The distribution of match activities relative to the maximal mean intensities in professional rugby league and Australian football

Johnston, Rich D., Thornton, Heidi R., Wade, Jarrod A., Devlin, Paul and Duthie, Grant M.

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ABSTRACT

This study determined the distribution of distance, impulse and accelerometer load accumulated at intensities relative to the maximal mean 1-minute peak intensity within professional rugby league and Australian football. Within 26 rugby league (n = 24 athletes) and 18 Australian football (n = 38 athletes) games, athletes wore GNSS devices (n = 608 match files). One-minute maximal mean values were calculated for each athlete per game for speed ($m \cdot min^{-1}$), accelerometer load ($AU \cdot min^{-1}$), and acceleration ($m \cdot s^{-2}$). Volumes for each parameter were calculated by multiplying by time, specifying total distance, accelerometer load and impulse. The distribution of intensity of which these variables were performed relative to the maximal mean was calculated, with percentages ranging from zero to 110%, separated into 10% thresholds. Linear mixed models determined if the distribution of activities within each threshold varied, and positional differences. Effects were described using standardized effect sizes (ES), and magnitude-based decisions. Across both sports, the distribution of activity (%) largely reduced the closer to the maximal mean 1-minute peak and was highest at ~60% of the maximal mean peak. When compared to Australian football, a higher percentage of total distance was accumulated at higher intensities (70-80% and 100-110%) for rugby league (ES range = 0.82 to 0.87), with similar, yet larger differences for accelerometer load >80% (0.78 to 1.07) and impulse >60% (1.00 to 2.26). These findings provide information of the volume of activities performed relative to the mean maximal 1-minute peak period, which may assist in the prescription of training.

Key Words: Team sports; match activities; moving average; physical; acceleration

INTRODUCTION

Team sports are typically invasion games that are characterized by periods of high-intensity activity, interspersed with periods of low-intensity activity (23, 24). The high-intensity activities performed are wide-ranging, including short sprint efforts, rapid changes of direction, high speed running, and also, in some sports, physical contact (14, 24, 34). The ability for practitioners to understand the activities of match-play is vital in implementing specific training interventions. With the advancement of tracking technology there has been a large growth in research targeted at assessing the physical demands of team sports. Typically, research has investigated the total volume (distance covered) and average intensity (speed; metres per minute) of match-play (1, 24), providing an insight into the global demands of competition (16, 18), although doing little to help guide the prescription of training intensity. Furthermore, assessing average speed over the duration of a game in intermittent sports may not be useful, as this does not provide information regarding intense passages of play, potentially resulting in athletes not being adequately exposed to competition intensity where planned.

An understanding of the high the high-intensity periods of team sport competition is important to allow for appropriate training intensities during technical-tactical drills to be prescribed. As such, research has partitioned games into fixed 3 to 5 min discrete periods from the start of the match (e.g. 1 to 3 min, 4 to 6 min etc.) (3, 20, 28). Whilst useful at identifying fluctuations in intensity, this method has been shown to underestimate the peak intensity of competition when compared to a moving average by as much as 20-25% (6, 31). Unlike fixed periods, a moving average involves calculating the mean of a variable over a subset period (i.e. 1-minute), then forward shifting this subset over the dataset, one datapoint at a time. The maximal value of the means is then established. This method has been used extensively across a range of team sports

(8, 10-12, 34), for a range of variables (speed, acceleration, and accelerometer load [the vector magnitude of triaxial accelerations]). Regardless of the variable assessed, a consistent finding of these studies is a decline in intensity as the duration of the moving average increases. Practically, this information permits the prescription of match specific intensities over a range of drill durations; allowing players to be exposed to maximal mean competition intensities. Within team sports, prescribing drills that aim to expose athletes to competition intensities is common practice, however little research has examined how this prescription should be periodized.

Although speed ($m\cdot min^{-1}$) and high-speed distance (distance covered above a pre-defined threshold [i.e. >5.5 $m\cdot s^{-1}$]) are important to measure, due to the intermittent nature of team sports, players are rarely afforded the opportunity to cover large distances at a constant velocity (23, 24). For example, in Australian Football, the maximal mean 1-minute speed is ~220 $m\cdot min^{-1}$, equating to ~3.6 $m\cdot s^{-1}$, which in most cases would still be considered low-speed activity. As such, measures of speed are likely to underestimate the true demands of competition and the constant changes in speed emphasize that acceleration is an important physical attribute of team sports (7). An effective method to quantify acceleration is the mean rectified acceleration for a given duration which represents the mean absolute change in speed over a given period (7). This method of quantifying changes in speed has been demonstrated as more reliable (7, 30) than using traditional counts of accelerations and decelerations within pre-defined thresholds (i.e. >2 $m\cdot s^{-2}$). Further, due to differing filtering processes, there are large inconsistencies in acceleration counts between manufacturers when monitoring the same activity (7, 30). Practically, examining the global acceleration intensity of team sports is useful as opposed to potentially sporadic high-intensity efforts, as this measure can be used to prescribe drills (7). Previous work has established the maximal mean rectified acceleration demands of match-play using the moving average method (8, 10). Evidently, there are regular changes of velocity that occur during team sport competition, which are not captured by simply measuring average speed or distance covered. Therefore, more information is required regarding these demands so that practitioners can prescribe appropriate drills that reflect the changes of pace that occur during competition.

Information regarding the maximal mean speed, accelerometer load and acceleration during competition is important, and can provide practitioners with relevant information for the prescription of the appropriate intensity of training drills. However, it must be noted that the 'peak' only occurs once throughout a game, thus not reflecting the overall demands of competition, specifically regarding the volume completed at, or close to this 'peak' intensity. Indeed, when the maximal mean demands of professional and semi-professional rugby league competition are assessed, there is little difference between standards (25). Whilst we can use maximal mean intensities to guide the prescription of training intensity, the training volume that should be performed at these intensities is unknown. Such information would assist in prescribing training drills (i.e. small-sided games [SSGs]) which potentially aim to expose athletes to competition intensities. For example, if an athlete only spends 1-minute of a game close to their maximal mean competition intensity, prescribing SSGs that expose athletes to this intensity for 10 minutes may be excessive, and not within the principles of training periodization. Further to this, despite some preliminary work showing greater running intensities in AFL compared with rugby league (33), it is unclear as to which variables derived from microtechnology devices best encapsulate the high-intensity activities performed in a sport. Given the free-flowing nature of AFL, compared to the stop-start, contact dominant activities performed in rugby league, there are likely differences between sports that practitioners working within these sports may need to be mindful of. As such, the aim of this study was to determine the distribution of the maximal mean 1-minute speed, accelerometer load and acceleration across both professional rugby league and Australian football competition.

METHODS

Experimental Approach to the Problem

Physical activity profiles were measured during professional National rugby league (NRL) matches and professional Australian Football League (AFL) matches across the 2018 and 2019 seasons using microtechnology devices. The maximal mean speed, accelerometer load and acceleration for a 1-minute period was established for each player across every match file. Subsequently, the positional mean of the maximal mean 1-minute speed, accelerometer load and acceleration were calculated. These maximal mean 1-minute periods were then used as the reference value in order to determine the distribution of relative intensity across the entire game for all other rolling 1-minute periods.

Subjects

Twenty-four rugby league (age = 25.4 ± 4.1 years; stature = 187.4 ± 6.4 cm; body mass = 100.4 ± 9.8 kg) and 38 Australian football (age = 24.0 ± 3.5 years; stature = 187.2 ± 6.2 cm; body mass = 84.4 ± 6.5 kg) athletes took part in this study from two clubs playing in the NRL and AFL competitions, respectively. Prior to the commencement of the study, ethical approval was sought (2018-290E). All data were collected as part of the routine monitoring processes of the club with players providing written consent for their data to be used for research purposes. Data were deidentified prior to analysis.

Design

Microtechnology devices were used to measure the physical activity profiles of players during 26 NRL (10 losses, 16 wins; n = 351 match files) and 12 AFL matches (15 losses, 3 wins; n = 367 match files). The NRL club used StatSports Apex units (StatSports, Newry, Northern Ireland), and the AFL club used Optimeye S5 units (Catapult Sports, VIC, Australia). These units have shown acceptable validity and reliability for measuring activities common to team sports (2, 30) and rugby league (21, 32). The microtechnology units used in this study (different manufacturers) comprized a 10 Hz multi-global navigation satellite system (GNSS) chip, a 100 Hz triaxial accelerometer, 100 Hz gyroscope and 10 Hz magnetometer. The same device was worn by each player, as to minimize interunit variability (5). The use of two separate GNSS devices is not deemed as a limitation in this study, as comparisons were made between sports after data was normalized, expressed as a percentage relative to individual maximal mean values.

Prior to the start of each match, the units were switched on approximately 20-min prior to the warm-up and fitted into a padded compartment sewn into the playing jersey. Jerseys were tight fitting, in order to minimize measurement noise, particularly accelerometer load (29). The quality of the data was determined by recording the horizontal dilution of position (HDOP), and the number of satellites; any files with a HDOP >1.5 were removed from the analysis. Subsequently, 0 AFL files, and 15 NRL files were removed. For AFL games, there was an average HDOP of 0.69 ± 0.09 and 10.5 ± 0.65 satellites. For NRL games, there was an average HDOP of 0.76 ± 0.25 and 17.7 ± 1.90 satellites.

Following each match, the data files were downloaded using the manufacturer provided software and trimmed to only include match time before being exported in their rawest form into a comma delimited file (csv), with each row representing a GNSS data point for each athlete. Once exported, moving averages were calculated over a 1-minute for speed ($m\cdot min^{-1}$), accelerometer load per minute ($AU\cdot min^{-1}$), and acceleration ($m\cdot s^{-2}$) in RStudio (Version 1.1.383, RStudio, Boston, MA). The GNSS variables (speed and acceleration) sampled at 10 Hz, therefore a 1-minute moving average included 600 data points, while for 100 Hz accelerometer load, the 1-minute moving average included 6000 data points. Subsequently, the maximal mean value was extracted for each athlete for each match file, and position specific (rugby league: forwards and backs; AFL: midfielder, small defender, small forward, ruck, tall back, and tall forward) averages for the maximal mean 1-minute period was used as the reference value to determine the relative intensity of all other rolling 1-minute periods. The reference values used are shown in Table 1.

Using the three variables calculated (speed, accelerometer load and acceleration), the total distance, accelerometer load and impulse accumulated over the duration of the match was established for each file. Subsequently, the distribution of these variables accumulated in 10% buckets (i.e., 110-100%, 100-90%, all the way to 0) was determined. As speed was provided in the manufacturer supplied export, the accumulated distance within each bucket was calculated. For example, using the rugby league dataset, the peak 1-minute speed was 171 $m\cdot min^{-1}$ or forwards, therefore the 90-100% threshold corresponded to speed ranging from 154 to 171 $m \cdot min^{-1}$. As such, the distance accumulated between 154 to 171 $m \cdot min^{-1}$ was established.

Accelerometer load is a vector magnitude of the sum of triaxial accelerations taken from the 100 Hz accelerometers embedded within the microtechnology devices. This is termed *Total Loading* in the Apex software, the formula is protected by a non-disclosure statement, so it cannot be presented in the paper. For the AFL games, within the manufacturer software, this variable is termed *PlayerLoad*™, where a similar manufacturer provided formula was used compared to that within the Apex software (4). Due to the differing terminology between manufacturers of this variable, within the present study, the terminology 'accelerometer load' was used. Additionally, GNSS derived acceleration and deceleration were calculated as the absolute rate of change of velocity ($m \cdot s^{-2}$). Acceleration was converted to a load measure, impulse, and the impulse accumulated at different percentages of the mean maximal acceleration was established by multiplying the corresponding acceleration by each individual athletes' body mass, and then multiplying this by the 0.1 seconds (sampling rate of the GNSS unit). The sum of impulse accumulated within each percentage of the maximal mean acceleration was then established to reflect the volume of acceleration/deceleration performed at different intensities. Subsequently, as explained above, the distribution of these variables (distance, accelerometer load and impulse) accumulated in 10% buckets (i.e., 110-100%, 100-90%, all the way to 0) was determined and normalized the variables, allowing for comparisons between variables to be made.

Statistical Analysis

To determine the difference in the percentage distance, accelerometer load and impulse accumulated at relative intensities linear mixed models were used. Separate models were built for each sport with match number and athlete identification number used as random effects, and variable (distance, accelerometer load and impulse) as fixed effects. Resulting SDs and mean differences were then assessed to establish standardized effect sizes (ES) and 90% confidence intervals (CI). Standardized effect sizes were described using the magnitudes; <0.20 trivial; 0.21 – 0.60 small; 0.61 – 1.20 moderate; 1.21 – 2.0 large and > 2.01 very large (19). Effects were deemed to be real if they were 75% greater than the smallest worthwhile difference (calculated as 0.6 x the between-athlete SD). A moderate worthwhile difference was deemed appropriate in the analysis of these data, due to the inherent variability of GNSS measured variables (i.e. speed) of team sport activity. For example, the SD of maximal mean running speeds over 5 minutes has previously been reported to be ~12 $m\cdot min^{-1}$ in elite rugby league (9). When multiplied by 0.2 (small effect), this results in the smallest worthwhile difference being 2.4 $m\cdot min^{-1}$ or 0.04 $m\cdot s^{-1}$, a value similar to the error previously reported when quantifying the mean speed assessed from GNSS devices in comparison to a criterion (VICON) system (13). All statistical analysis was performed in R Studio software (version 1.0.143, RStudio Inc.)

RESULTS

The mean maximal 1-minute values by position for both Australian football and rugby league used for the analysis are shown in Table 1. The percentage distribution of distance, accelerometer load and impulse relative to the maximal mean 1-minute peak intensity for

Australian football and rugby league are shown in Figure 1 A and B, respectively. The raw values for the activity performed in each zone are shown in Table 2 for both sports.

*** Insert Table 1 near here***

*** Insert Figure 1 near here***

*** Insert Table 2 near here***

Within Sport Comparison

Differences between distance, accelerometer load and impulse within each zone are shown in Figure 2. In Australian football, there were no substantial differences between the proportion of accelerometer load and distance accumulated in each zone other than at 20-30% in favour of accelerometer load (Figure 2A). There was however a trend for a greater proportion of distance over 50-80% zones, and a greater proportion of accelerometer load at 100-110%, with *small* to *moderate* differences. In rugby league however, there was a substantially greater proportion of distance compared to accelerometer load from 50-80%, with *moderate* to *large* differences; these differences decreased as intensity increased. At very high intensities, there was a trend for greater accelerometer load compared to distance, 90-100% (ES = 0.34 [0.22-0.45] and 100-110%; ES = 0.34 [0.23-0.45]), although these were unsubstantial.

Insert Figure 2 near here

As shown in Figure 2B, Australian footballers performed a lower proportion of impulse compared to distance at intensities between 60-100% of the maximal mean 1-minute period

(ES range = 1.19 to 0.50). This difference decreased as intensity increased, with no difference at 110%. In rugby league however, above 70% of the maximal mean 1-minute period, athletes accumulated a greater proportion of impulse compared with distance (*moderate* to *small*), with the greatest difference occurring at 80-90% (ES = 0.83 [0.56-1.12]).

In Australian football, there was a greater proportion of accelerometer load compared with impulse (ES range = 0.29 to 0.43) for intensities above 80% of the maximal mean 1-minute period (Figure 2C). However, in rugby league, there was a greater (*large* to *small*) proportion of impulse compared to accelerometer load across 60-100%, of peak 1-minute (ES range = 0.35 to 1.27); this difference decreased as the intensity increased.

Between Sport Comparison

For distance, when compared to Australian football, the intensity distribution distance was substantially higher for rugby league between 60-70% (ES = 0.82 [0.52-1.11]) and 100-110% (ES = 0.87 [0.58-1.16]). For accelerometer load, the relative intensity was substantially higher for Australian football compared to rugby league between 80-110% (ES range = 0.78 to 1.07). Impulse was higher for rugby league between 60-110% (ES range = 1.00 to 2.26), whereas for lower intensities (0-60%), impulse was higher for Australian football compared to rugby league (ES range = 0.70 to 2.15).

DISCUSSION

The purpose of this study was to determine the distribution of distance, accelerometer load and impulse accumulated relative to the maximal mean 1-minute period during professional rugby league and Australian football competition. A primary finding of this study within both rugby league and Australian football was that the distribution of activity (%) largely reduced the closer to the maximal mean 1-minute peak, however the highest distribution for both sports was at approximately 60% of the maximal mean. There were different distributions of activity between sports, with Australian football having a greater proportion of distance and accelerometer load accumulated closer to the 1-minute peak period compared to impulse. Whereas in rugby league, there was less distance and more impulse and accelerometer load accumulated closer to the peak 1-minute period. This information develops our understanding of the volume of activities performed relative to the mean maximal 1-minute peak period, which may be useful in the prescription of skill-based training.

Previous research has assessed the mean maximal periods during Australian football (10, 27) and rugby league (8, 15, 34). Whilst this information has been vital in understanding the most intense periods of team sport competition (35), they only provide information on the peak, which happens once a game. The lack of information on the volume of work performed at these intensities causes difficulties for practitioners in implementing periodized programs that expose athletes to the demands of competition. The results in this study demonstrate the volume and proportion of activity in relation to the mean maximal 1-minute period as depicted in Figure 1 and Table 1. A primary finding of this research was that in Australian football, players perform accumulated 13% of total distance, 7% of total impulse, and 11% of the total accelerometer load above 70% of the mean maximal 1-minute period. In rugby league, 17% of total distance, 23% of total impulse, and 16% of total accelerometer load were accumulated above 70%. Interestingly, as depicted in Figure 1, the distribution of activity across each threshold followed a normal distribution (i.e. a bell curve) with the volume of activity being the greatest at ~60% of the maximum mean 1-minute peak, falling thereafter. Together, these data may be used by practitioners to more precisely prescribe skill-based training drills, where the volumes at specific intensities can be prescribed, rather than simply using the maximal mean 1-minute value as a guide.

As depicted in Figure 1 and Table 1, within Australian football, a greater proportion of distance was accumulated at higher intensities compared to impulse and accelerometer load, although not at intensities above the mean maximal 1-minute period. However, in rugby league, at higher intensities, athletes had a greater proportion of impulse, and even higher accelerometer load. These differences are likely a reflection of the distinct movement patterns of the two sports. Further, Australian football is played over a longer period, with approximately 100 minutes playing time, and on a larger playing area compared with rugby league (23, 24). Therefore, players have more opportunity to accumulate large distances, with the most intense periods of play occurring during expansive passages of play. In rugby league on the other hand, there are fewer opportunities to cover large distances, and the most intense periods of match-play typically occur when defending the goal-line (17). Given that goal-line defence could occur for prolonged periods of play (e.g. repeated defensive sets) unlike open running, it is unsurprising that players accumulate a larger proportion of accelerometer load and impulse at higher intensities. Indeed, previous research has shown that accelerometer loading is sensitive to changes of direction and non-running activities such as contact (21, 22, 26). Based on this information, distance is likely to be a better metric to quantify the high-intensity passages of play in Australian football other than for very high-intensity periods of play (e.g. 100-110% of maximal mean 1-minute), where there is a greater proportion of accelerometer load, but these periods are likely to be less than 1-minute in duration. In rugby league however, periods of accumulating large distances are rare, and therefore accelerometer load or impulse are likely to be more reflective of the most intense periods of competition.

When comparing the proportion of impulse compared to accelerometer load accumulated at intensities above 50% of the mean maximal 1-minute period, there was a difference between sports as depicted in Figure 2. Australian football match-play was characterized by a greater proportion of accelerometer load compared to impulse at high intensities of match-play (≥70%). This was the opposite in rugby league, where impulse was greater than accelerometer load at high intensities, although the difference was reduced as the intensity increased. The reason for this is likely due to the activity patterns of the sports. Rugby league is an onside sport, with the 10-m rule and tackle contest producing large changes of velocity, largely in the sagittal plane, whereas the offside nature of Australian football likely produces more directional changes (i.e. 360°) which are related to the accelerometer derived loading metrics that are available from the proprietary software of wearable devices. As such, impulse in rugby league and accelerometer load in Australian football may be useful metrics to monitor high-intensity activity.

Overall the results of this study demonstrate that the highest volume of activity is performed at ~60% of the maximal mean 1-minute period of match-play, following a normal distribution trend. In Australian football, there is a greater proportion of distance covered at, or close to the maximal mean 1-minute period although greater accelerometer load above 100%. In rugby league however, there is a greater proportion of impulse as the intensity of match-play increases in comparison to accelerometer load and distance. This information can be used to guide training practices, particularly in regards the type and volume of activity that is performed close to the maximal mean 1-minute period. There are some limitations with the rolling average method utilized in this study and elsewhere in that data points in the first and last minute of each half will be underrepresented in all the moving average periods. Whilst this only represents a small sample of the overall game, there may be some information that is missed using this approach. It is also important to note that the match intensities reported in this study are unlikely to be of sufficient intensity to induce significant training adaptations from a physiological standpoint. As such, these data should be used to prescribe training intensity for skill-based drills rather than generic conditioning drills that do not involve any technical and tactical components.

PRACTICAL APPLICATIONS

- In rugby league, above 70% of the maximal mean 1-minute peak, there is 17% of distance, 23% of impulse, and 16% of accelerometer load accumulated, therefore training drills should reflect this distribution.
- In Australian football above 70% of the maximal mean 1-minute peak, there is 13% of distance, 7% of impulse, and 11% of accelerometer load accumulated. As such, training drills should reflect this distribution.
- For rugby league, high-intensity drills with a focus on change of velocity should be more frequent than high-speed drills.
- In Australian football, high-intensity periods of distance are the most frequent, other than above the maximal mean 1-min period, where accelerometer load dominates.

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Table 1. The maximal mean 1-minute period values used for the analysis from professional Australian football and rugby league matches. Data are expressed as mean and standard deviation.

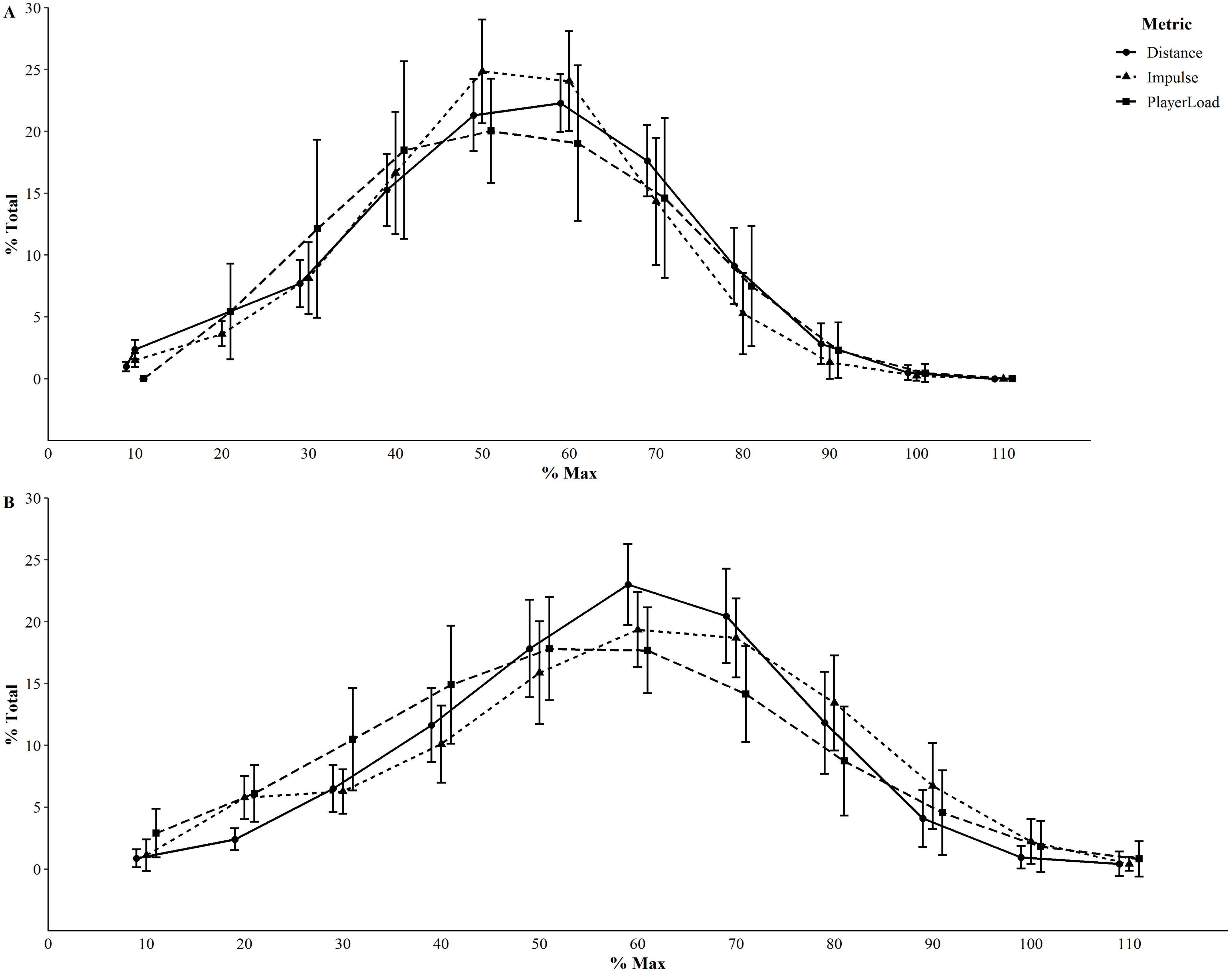
Intensity zone	**Speed ($m \cdot s^{-1}$)**	**Acceleration ($m \cdot s^{-2}$)**	**Accelerometer load ($AU \cdot min^{-1}$)**
Australian football			
Midfielder	234 ± 13	0.81 ± 0.06	26.3 ± 3.8
Small defender	228 ± 15	0.81 ± 0.07	23.1 ± 2.3
Small forward	247 ± 16	0.81 ± 0.06	26.8 ± 3.0
Ruck	208 ± 15	0.69 ± 0.04	20.1 ± 1.0
Tall back	221 ± 19	0.80 ± 0.08	23.5 ± 1.2
Tall forward	240 ± 13	0.76 ± 0.05	25.5 ± 4.8
Rugby league			
Forward	175 ± 34	0.92 ± 0.10	3.3 ± 0.6
Back	173 ± 38	0.87 ± 0.11	3.5 ± 0.6

AU = arbitrary units.

Table 2. Distance, impulse and accelerometer load accumulated in each zone relative to the maximal mean 1-minute period during professional Australian football and rugby league matches. Data are expressed as mean and standard deviation.

	Australian football			Rugby league		
Intensity zone	**Distance (m)**	**Impulse (kN.s)**	**Accelerometer load (AU)**	**Distance (m)**	**Impulse (kN.s)**	**Accelerometer load (AU)**
0-10%	140.3 ± 46.7	4.3 ± 1.3	0 ± 0	52.1 ± 32.5	1.9 ± 1.7	2.9 ± 1.4
10-20%	337.6 ± 96.1	10.5 ± 2.5	76.2 ± 50.6	157.2 ± 59	11.4 ± 3.3	6.4 ± 2.4
20-30%	1109.2 ± 262.6	23.4 ± 7.7	171 ± 95.5	428 ± 144.5	12.4 ± 4	11 ± 4.3
30-40%	2204.9 ± 436.2	48.2 ± 13.9	262.7 ± 99.6	768.8 ± 243	20 ± 6.9	15.9 ± 5.6
40-50%	3089.2 ± 508.6	72.4 ± 13.5	287.4 ± 70.2	1185.2 ± 357.1	31.6 ± 9.5	19.2 ± 5.9
50-60%	3236.8 ± 492.2	70.7 ± 15.7	275 ± 99	1550.8 ± 442.2	39 ± 10.7	19.1 ± 6
60-70%	2564.8 ± 525.7	42.4 ± 17.1	212.5 ± 102.1	1383.1 ± 453.5	38.2 ± 12.6	15.4 ± 6.3
70-80%	1334.3 ± 490.8	15.7 ± 10.5	110.5 ± 78.8	798.2 ± 361.5	27.7 ± 12	9.7 ± 5.8
80-90%	414.6 ± 248.9	4 ± 4.2	34.2 ± 36.1	276.9 ± 179	13.8 ± 8.4	5.1 ± 4.2
90-100%	72.8 ± 88.5	0.7 ± 1.2	6.8 ± 10.6	65 ± 67.5	4.6 ± 4	2.1 ± 2.4
100-110%	0.0 ± 0.5	0 ± 0	0 ± 0.2	28.6 ± 65.4	0.9 ± 1.2	0.9 ± 1.6
Match total	14505 ± 1483	292 ± 33	1436 ± 199	6694 ± 1589	202 ± 47	108 ± 25

AU = arbitrary units. kN.s = kiloNewton seconds.


A
B
Metric
Distance
Impulse
PlayerLoad
% Total
% Max
0
5
10
15
20
25
30
0
10
20
30
40
50
60
70
80
90
100
110