction for intensity ($F(1,6) = 1.96$, $p>0.05$, $\eta^2=0.02$). Following Bonferroni post hoc comparisons, it was revealed that there were only significant differences between the HC Defense and LC Defense for total distance ($p<0.001$; 6761.66±622.24 m vs 4965.92±1596.14 m, respectively; Fig 1), and work rate ($p<0.001$; 67.01±5.87 $m \cdot min^{-1}$ vs 50.62±16.69 $m \cdot min^{-1}$, respectively; Fig 2). There were no significant differences ($p>0.05$) found between the other positions (attack, offensive midfield, defensive midfield, long stick midfield, goalie, and faceoff) based on classification (insignificant data shown in appendix).

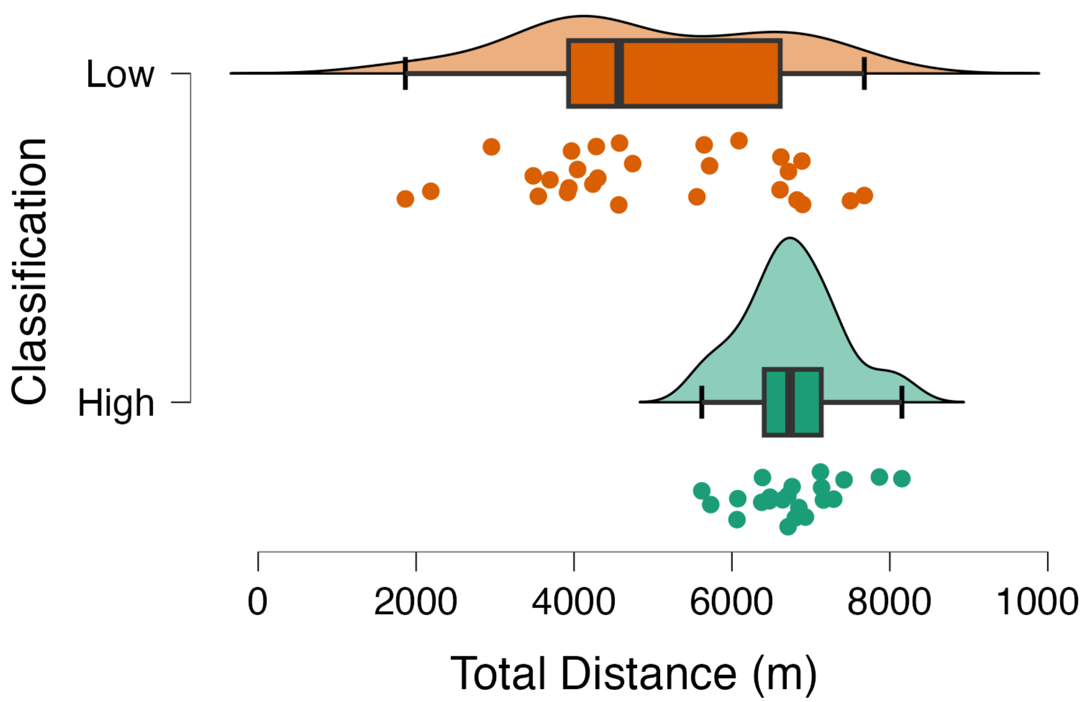


Fig 1. Difference in Total Distance performed by Defensive players between game classification. p<0.05

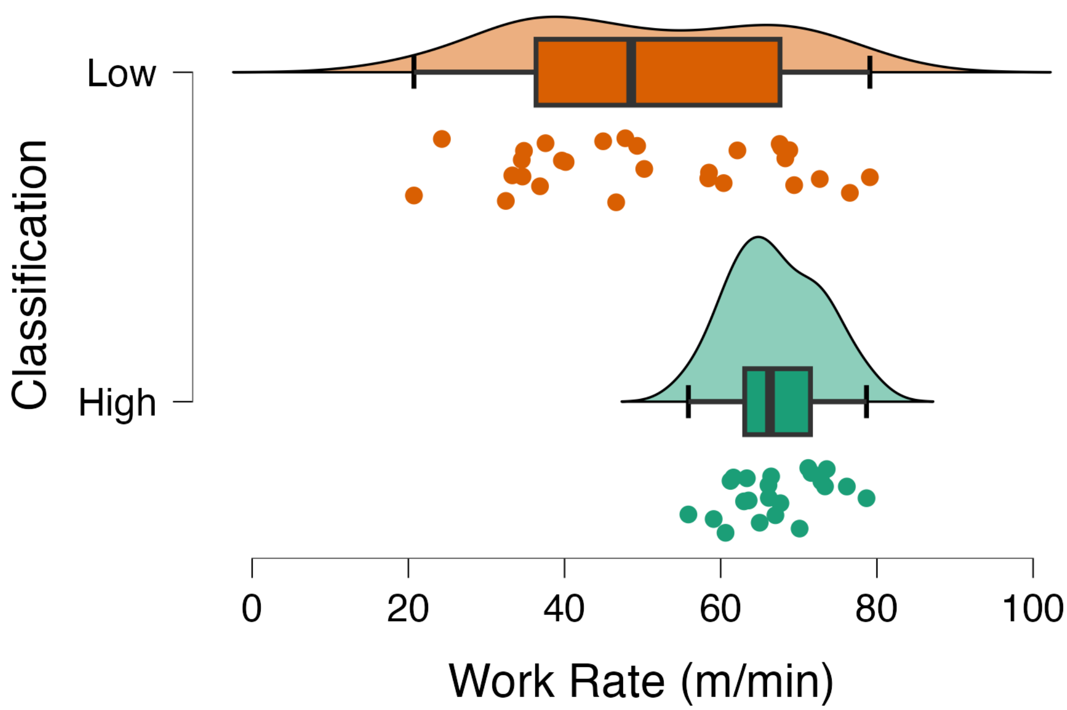


Fig 2. Difference in Work Rate performed by Defensive players between game classification. p<0.05

Similarly, there were significant interactions found between Competition Level and Position for 2D load ($F(1,6) = 2.24$, $p<0.05$, $\eta^2=0.03$) and 3D load ($F(1,6) = 2.51$, $p<0.05$, $\eta^2=0.03$). Again, Bonferonni post hoc comparisons revealed that there were significant differences between HC Defense and LC Defense for both 2D load ($p=0.03$; 271.06±25.73 AU vs 201.36±66.49 AU, respectively; Fig 3) and 3D load ($p = 0.006$; 416.08±33.57 AU v 303.71±98.54 AU, respectively; Fig 4).There were no significant differences ($p>0.05$) found between the other positions based on classification.

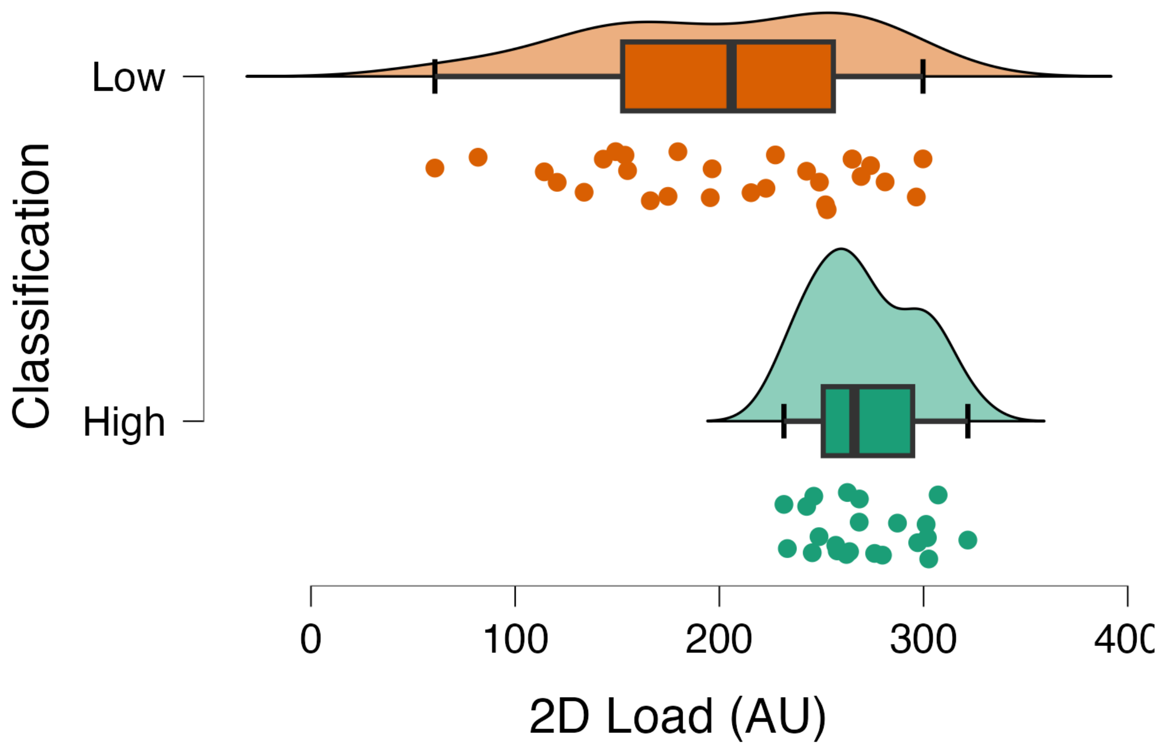


Fig 3. Difference in 2D Load performed by Defensive players between game classification. $p<0.05$.

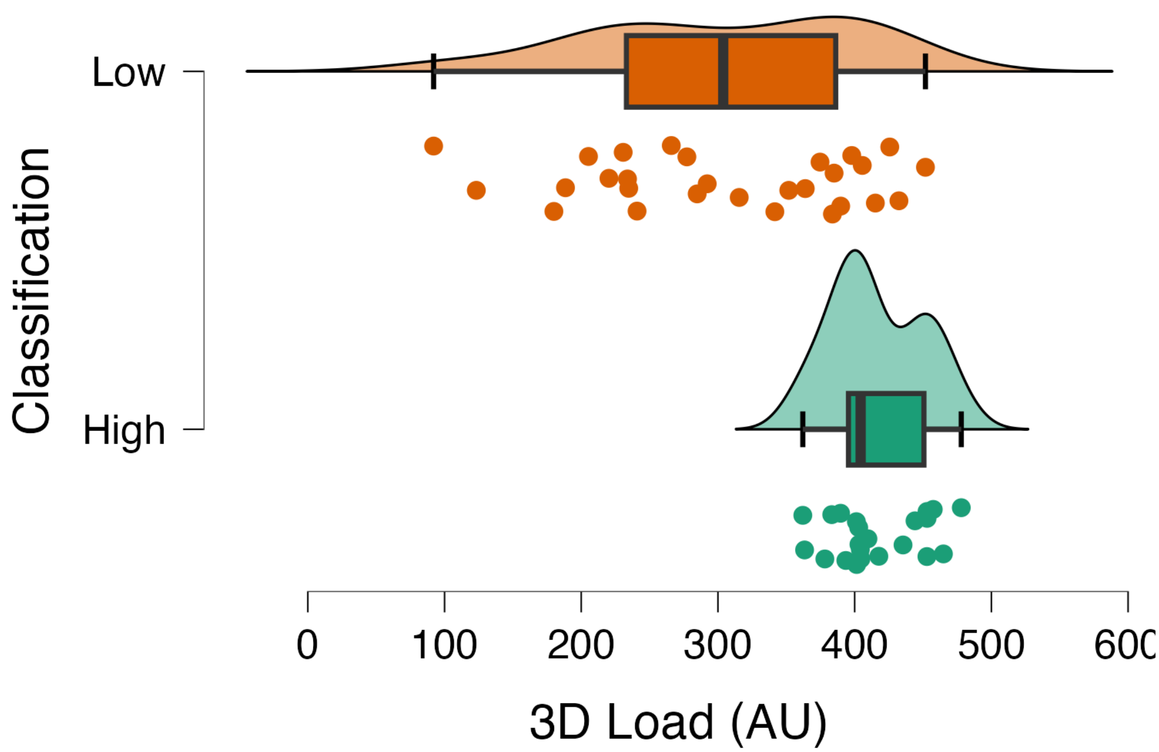


Fig 4. Difference in 3D Load performed by Defensive players between game classification. $p<0.05$.

**Table 2**. Results comparing Low and High competition between positions

| *Variable* | *Position* | *Low Competition* | | | *High Competition* | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| | | *Mean* | *SD* | *95% CI (LL, UL)* | *Mean* | *SD* | *95% CI (LL, UL)* |
| *Total Distance (m)* | *Attack* | 5624.80 | 245.90 | 5140.98, 6108.61 | 6800.82 | 261.45 | 6286.42, 7315.23 |
| | *Defense** | 4965.92 | 236.96 | 4499.7, 5432.13 | 6761.66 | 267.33 | 6235.7, 7287.62 |
| | *DM* | 4107.22 | 232.84 | 3649.11, 4565.33 | 5151.04 | 245.90 | 4667.23, 5634.86 |
| | *FOM* | 3215.25 | 417.96 | 2392.93, 4037.58 | 3535.97 | 626.93 | 2302.48, 4769.46 |
| | *G* | 2904.29 | 396.51 | 2124.16, 3684.42 | 3560.96 | 473.92 | 2628.53, 4493.39 |
| | *LSM* | 4322.08 | 280.37 | 3770.44, 4873.71 | 5443.20 | 313.47 | 4826.46, 6059.95 |
| | *OM* | 3397.20 | 169.07 | 3064.56, 3729.85 | 3445.31 | 169.07 | 3112.67, 3777.96 |
| *Work Rate (m/min)* | *Attack* | 56.91 | 2.40 | 52.18, 61.63 | 66.60 | 2.55 | 61.58, 71.62 |
| | *Defense** | 50.62 | 2.31 | 46.07, 55.17 | 67.01 | 2.61 | 61.88, 72.15 |
| | *DM* | 41.69 | 2.27 | 37.22, 46.17 | 50.09 | 2.40 | 45.36, 54.81 |
| | *FOM* | 32.27 | 4.08 | 24.24, 40.3 | 34.37 | 6.12 | 22.32, 46.41 |
| | *G* | 29.36 | 3.87 | 21.74, 36.98 | 34.71 | 4.63 | 25.61, 43.82 |
| | *LSM* | 43.64 | 2.74 | 38.25, 49.02 | 53.73 | 3.06 | 47.71, 59.75 |
| | *OM* | 33.98 | 1.65 | 30.73, 37.23 | 33.80 | 1.65 | 30.56, 37.05 |
| *Intensity (AU)* | *Attack* | 18.48 | 1.17 | 16.18, 20.78 | 23.18 | 1.24 | 20.73, 25.62 |
| | *Defense* | 15.44 | 1.13 | 13.22, 17.65 | 22.09 | 1.27 | 19.59, 24.59 |
| | *DM* | 14.38 | 1.11 | 12.21, 16.56 | 18.99 | 1.17 | 16.69, 21.29 |
| | *FOM* | 8.83 | 1.99 | 4.92, 12.74 | 11.50 | 2.98 | 5.64, 17.37 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | *G* | 6.17 | 1.89 | 2.46, 9.88 | 8.19 | 2.25 | 3.76, 12.63 |
| | *LSM* | 15.29 | 1.33 | 12.67, 17.91 | 20.16 | 1.49 | 17.23, 23.09 |
| | *OM* | 10.07 | 0.80 | 8.49, 11.65 | 10.65 | 0.80 | 9.06, 12.23 |
| *2D Load (AU)* | *Attack* | 244.06 | 13.29 | 217.92, 270.21 | 277.81 | 14.13 | 250.01, 305.61 |
| | *Defense** | 201.36 | 12.81 | 176.17, 226.56 | 271.06 | 14.45 | 242.64, 299.49 |
| | *DM* | 191.02 | 12.58 | 166.26, 215.78 | 245.17 | 13.29 | 219.02, 271.32 |
| | *FOM* | 175.54 | 22.59 | 131.09, 219.98 | 175.63 | 33.88 | 108.97, 242.3 |
| | *G* | 121.36 | 21.43 | 79.2, 163.53 | 164.42 | 25.61 | 114.03, 214.82 |
| | *LSM* | 218.76 | 15.15 | 188.95, 248.58 | 294.02 | 16.94 | 260.69, 327.35 |
| | *OM* | 157.09 | 9.14 | 139.11, 175.07 | 162.43 | 9.14 | 144.45, 180.4 |
| *3D Load (AU)* | *Attack* | 368.20 | 19.14 | 330.55, 405.85 | 422.18 | 20.35 | 382.15, 462.21 |
| | *Defense** | 303.71 | 18.44 | 267.42, 339.99 | 416.08 | 20.81 | 375.14, 457.01 |
| | *DM* | 284.90 | 18.12 | 249.25, 320.55 | 364.40 | 19.14 | 326.75, 402.05 |
| | *FOM* | 250.92 | 32.53 | 186.92, 314.91 | 249.63 | 48.79 | 153.63, 345.62 |
| | *G* | 172.99 | 30.86 | 112.27, 233.7 | 236.76 | 36.88 | 164.19, 309.32 |
| | *LSM* | 317.53 | 21.82 | 274.6, 360.46 | 423.11 | 24.40 | 375.11, 471.1 |
| | *OM* | 232.53 | 13.16 | 206.65, 258.42 | 239.71 | 13.16 | 213.83, 265.6 |

* Significant differences ($p<0.05$) were reported between the low and high competitions. DM = defensive midfield; FOM = face-off midfield; G = goalie; LSM = long stick midfield; OM = offensive midfield.

## DISCUSSION

Following the season, the participants competed against a total of eighteen teams in 20 games. Of these eighteen teams, eight of them made it into the NCAA Tournament while the other 10 teams were considered low competition, with half of these teams having a losing record. Considering this dichotomy of competition across the season, comparing external loads on the entire team as well as between positions between the higher competition and the lower competition is of interest.

Understanding the physiological impact of lacrosse on the athlete is of great importance to sports performance specialists, coaches, and athletic trainers in order to better prepare and rehabilitate athletes. Our research found that defensive players generally experienced greater differences in external loads between HC and LC matches as compared to the other positions on the field. There are many different explanations for why this could be.

Playing defense in lacrosse, as in any sport, is predicated on reacting to what the opposing offense does. Very rarely is a defense able to dictate what the offense does, at least not to a great degree. As a result, defensemen experience a greater load though change of direction, as indicated by the 2D and 3D loads. This indicates the defensemen quickly reacting and changing directions in response to external stimulus resulting in greater lateral shuffling or crossover movements.

In comparison to other sports, a study looking at the external loads on male field hockey players reported that field hockey athletes experienced Total Distance loads of 5,448±1,368.16 m and Work Rates of 106.6±10.24 m/min (6). Another comparable study reported Division III men's soccer players undergoing median Total Distances of 7,026 m and median Work Rates of 73.27 m/min. This study was also able to report median 3D Loads for the soccer players at 535.85 AU (9). Total Distance and Work Rate seemed to be the most commonly reported, and given that certain devices use different thresholds for Walk, Jog, and Sprint distances, it makes the most sense to compare these values between sports.

Defensemen add to their external load through the clearing segment of the game. On average, they must attempt to clear the ball 24.5 times per match, and this often involves substitutions, sprints, and change of direction to maneuver the ball to the offensive end of the field (14). The 80 second shot clock also factors into the pace of play of each match, and this can either increase or decrease the defensemen's external load depending on their opponent's ability to play faster or slower. Winning faceoffs will help to lower the defensive external load as there will be fewer possessions for the opponent.

In contrast, offensive players did not see significant differences in external load between the HC and LC matches. In HC matches, similar to the defensive players, all positions are playing at their peak intensities. However, unlike for defensive players, offensive personnel experience similar loads between competitions due to the increased number of offensive possessions that most likely occur against LC opponents. As a result, attack and midfield players had similar loads between HC and LC. For example, the HC Work Rate for Attack players was found to be 422.18±20.35 m/min, whereas the LC Work Rate was 368.2±19.14 m/min. This was deemed statistically insignificant. Of the midfielders, the Offensive Midfielders experienced Intensities of 10.65±0.8 AU for HC matches and 10.07±0.8 AU for the LC matches.

The uses for this type of research are becoming increasingly clear. Depending on the relative strength of a team's schedule, defensive players could be placed under much more physiological stress over the course of a rigorously scheduled season than the other positions, so special considerations should be made. Curtis et al spoke to the importance of load management in collegiate men's soccer players as the density of matches increases (2). Preemptively, defensemen should be in top physical condition, specifically in their lower body. Their ability to change direction and keep up with offensive players is essential to high performance. It has been reported in male field hockey players that an increase in Work Rate actually decreased their injury risk, but it was discussed that the lower Work Rates were due to players playing through minor injuries (6). From a return to play standpoint, athletic trainers and strength coaches should have a heightened awareness surrounding their protocols for this position. Reactivity conditioning drills should be included regularly towards the end of a recovery period in order to truly test the athlete's game-like abilities. This includes cone drills, stick skill sessions, and simulated game situations. These types of drills could be incorporated into a non-contact portion towards the end of an athlete's recovery protocol before they begin to return to full play. Gradually increasing external loads to match match levels is essential for sport performance.

A study done in Division III level soccer players suggested that including running drills that simulated high intensities similar to games in a practice could help to increase workload in athletes that may not play as much; this would keep the reserves in condition to perform at the appropriate level (9). A separate study in collegiate soccer players concluded that starting players accumulated greater loads throughout the course of the season, so remaining vigilant and keeping the reserves up to the proper levels of external load is critical (2). An important metric in understanding a player's workload over the course of a season is the Acute:Chronic Workload Ratio (ACWR). This metric can be used over several weeks to monitor injury risk, and although it was not utilized in our research, other studies have established its practicality and importance in protecting athletes from preventable injuries. Minimizing the changes in ACWR was discussed as an important goal to help maintain performance within a season (6).

One similar study has been conducted at the Division III level in men's lacrosse, and it focused on the external load placed on athletes throughout practices and games (3). These researchers cited the importance of comparing external loads in games to those in practice sessions. While our study did not include the loads experienced in practice sessions, our values for Total Distance for defensemen fell within the ranges for game Total Distances given by Fields et. al. (3). Our study did not report the loads experienced by different positions in practices, but this knowledge would be valuable combined with the knowledge of external loads in high and low competition matches as it would allow for the comparison of practice loads to the two competition classifications.

The application of this research extends beyond Division III lacrosse. Future research should be done in Division I and II men's lacrosse as well as women's lacrosse across all NCAA divisions. This would allow for comparisons of athletic profiles for athletes in these different divisions, and it would grow the body of research surrounding the sport of lacrosse.

Earlier research performed on a Division I women's lacrosse team looked at the differences in external loads experienced during in conference (IC) and out of conference (OC) competitions as a way to stratify and compare matches (12). The study's method was able to concentrate on different portions of the season, as most OC competitions took place towards the beginning of the season and most IC competitions were scheduled towards the end of the season. Their findings included playing time as a metric, and they reported that more playing time was required per player in OC games as opposed to IC games (12). This study was very similar to one performed in Division I women's soccer; their research found that OC games were considerably more intense than IC games, and the researchers suggested that training load should be altered when preparing for OC competitions (1). While our research was limited as playing time was not included as a metric, it is understood that defensive players spend the majority of a HC match on the field as opposed to being substituted during a LC match. Comparing the external loads between IC and OC games could be similar to understanding the external loads between HC and LC matches.

The rules of collegiate lacrosse differ greatly from the rules of international lacrosse, specifically surrounding the shot clock, but the results from this study can be beneficial to directing future research with newer technologies at the collegiate level (8). The researchers found that certain time frames within the game elicited greater levels of intensity from each position. For example, in this study, defensemen showed greater instances of jogging distances in quarters 1 and 3 of the competitions (8). Future research could stratify findings into HC and LC and look into the differences between quarters.

A limitation of this research is that conveniently, the participants competed against a fairly even number of high and low stratified opponents based on the NCAA Tournament. However other Division III teams may not have such a balanced schedule, and therefore the results of replicating this research could be different. Some conferences may not have as many NCAA qualifying teams. This could also be reversed and a team may play against NCAA tournament qualifiers more regularly, and this would skew the data. Ultimately, a more repeatable method should be developed for stratification of teams into high and low competition; a relative method would be more appropriate across the Division III landscape. There are potential matches in the LC category that elicit external load measures close to or higher than some of the HC matches. Development and use of a relative formula would allow this research to be replicated at the Division I and Division II level as well. As mentioned, a portion of the research that was limited was determining how to monitor playing times. Unlike sports like ice hockey, football, and baseball that have the ability to track when players enter the playing field, the substitution patterns in men's lacrosse are extremely random, making it challenging for statisticians to track playing times. Therefore, our research chose to select the three starting attackmen, three starting defenseman, starting goalkeeper, starting faceoff midfielder, at least two defensive midfielders, two long stick midfielders, and three to six offensive midfielders to analyze. As the sport continues to grow in popularity, it is likely that better methods will be developed for recording time of play, and this will assist in future research accuracy when analyzing interactions between external loads and playing time.

In conclusion, our research revealed that defensive players experience a significant difference in external loads between HC and LC matches. With this, it is imperative that defensive players are kept in good condition throughout the course of a season in order to remain prepared for the demands of their position. For the other positions on the field, the loads placed on them during matches, regardless of competition level, will allow them to experience proper external loads to maintain desirable levels of performance.

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**APPENDIX**

| Opponent | High or Low Classification |
|---|---|
| **Ferrum College** | **Low** |
| **Greensboro College** | **Low** |
| **Cabrini University** | **High** |
| **Salisbury University** | **High** |
| **St. Mary's College of Maryland** | **Low** |

| | |
|---|---|
| **Denison University** | **High** |
| **Christopher Newport University** | **High** |
| **Tufts University** | **High** |
| **Virginia Wesleyan University** | **Low** |
| **Washington and Lee University** | **High** |
| **Shenandoah University** | **Low** |
| **Guilford College** | **Low** |
| **Roanoke College** | **High** |
| **Randolph College** | **Low** |
| **Randolph-Macon College** | **Low** |
| **Bridgewater College** | **Low** |
| **Hampden-Sydney College** | **Low** |

* Schedule presented in chronological order over the season.

**INSIGNIFICANT RESULTS**

**Results Table**

| Full Team Data | Total Distance (m) | | Work Rate (m/min) | | Intensity (AU) | | 2D Load (AU) | | 3D Load (AU) | |
|---|---|---|---|---|---|---|---|---|---|---|
| Classification | High | Low | High | Low | High | Low | High | Low | High | Low |
| Mean | 4,933.050 | 4,156.314 | 48.416 | 41.987 | 16.497 | 13.166 | 223.652 | 188.317 | 332.993 | 279.475 |
| Std. Deviation | 1,898.651 | 1,471.640 | 18.063 | 15.307 | 8.244 | 6.596 | 88.677 | 71.837 | 129.922 | 106.540 |

*Total Distance (m):*

*Attack*

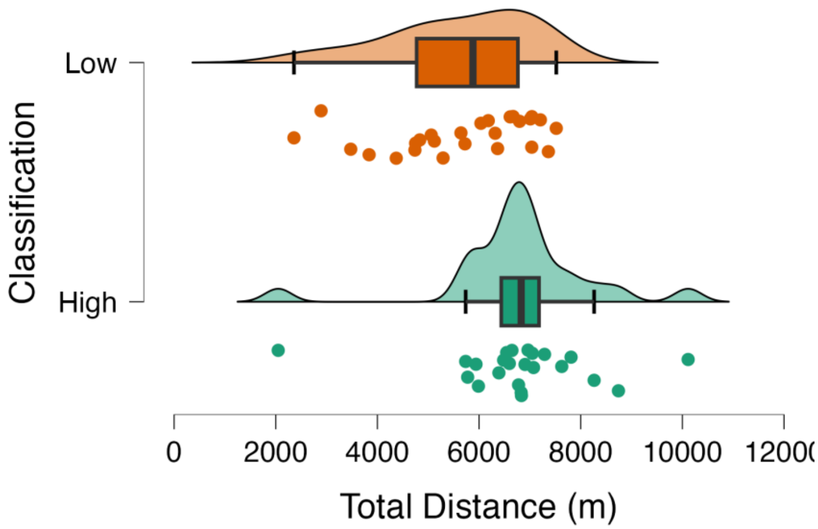


Fig 5. Difference in Total Distance performed by Attack players between game classification. p>0.05.

***D Mid***

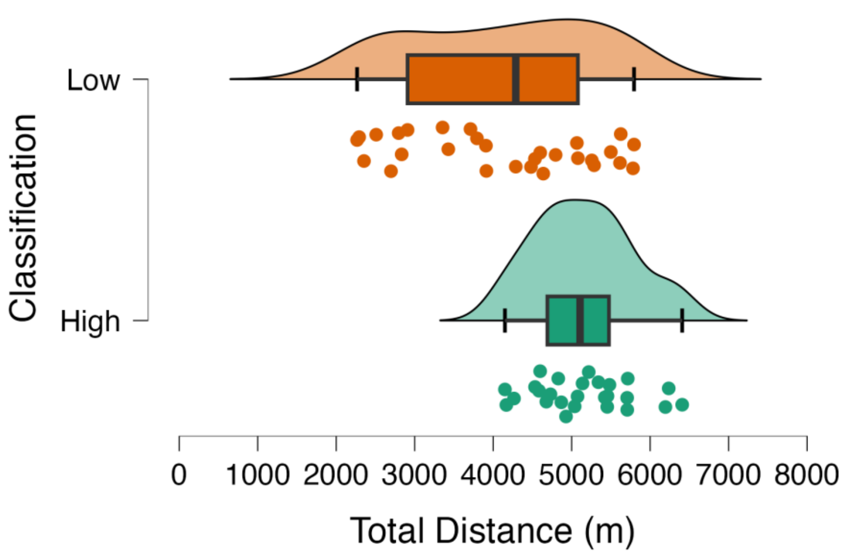

Fig 6. Difference in Total Distance performed by Defensive Midfield players between game classification. p>0.05.

***O Mid***

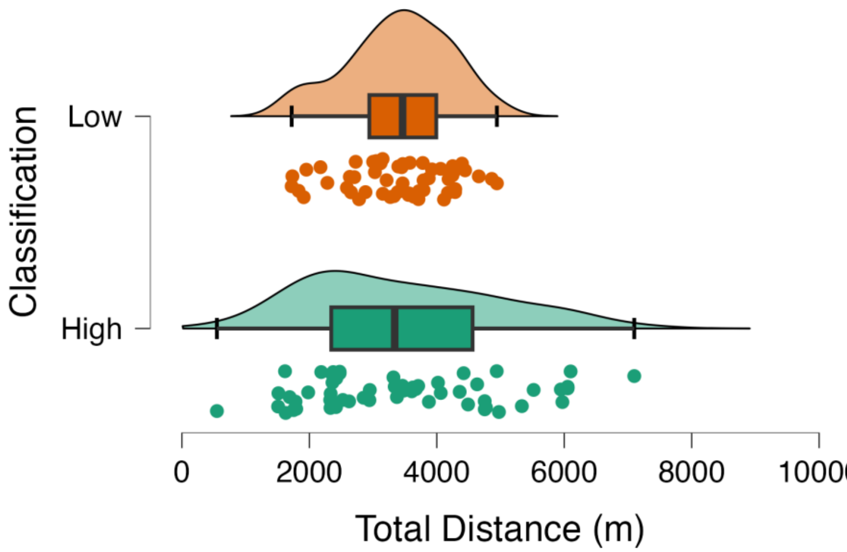


Fig 7. Difference in Total Distance performed by Offensive Midfield players between game classification. p>0.05.

***Long Stick Mid***

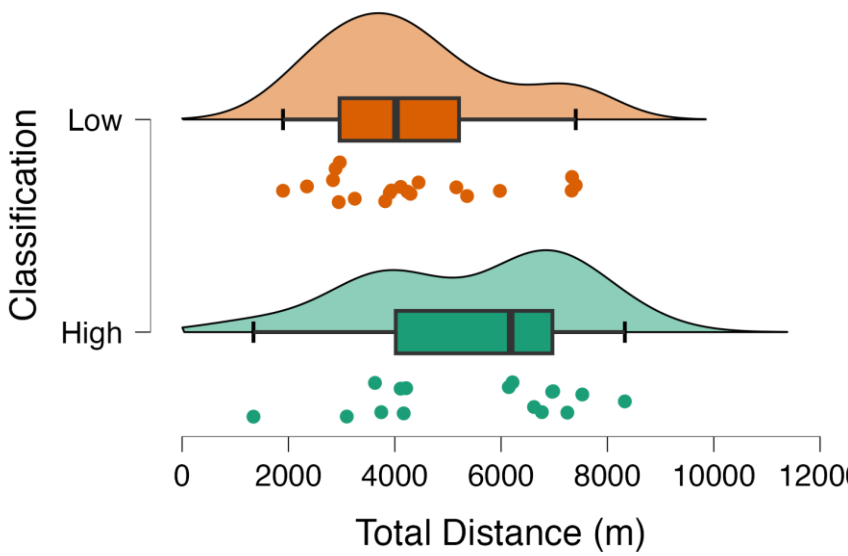

Fig 8. Difference in Total Distance performed by Long-Stick Midfield players between game classification. p>0.05.

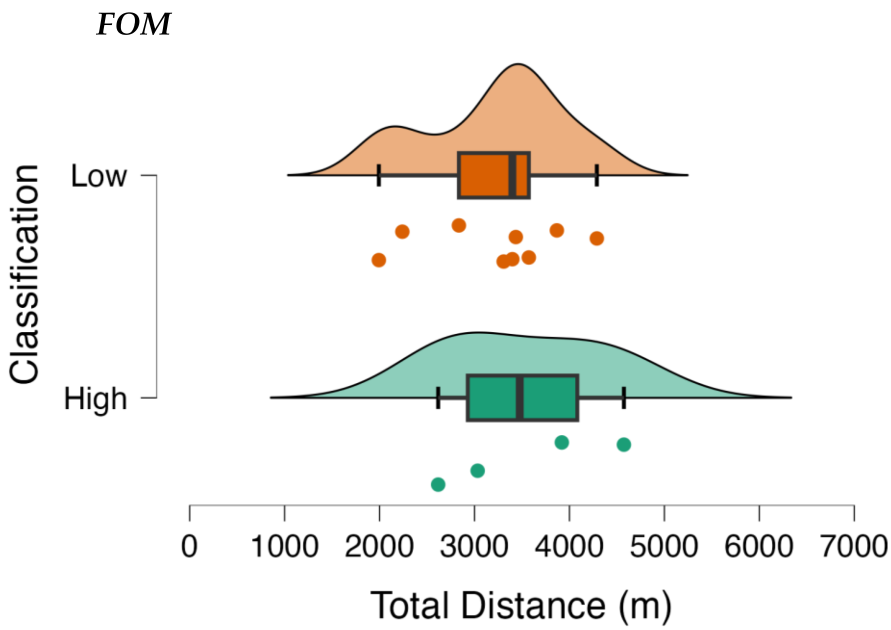


Fig 9. Difference in Total Distance performed by Faceoff Midfield players between game classification. p>0.05.

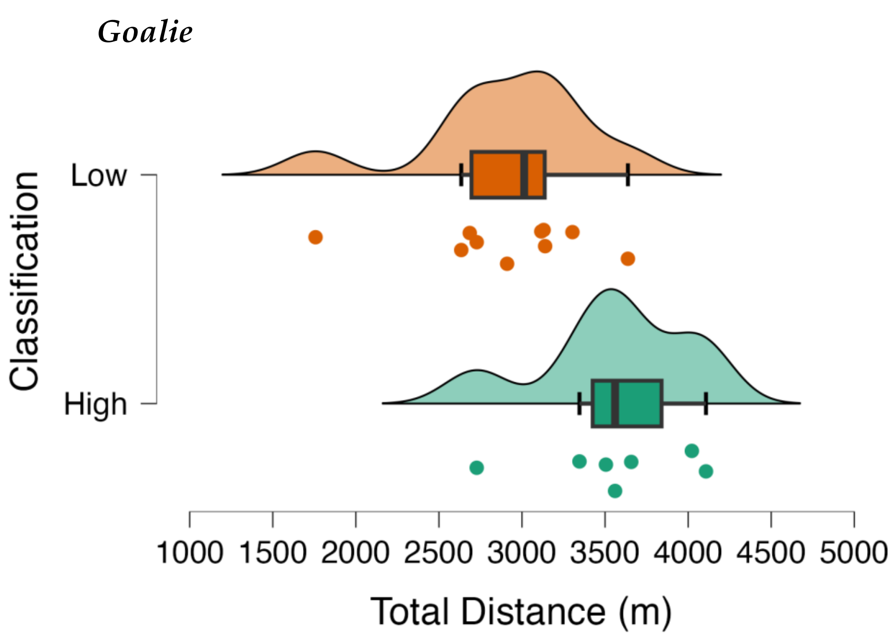

Fig 10. Difference in Total Distance performed by Goalies between game classification. p>0.05.

***Work Rate (m/min):***

***Attack***

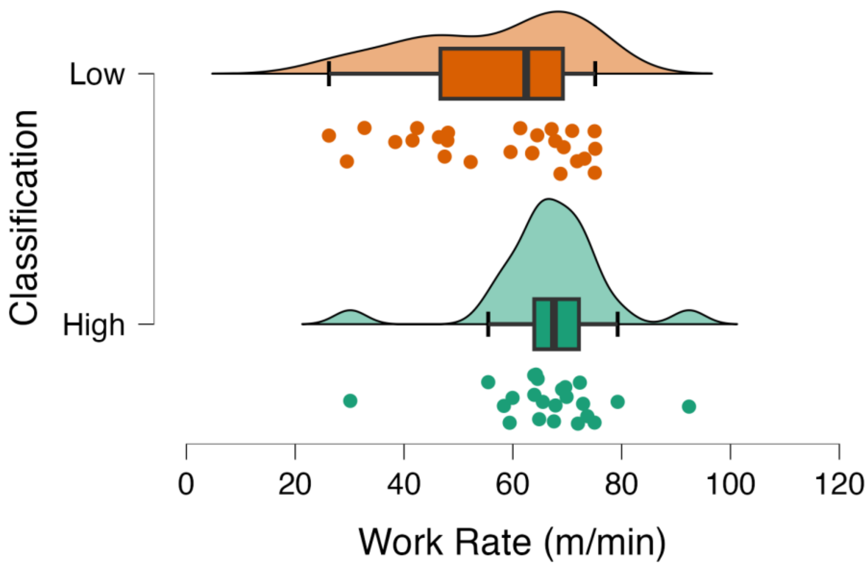


Fig 11. Difference in Work Rate performed by Attack players between game classification. p>0.05.

***D Mid***

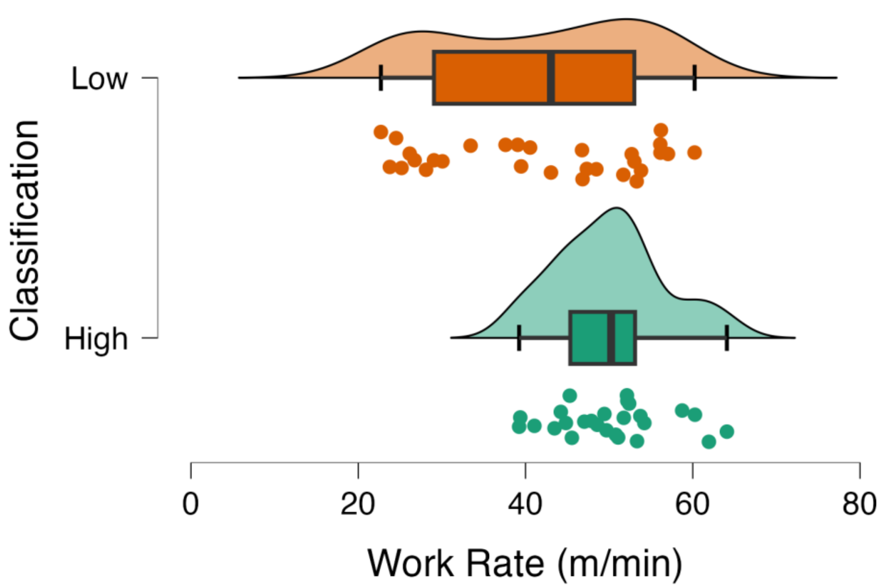

Fig 12. Difference in Work Rate performed by Defensive Midfield players between game classification. p>0.05.

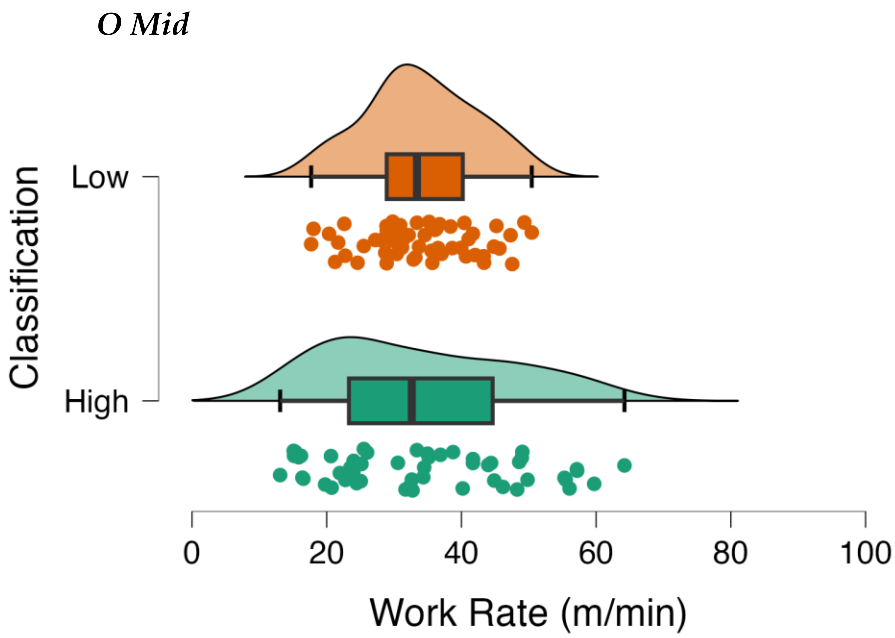


Fig 13. Difference in Work Rate performed by Offensive Midfield players between game classification. p>0.05.

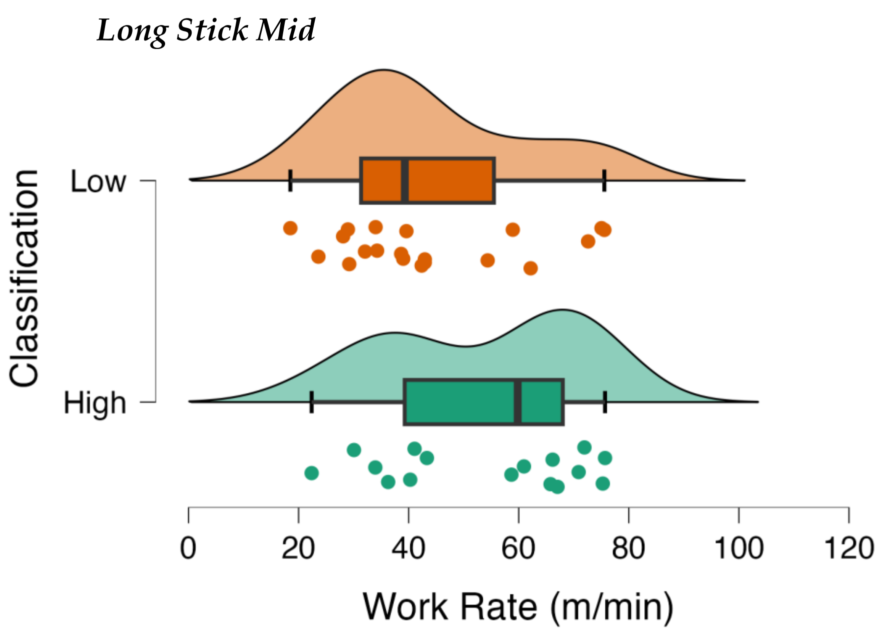

Fig 14. Difference in Work Rate performed by Long-Stick Midfield players between game classification. p>0.05.

***FOM***

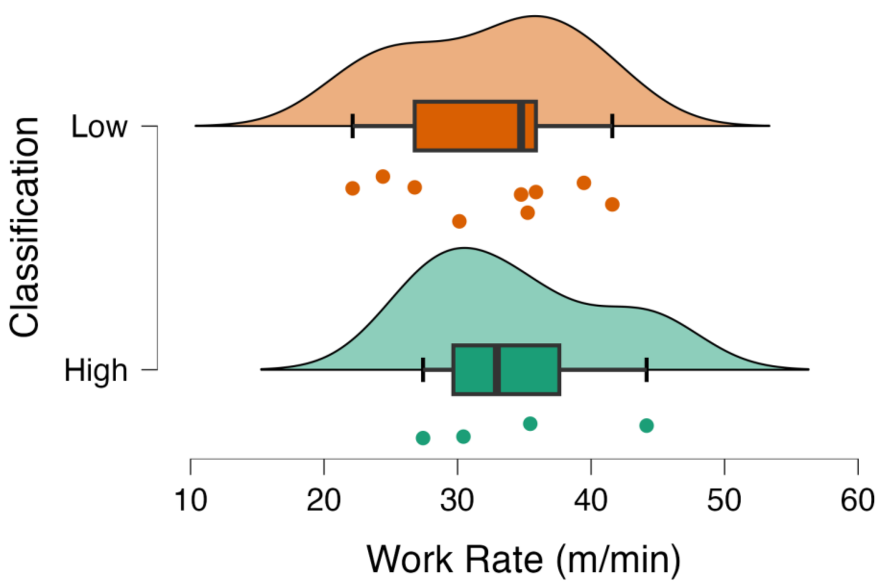


Fig 15. Difference in Work Rate performed by Faceoff Midfield players between game classification. p>0.05.

***Goalie***

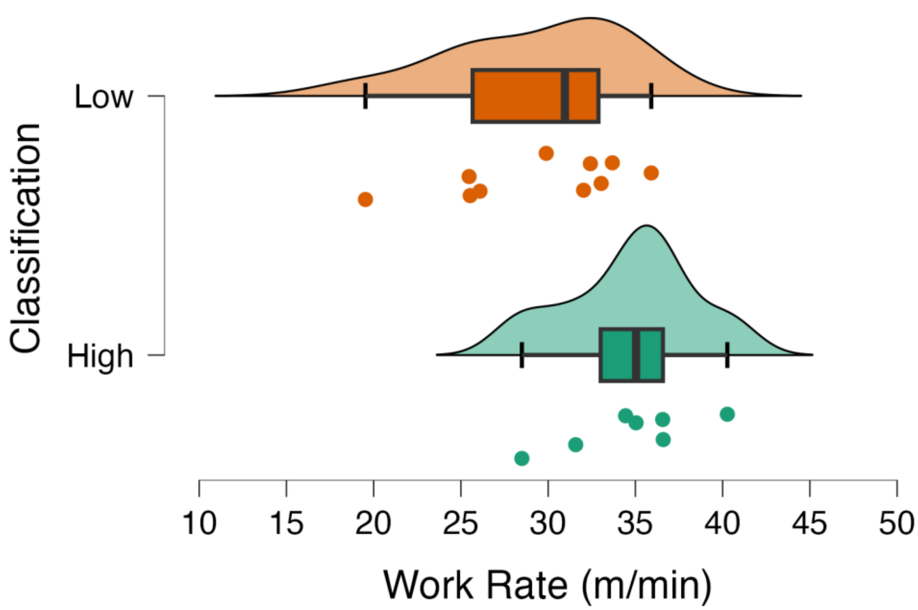

Fig 16. Difference in Work Rate performed by Goalie players between game classification. p>0.05.

***Intensity (AU):***

***Attack***

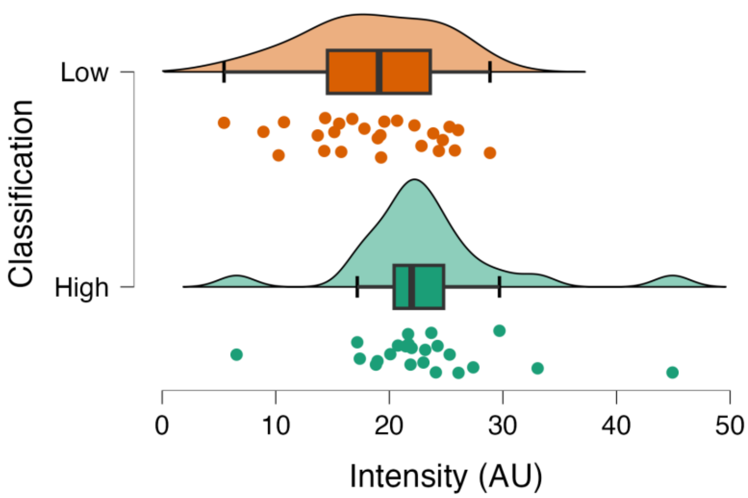


Fig 17. Difference in Intensity performed by Attack players between game classification. p>0.05.

***Defense***

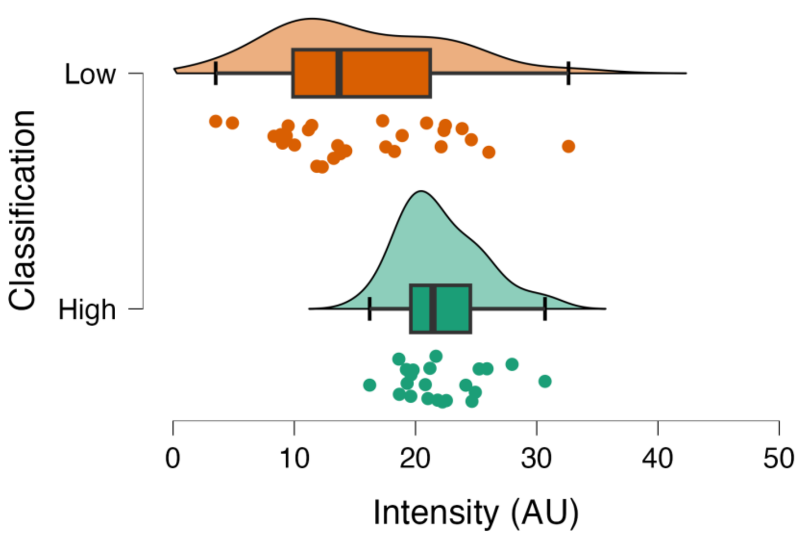


Fig 18. Difference in Intensity performed by Defense players between game classification. p>0.05.

***D Mid***

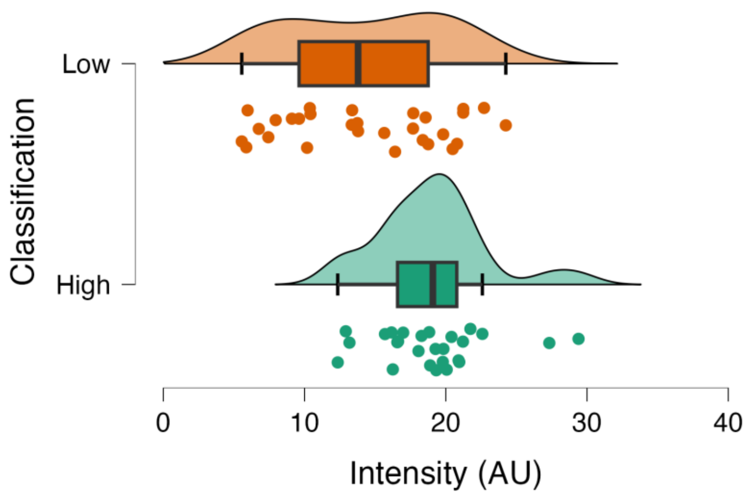


Fig 19. Difference in Intensity performed by Defensive Midfield players between game classification. p>0.05.

***O Mid***

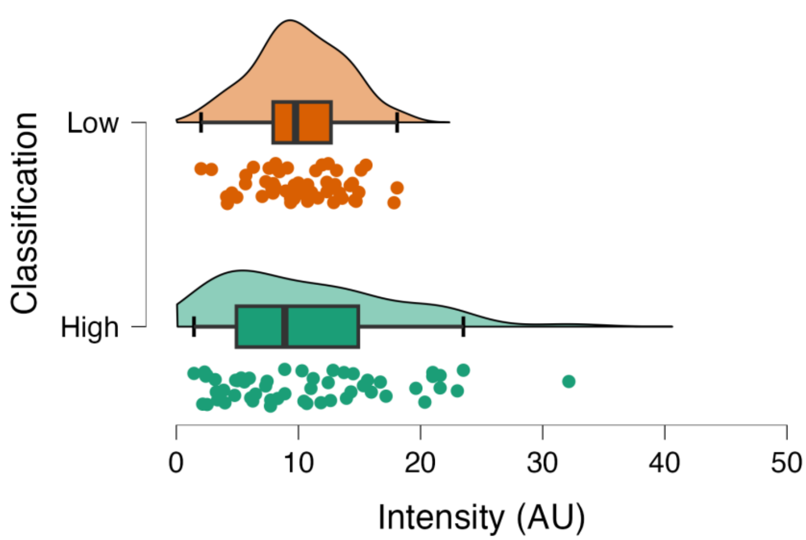


Fig 20. Difference in Intensity performed by Offensive Midfield players between game classification. p>0.05.

***Long Stick Mid***

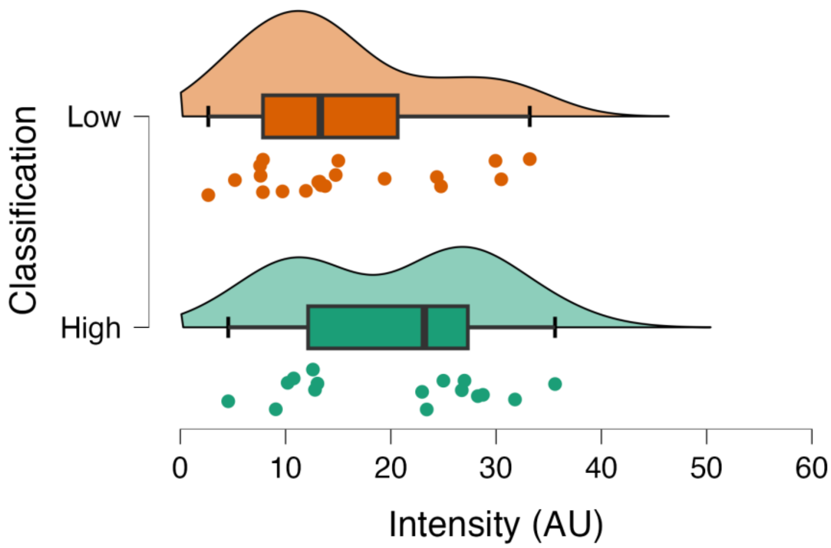


Fig 21. Difference in Intensity performed by Long-Stick Midfield players between game classification. p>0.05.

***FOM***

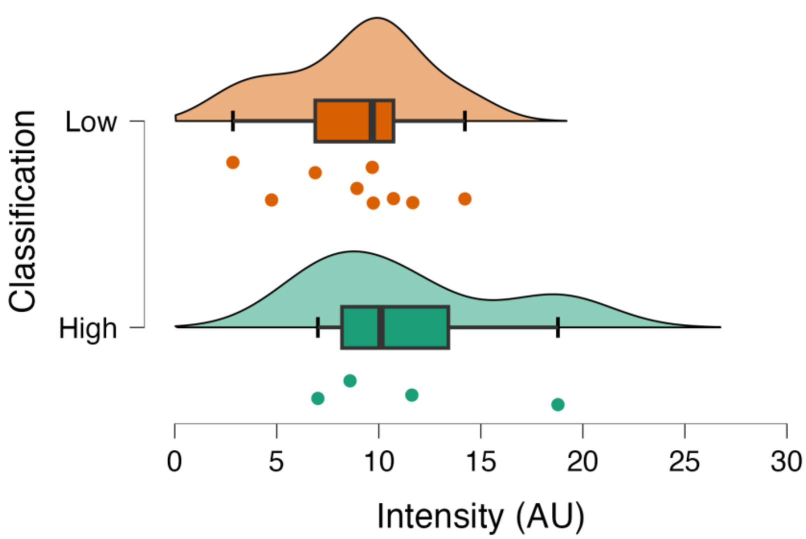


Fig 22. Difference in Intensity performed by Faceoff Midfield players between game classification. p>0.05.

***Goalie***

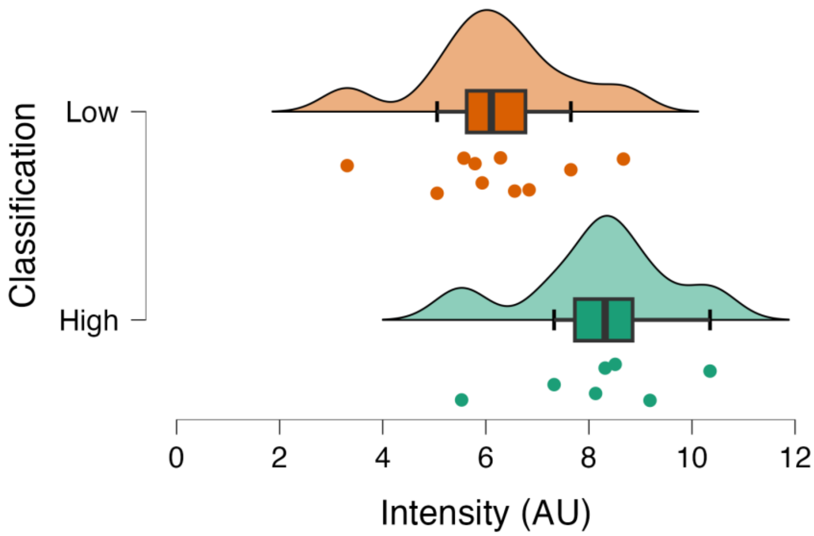


Fig 23. Difference in Intensity performed by Goalie players between game classification. p>0.05.

***2D Load (AU):***

***Attack***

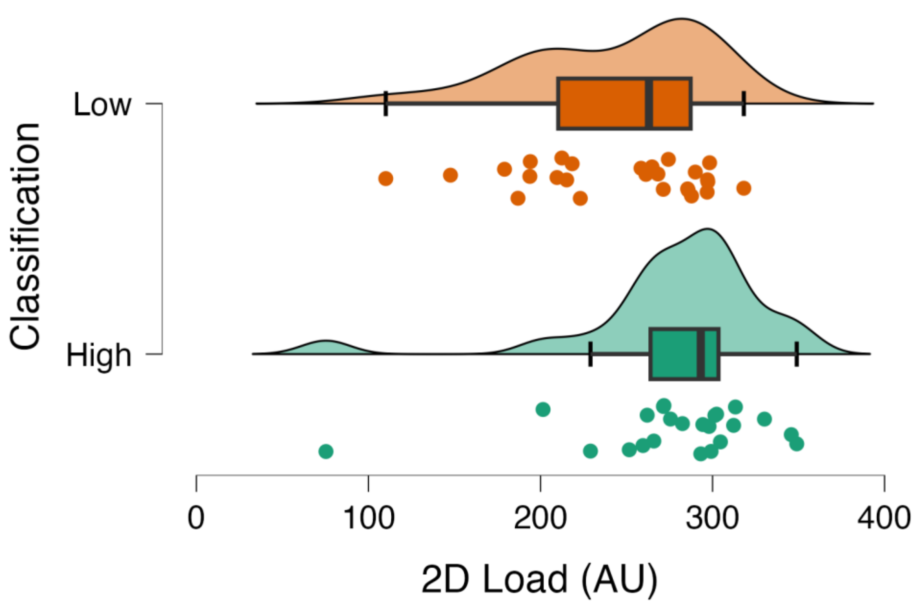

Fig 24. Difference in 2D Load performed by Attack players between game classification. p>0.05.

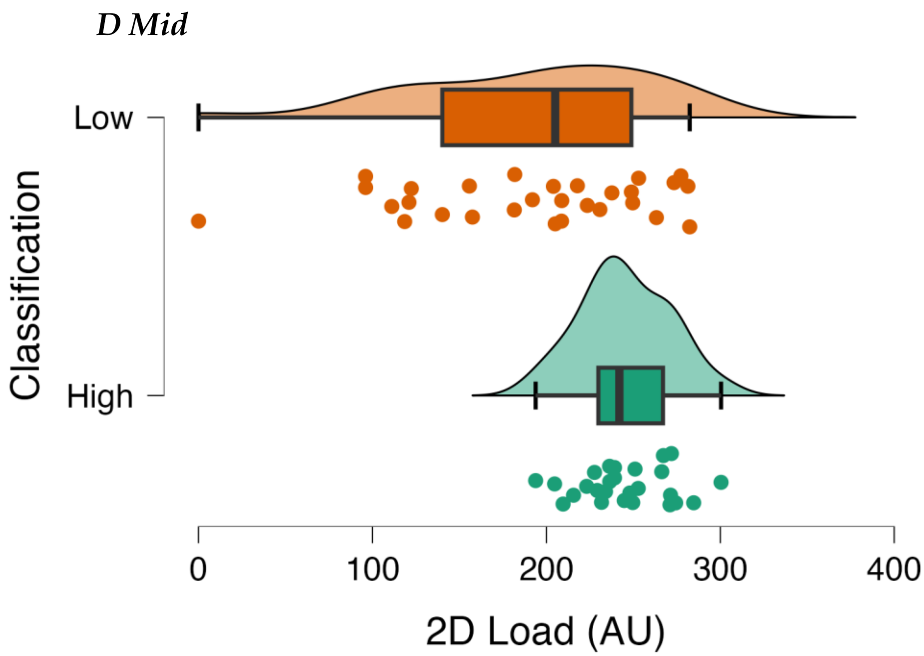


Fig 25. Difference in 2D Load performed by Defensive Midfield players between game classification. p>0.05.

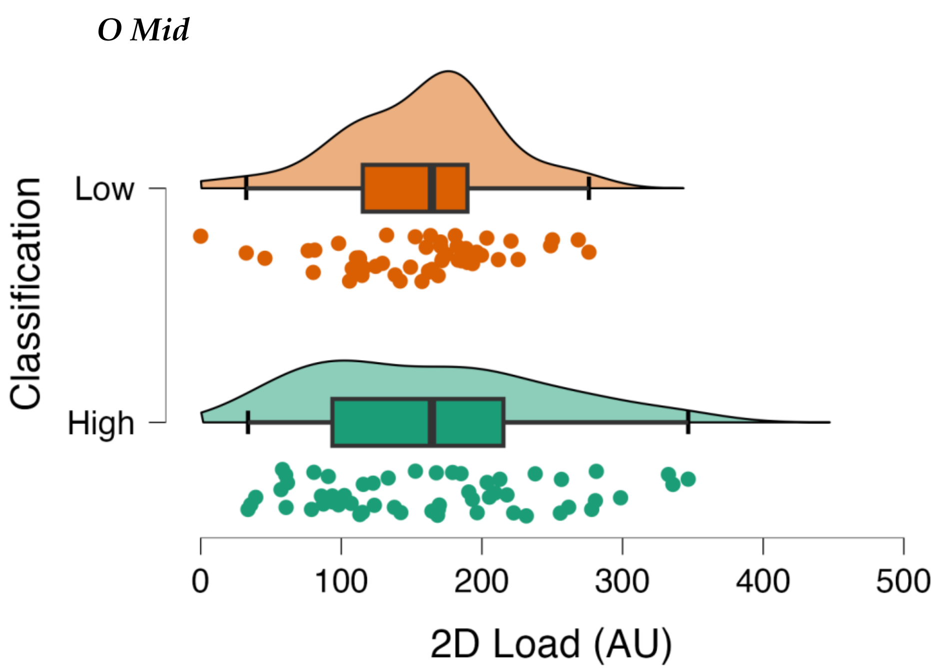


Fig 26. Difference in 2D Load performed by Offensive Midfield players between game classification. p>0.05.

*Long Stick Mid*

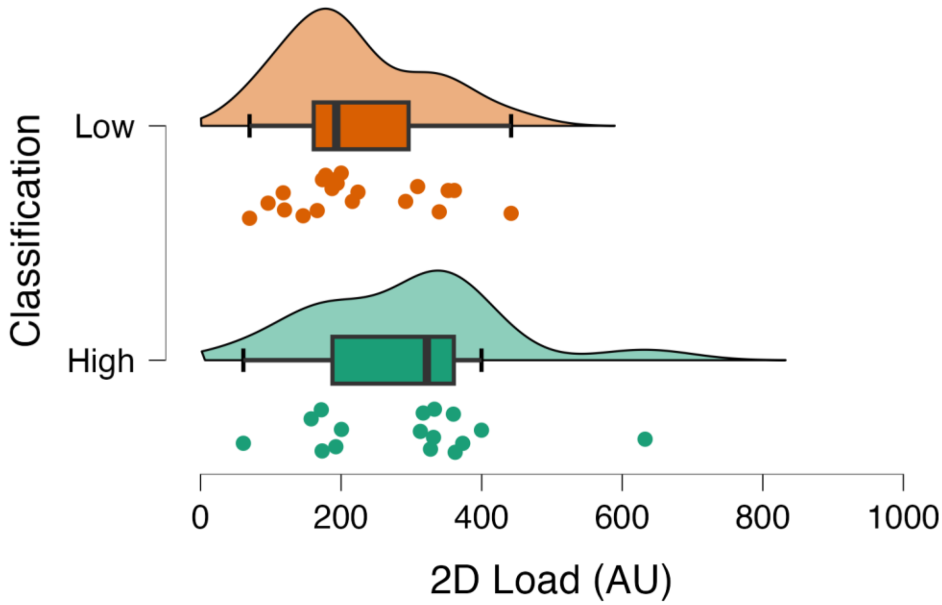


Fig 27. Difference in 2D Load performed by Long-Stick Midfield players between game classification. p>0.05.

*FOM*

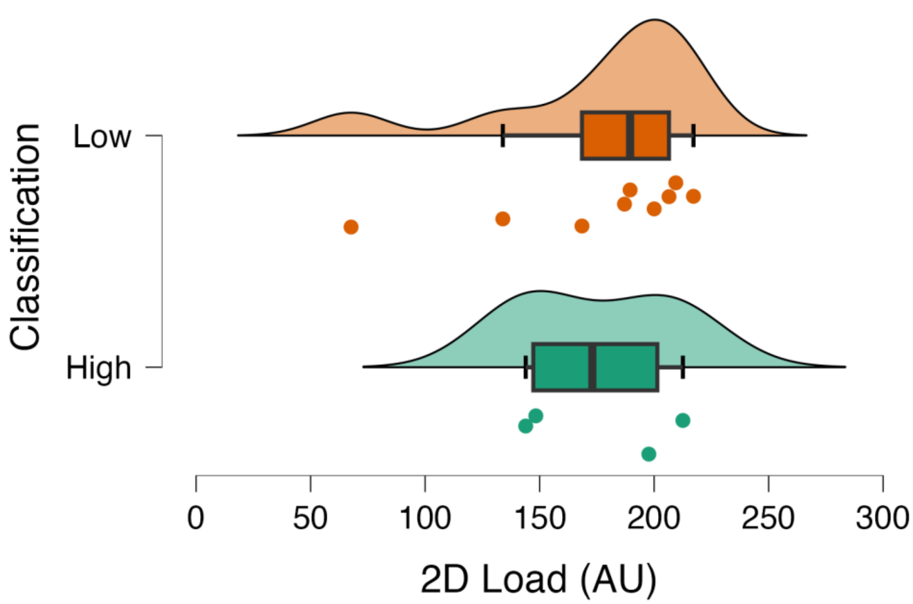


Fig 28. Difference in 2D Load performed by Faceoff Midfield players between game classification. p>0.05.

*Goalie*

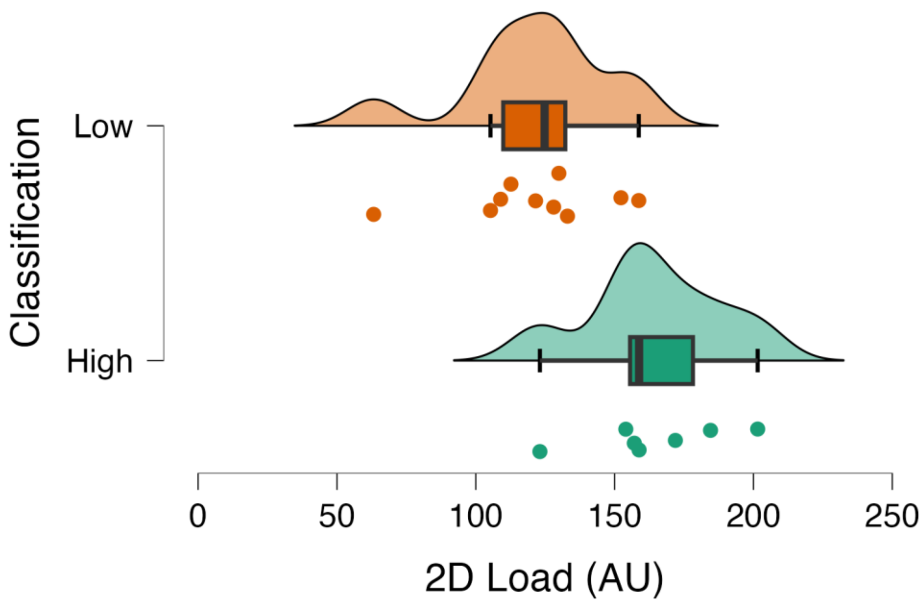

Fig 29. Difference in 2D Load performed by Goalie players between game classification. p>0.05.

***3D Load (AU):***

***Attack***

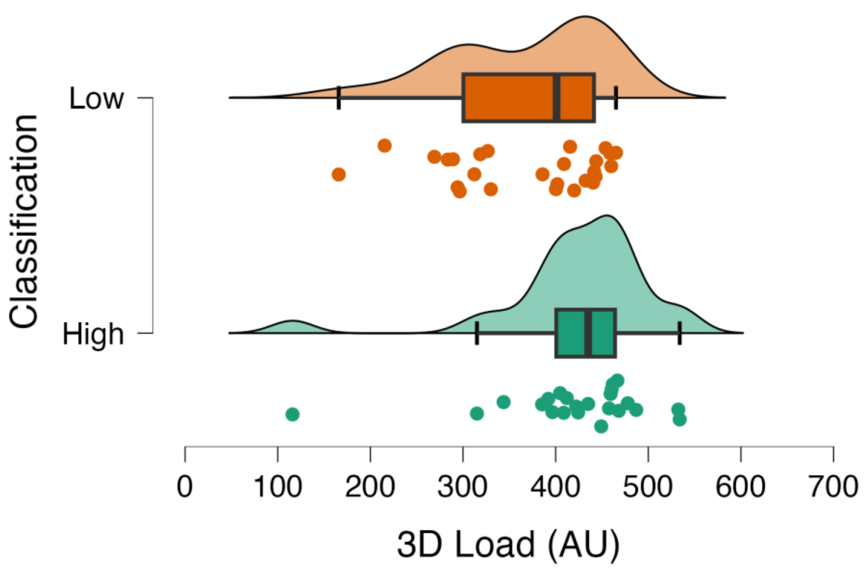

Fig 30. Difference in 3D Load performed by Attack players between game classification. p>0.05.

***D Mid***

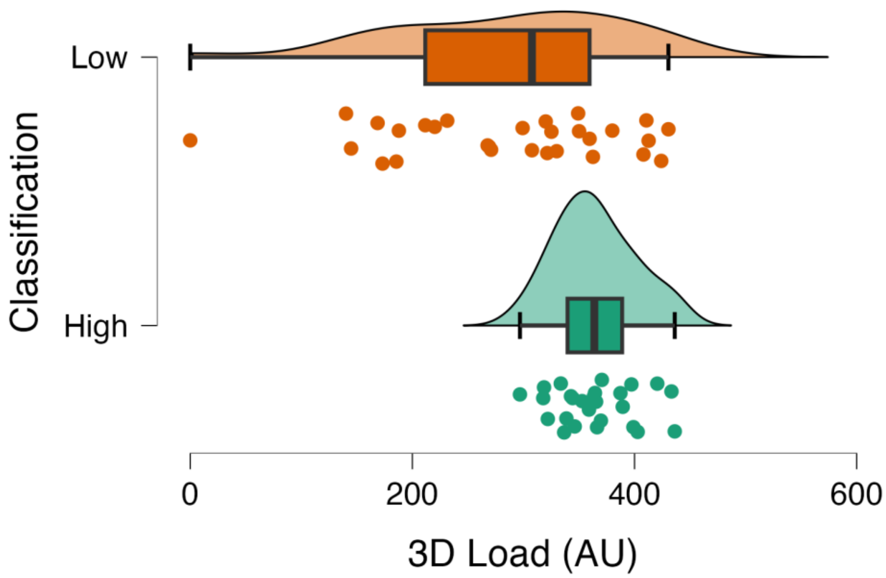

Fig 31. Difference in 3D Load performed by Defensive Midfield players between game classification. p>0.05.

***O Mid***

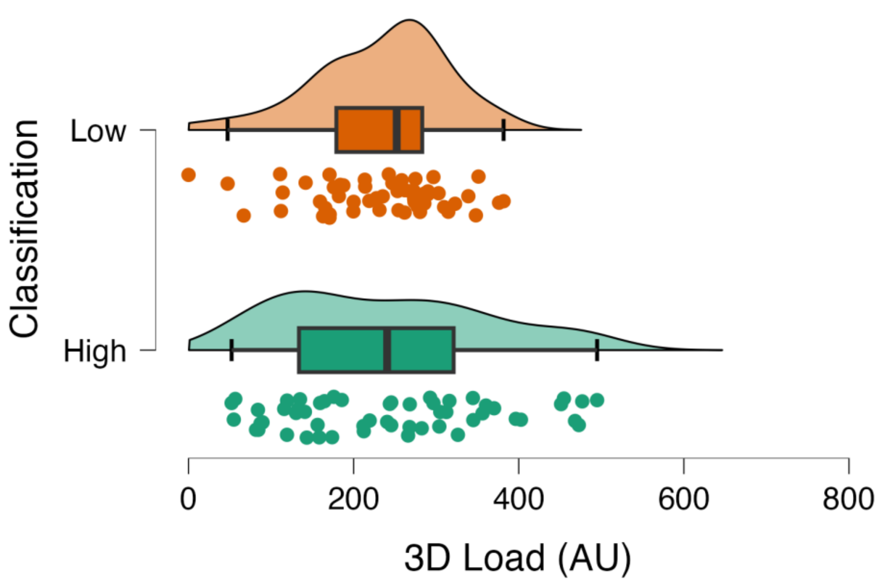

Fig 32. Difference in 3D Load performed by Offensive Midfield players between game classification. p>0.05.

***Long Stick Mid***

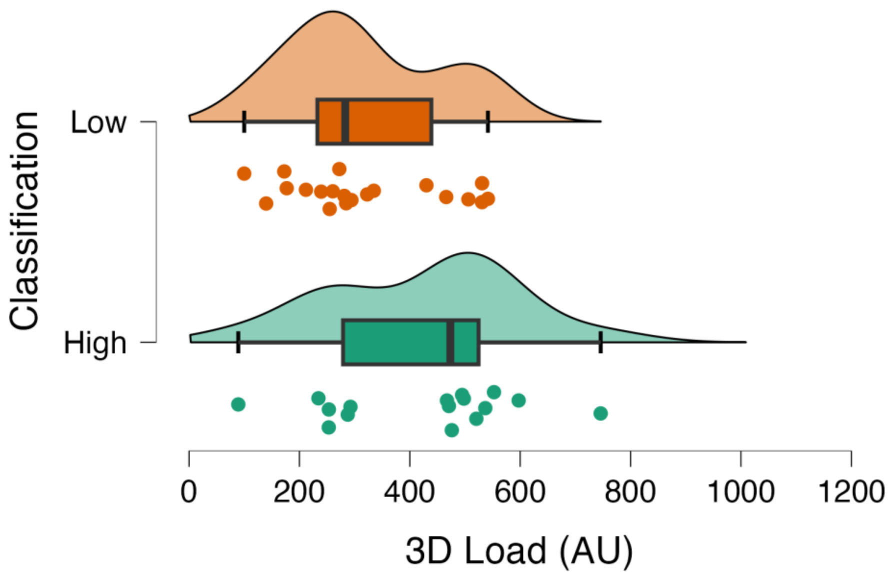


Fig 33. Difference in 3D Load performed by Long-Stick Midfield players between game classification. p>0.05.

***FOM***

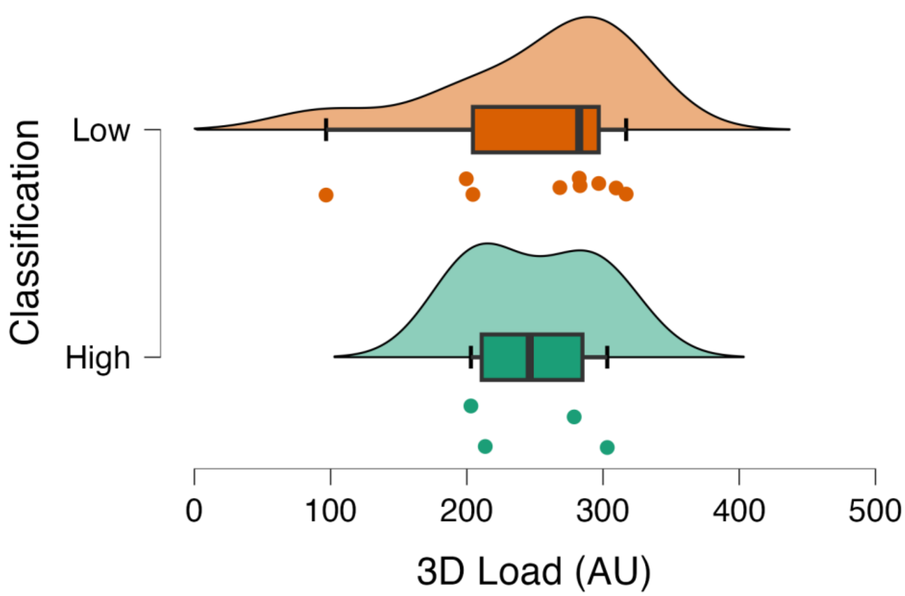


Fig 34. Difference in 3D Load performed by Faceoff Midfield players between game classification. p>0.05.

***Goalie***

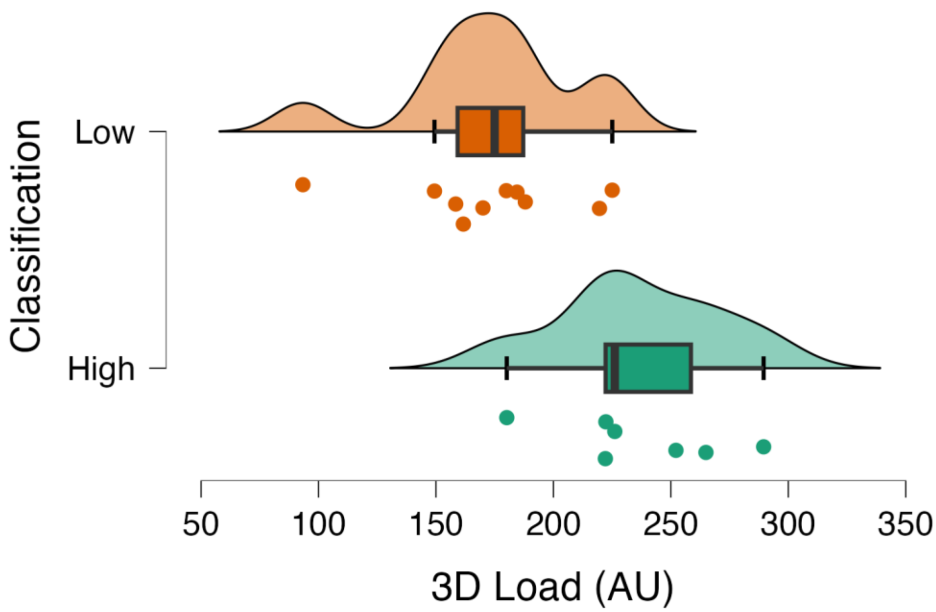

Fig 35. Difference in 3D Load performed by Goalie players between game classification. p>0.05.

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