Is the difference between two methods of measuring soccer training load effected with different training themes?

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Abstract:

Purpose: This study was to investigate whether the difference between measuring soccer training loads using the speed zone only method and metabolic power method was affected when the training sessions differ from aerobic endurance to speed strength (anaerobic). Due to the different physiological demands put on the participants brought about with different session themes, the effect on training load measurement was investigated. **Methods:** 18Hz vest worn GPS units were used to collect data from 22 participants participating in an aerobic endurance and a speed strength training themed sessions performed by a semi-professional soccer team. **Results:** Measuring the aerobic endurance session using metabolic power method had mean energy cost for the session of 1303.4 ± 332.0 kJ whereas with the speed zone only method the result was that of 1242.5 ± 289.5 kJ (Means ± SD). Measuring the speed strength session using metabolic power method, the mean energy cost for the session was that of 1291.2 ± 45.4 kJ whereas with the speed zone only method the result was that of 1268.3 ± 43.6 kJ (Means ± SD). The difference in energy cost for both sessions when calculated with both methods were not significant, $p = 0.512$ and $p = 0.577$ for the aerobic endurance and speed strength session respectively. **Conclusions:** In this study there was a difference between the two methods of measuring training loads in line with previous literature and also the aerobic endurance session had a mean of 3.1% higher difference between the two methods when compared with the difference between methods for the speed strength session. Although the difference in energy cost (kJ) calculation was affected when the session theme was changed, the difference was not statistically significant. Further studies with increased number of participants and participating teams should give a clearer answer.

Keywords: training loads, soccer, GPS

Introduction:

Soccer is a multidirectional sport in which players accelerate towards a direction, decelerate, change direction and re-accelerate (Little & Williams, 2003). As this is not straight forward running a measured distance, it poses a great challenge for practitioner to calculate the effort load exerted by the player. Measuring external load of an individual player is of great importance. By having a good external load reading of the player, the practitioner can calculate and manage the overload prescription for the individual player and also better estimate the rest and recovery period needed. External load is commonly measured using different measurements such speed zones, total distances covered, average speed, average power, time of effort intensity absolute and relative (Halson, 2014). Since measuring an individual's external load is somewhat difficult within team sport due to the nature of the game, players are at risk overloading more than they should and this could result in overuse injuries or injuries caused by fatigue (Gabbett, 2016; Halson, 2014; Small et al., 2009).

Initial global positions systems (GPS) units had frequencies of 1 to 8Hz which were not reliable to measure external load (Vickery et al., 2014). GPS have recently become more accessible, affordable and practical to use with just a small device fitting inside a small pocket between the scapulae within a vest. The use of GPS has become more wide spread with practitioners using multiple methods to quantify training loads (Clemente, et al., 2018). The use of GPS has been that of quantifying distance ran during training session and also to evaluate the time and distance covered at specific velocities zones.

As standard the GPexe system which is one of the strongest devices in the market uses the velocity zones as follows: 0 < 2.22 m/s (0 < 8 km/hr), 2.22 m/s ≤ to < 6.11 m/s (8 km/hr ≤ to < 22 km/hr) and ≥ 6.11 m/s (≥ 22 km/hr). The time (mm:ss), distance (metre) and energy (j/kg) of each zone are quantified and thus practitioner calculates the external load of the player using such parameters (Nagahara, et al., 2017; Cassirame et al., 2017). The velocity zone thresholds can also be costumed according to the practitioner's preference. Weston (2013) findings argue the that for more realistic measurement the speed zones so be individualised according to the player. The major importance is given towards the high-speed zones. Speeds which are ≥ 4 m/s (≥ 14.4 km/hr) are considered to be high-speed running and previous literature has linked it to match performance (Mara, et al., 2017; Jastrzebski & Radziminski, 2015; Harley et al., 2010; Abt & Lovell, 2009; Carling et al., 2007; Rampinini et al., 2007). High speed running accounts to 30 to 40% of the distance ran in a soccer match according to literature and the energy cost of such speed in relation to the entire match energy cost has also been looked into. (Ingebrigtsen et al., 2012). The major importance given to high-speed zones is due to the high energy demands of such running which amounts to 35-50 % of the overall energy demands of a match (Stølen et al., 2005). Others such as Osgnach et al. (2009) have measured the high-power activities instead the speed-only zone only. The aforementioned study findings result that from a match of 10,950 ± 1044 m, 26 % of that distance was covered in high-power (> 20 W/kg) which accounted for 42 % of the entire energy cost of the match. The latter finding further therefore also confirms the importance of high-speed, high-power action throughout a match for external load estimations.

The importance on high-speed high-power activities has led to some criticizing such way of calculating training load as underestimating the true real cost of energy. When players are accelerating or decelerating the action is happening at low speed zones though the effort cost is high. Using the speed zone method, the effort/energy cost of the player when accelerating is over looked as the actual speed would be low. On the forefront of the discussion is Martin Buchheit a French strength and conditioning coach whose head of performance at Paris Saint-Germain Football Club which is one of the top teams in European football. Buchheit argues that speed zone methods only to measure training loads is correct, with multiple studies advocating the role and effectiveness of such method. On the other side of the argument Professor Pietro Enrico di Prampero together with Cristian Osgnach have advocated on using instantaneous metabolic power as energy cost estimation to calculate external but also having the ability to calculate the internal training load which would be a more individualistic approach.

To calculate the energy cost of acceleration and to introduce the effort into the total energy cost calculation of the training load, Prompero introduces a theoretical model comparing uphill running at constant velocity as equivalent in energy cost to accelerating on flat terrain (Prampero et al., 2005). Knowing the cost of energy or running uphill at constant velocity (4.6 j/m/kg) from previous literature allows the practitioner to further quantify the external and internal load of each player more accurately when running at constant speed (Minetti et al., 2002; Margaria et al., 1963). The 4.6 J/m/kg energy cost of running at constant velocity value has been discussed in various literature and the different running surfaces such as asphalt, artificial turf and natural grass have been investigated on what effect this variable might have on the value. Sassi et al. (2011) when comparing the three types of surfaces mentioned found that 4.2 J/m/kg value for energy cost was more suited for amateur level football players this after assessing energy cost using respiratory gas exchange whilst conducting 50 metre runs. On the contrary Di Michele et al. (2009) found higher blood lactate and higher heart rate readings running on artificial turf compared to natural grass when running at same speed. Literature on energy cost of running seem to be contradictory but it is important to consider that there are various characteristics that influence the value such as the type of grass used for the study, the type of shoes used (running vs. football shoes), differences within football shoes (multi-low-studs vs. blade studs) and subjects characteristics. Di Michele et al. (2009) have used youth soccer players but does not specify whether the players are habitual natural grass or artificial turf users which might have an impact on the familiarity of the players. The subjects were high level soccer players, the possibility of such level players having access to real grass for regular training than other players is higher.

GPS units have a vital role in modern training practices, soccer training has changed throughout the years from players having to run long distances at constant pace to more specific small sided. The notion of quality over quantity has gained the upper hand having practitioners always seeking way to improve the quality of the limited contact time they have with the players and try to maximise the improvement of the squad. Various literature findings show how intermittent sports does benefit equally from short multiple sprints to increase the aerobic fitness as to running long distances at a constant pace (Meckel et al., 2009; Bravo et al., 2008; Glaister, 2005). This is reaffirmed by studies such as Di Mascio and Bradley (2013), showing the changes in intensities and thus heart rates during football matches when analysing elite soccer matches.

Two of the most popular methods used to increase aerobic and anaerobic fitness in modern soccer training are intermittent runs and small sided games. Small sided games (SSG) are used by practitioners for their unique set up, allowing not only the use and improvement of aerobic and anaerobic energy systems but also work on the four corners of the soccer player development which are: the tactical, technical, physical and physiological aspects of the game (Castagna, 2009). Thus, with the use of SSG the player gets to think tactically, practices his ability (technique) with the ball, improves his psychological performance by being more alert and sharp, all this whilst improving his aerobic and anaerobic fitness components. This makes the ideal most logical selection for the practitioner to maximise a training session quality and benefit. SSG can also be modified in accordance to what the practitioner wants to work on by changing pitch size, number of players, conditions such as maximum number of touches, time and other game related variables.

The other popular method of improving aerobic and aerobic fitness is intermittent sprints using the maximal aerobic speed (MAS) of each player. This method is popular because of the easy implementation nature and for introducing individuality within team training. An intermittent aerobic fitness test such as the 30-15 is performed by the squad and the speed at which the player has failed will be chosen as their maximal aerobic speed (Buchheit, 2010). When the practitioner then prescribes distances to run intermittently, different distances are marked down on the pitch and each player runs the distance in according to his % of his own MAS. This method is obviously much more accessible than using GPS units for reasons of cost and can also be used by practitioners having GPS units for those players whom are not motivated to give their upmost in SSG.

Intermittent runs do not have the same benefits that SSG do and the player does not get to practice with the ball, tactical movements and communication with team mates and hence such method may not be as beneficial especially for a practitioner working in an amateur, semi-professional setup in which player contact time and availability is limited. Thus, the importance of having a reliable method of measuring external and internal training loads is essential. Having a reliable measure of training loads the practitioner can make the best use of SSG and control more effectively caloric intake of players and avoid over training.

In 2015, Buchheit et al. analysed fourteen soccer players going through a 1minute bout of effort within a circuit having 30 seconds recovery time and repeated for another two times. The players had a portable gas analyzer and also a 4Hz GPS system within a vest using > 20 W/kg as threshold. When comparing the VO_2 responses the authors found that using GPS for measuring training load with metabolic power, the latter was 29 ± 10 % in load lower during exercise bouts. The authors concluded that using metabolic power alone has poor reliability for monitoring training loads. As a response Osgnach et al. (2016) issue a brief response highlighting the limitations of such study starting with the technology used such as the 4Hz GPS in which various literature has already shown how GPS units at 5-Hz, and below anything under 10Hz are not a reliable tool for measuring high-speed runs and change of directions (Johnston et al., 2014; Cummins et al., 2013; Jennings et al., 2010; Coutts & Duffield, 2010). Another similar study by Brown et al. (2016) using a 15Hz found that there was no significant differences between energy expenditure measured using GPG P_{met} and VO_2 readings thus reaffirming di Prampero's earlier findings. Other issues with the study is also the number of subjects used which is low for strong statistical power, also the validity of such study is put into question when having the subjects going through a drill with a portable gas analyser.

Gaudino et al. (2013) using 15Hz GPS units and collecting data from 26 players over 24 training sessions have found that there was a difference between methods when calculating training loads using high-speed running (> 14.4 km/hr) totals and high metabolic power (> 20 km/hr) totals. The difference also changed according to positional play such as the central defenders had an 85% variance between both methods were as attackers had 60% difference. Additionally, as the high-speed distance within the session increased the difference between methods decreased, thus showing that the difference of training loads is increased when calculating lower speeds or lower power intensities.

The purpose of this study was to build upon the work of Brown et al. (2016) and Gaudino et al. (2013) in which both confirm the validity of using GPS units to monitor training loads. With Gaudino et al. (2013) also finding a difference between the traditional method using speed-zones only and the metabolic power method. In the aforementioned study the metabolic power method resulted in a 6 % higher energy cost total when compared with the speed-only method, such findings are also supported by in a similar study by Osgnach et al. (2016) in which the metabolic power methods was 8 % higher when compared with the speed-running zone. Both Brown et al. (2016) and Gaudino et al. (2013) findings show that the greater the high-intensity quantity the greater the difference between methods is.

Different soccer training sessions have different levels of intensity and this depending on what the practitioner wants to get out of the session. Session themes could range from increasing aerobic endurance, improving tactics, working on improving top speed and change of direction or recovering from a match (Little & Williams, 2006; Bangsbo, 1998). Previous literature has shown a difference between methods of measuring training load and has related such difference to the high-intensity running amount in each session. To this present day no study has investigated into whether such difference in methods is noted when monitoring the entire training session. The effect of different training themes on the different methods of measuring training load has also been investigated. Such findings could help the practitioner be more aware of what session theme changes might have on the entire energy cost estimate and have better decisions on recovery periods, session performance and nutritional quantities.

Methods:

Participants.

The data was collected from 22 male soccer players (not including goalkeepers), competing in the Malta Premier League (height = 174.9 ± 5.5 cm; age = 25.1 ± 5 years; body mass = 73 ± 4 kg) from an aerobic endurance and speed strength themed sessions within the in-season period of the 2017-2018 league season (Hoff, & Helgerud, 2004). All participants signed a written informed consent detailing the aim of the study together with the risks involved before the data collection started. The study was approved by the St Mary's Ethics Board, which was performed in accordance with the ethical standards of the St Mary's health and safety guidelines.

Measurements.

The data was collected during an aerobic endurance themed session and a strength speed themed session using a portable global positioning system (GPS) from (GPEXE LT, Exelio srl, Udine, Italy). Velocity, acceleration and distance data was collected at 18Hz (18 samples per second). The GPS units were turned on 15 minutes prior the training session for satellite signal as this has been the time advised in previous literature (Vickery et al., 2014; Waldron et al., 2011; Duffield et al., 2010). Session data collected with 7 or less satellite signals have been removed in accordance with GPS validity literature (Varley, Fairweather, & Aughey, 2012). The duration (s), distance covered (m) and distance covered (m) in high-speed running

(>14.4km/hr) and high-metabolic power (> 20 W/kg) were exported and calculated using an Excel spreadsheet from the raw data available from the device software GPEXE Bridge 2 (Exelio srl, Udine, Italy). The surface of the pitch used was a third-generation artificial turf in accordance of the FIFA Quality Programme.

Velocity and instantaneous power energy cost.

The methods used to calculate training loads for both sessions are in Table 1.

Insert Table 1 here.

Observation performance.

Session structure always followed the same structure: Dynamic warm up, ball drills, main activity, practice and cooling down. For the purpose of this study the main activity and practice parts of the session were the ones monitored. For the aerobic session the main activity involved a 5 vs. 5 match, with pitch dimensions being 40 metres by 60 metres, with maximum touches of three as a condition and all players had to be past half way line but one in order to score. The duration was of 4 minutes for 4 sets, with 2 minutes of rest in between sets. During the practice part of the session the players performed again a 5 vs. 5 match with the same dimensions, this time the players had no touch or scoring conditions. Duration depended on the main coach decision depending on quality of play. During the speed strength session the main activity involved 1 vs. 1 matches with pitch dimensions being 10 metres by 15 metres, scoring as many goals as possible in a 1.5 metre goal post within 20 seconds (Dellal et al., 2012). The rest ratio was that of work 1: 10 rest. A circuit with resisted runs stations, plyometric jumps and medicine ball throws followed the 1 vs 1 matches (Hoff, & Helgerud, 2004). For the practice part of the session the players played 3 vs. 3 matches without conditions having pitch dimensions of 25 metre by 30 metre and duration of 1 minute by 6 sets with 1.5 minutes rest and having the entire set repeated twice (Stewart & Turner, 2016). The work rest ratio chosen to also be in line with match demands (Reilly, 1997).

Statistical analysis.

The means and standard deviations of load from both methods will be presented. A Shapiro-Wilk test will first be conducted to assess the distribution of the data and determine whether it is distributed normally or not. An independent samples t-test will be used to compare the means for the two independent groups. Statistical analysis was performed using Statistical Package for the Social Science (version 18.0 SPSS Inc, Chicago, IL.) Statistical significance was set at $p < 0.05$.

Results:

The training load difference between the two methods.

The Shapiro-Wilk test for normality and homogeneity of variance resulted to be normally distributed, p = 389 hence the data was treated as parametric. Table 2 displays the training loads of the sessions. Using method 1 and method 2 for the aerobic session resulted in a training load of 1242.5 ± 289.5 kJ and 1303.4 ± 332.0 kJ respectively (mean ± SD). The difference between the two methods for the aerobic session was that method 2 using average power had 4.9% higher estimation of energy cost when compared to method 1. Despite the difference in training load this was not statistically significant, t = 0.438, df = 42, p = 0.512. Using method 1 and method 2 for the speed strength session resulted in a training load of 1268.3 ± 43.6 kJ and 1291.2 ± 45.4 kJ respectively (mean ± SD). The difference between the two methods for the speed strength session was that method 2 also had 1.8% higher estimation of energy cost when compared to method 1. The difference in training load was once again not statistically significant, t = 0.316, df = 42, p = 0.577. The difference between the methods was higher when calculating the aerobic endurance session at 4.9% when compared to the difference in training loads using both methods for the strength speed session which was 3.1% less at 1.8%.

Insert Table 2 here.

Training demands: total high-speed running distance vs. total high-instantaneous power.

Table 3 details the activity of high-speed running (> 14.5 km/hr; HSR) and high-power activity (> 20 W/kg; HP) throughout the aerobic endurance and speed strength themed sessions. In the aerobic endurance session 508.9 m more were covered within the HSR zone when compared to the speed strength themed session, 1092.6 ± 732.6 m vs. 583.7 ± 211.7 m, respectively (mean ± SD). The aerobic session also had 411.3 m more covered in the HP zone when compared to the speed strength themed session, 1202.2 ± 548.8 m vs. 790.9 ± 239.1 m, respectively (mean ± SD). The 508.9 m distance difference between the aerobic endurance session and the speed strength session was statistically significant $t = 0.090$, $df = 42$, $p = 0.002$.

Insert Table 3 here.

Training demands: total high-speed running distance vs. total high-instantaneous power relative to playing position.

Table 4 and 5 outline the duration and distances covered at HSR and HP activities relative to the playing position of the aerobic endurance and speed strength themed sessions respectively. In the aerobic endurance session wide midfield position players had the highest distance ran within the HSR zone, this was also the case for the speed strength session, 1466.1 ± 739.4 m and 679.0 ± 265.1 m, respectively (mean ± SD). For the HP activity again, the wide midfield players performed the highest distance within this range for both the aerobic endurance and speed strength session, 1499.7 ± 575.6 m and 896.1 ± 272.9 m, respectively (mean ± SD).

Insert Table 4 here.

Insert Table 5 here.

Figure 1 is comparing the amount of metres covered in high speed running (HSR) > 14 km/hr. During the aerobic endurance session the amount covered in HSR was of 1092.6 ± 732.6 m and during the speed strength session the distance covered in HSR was that of 583.7 ± 211.7 m (Means ± SD).

Insert Figure 1 here.

Figure 2 contains the amount of metres covered in high power activity (HI) > 20 W/kg. During the aerobic endurance session the amount covered in HI was of 1202.2 ± 548.2 m and during the speed strength session the distance covered in HI was that of 790.9 ± 239.1 m (Means ± SD).

Insert Figure 2 here.

Discussion:

As there is no gold standard method on how to calculate training loads, there have been various attempts of measuring external training load in team sports and this is because of the many variables such as change of directions within this type of sport (Lambert & Borresen, 2010; Casaminchana et al., 2013). Therefore, this study has looked into whether there was any effect on two different methods outcomes of measuring external load when monitoring two different training sessions with different themes, one aerobic endurance and another speed strength theme. Traditionally training load has been measured using running speeds alone, using various speed zones (Cummins et al., 2013). Other methods for measuring training load and intensity such as heart rate monitors have been not as supported due to practical and accuracy reasons (Lambert & Borresen, 2010). Using methods such as the RPE Borg scale, which is another method of measuring exerted Casamichana et al. (2013) finding that the RPE Borg scale has a strong correlation with speed zone methods, confirming its validity. With GPS technology becoming more reliable from initial units being only 4Hz to now having 15Hz to 20Hz, more practitioners are inclined towards using such technology to measure training loads (Aughey, 2011).

Osgnach et al. (2010) argue that since the traditional method of measuring training loads uses speed zones only, the acceleration efforts are being underestimated because such efforts are not performed in high speed zones. The aforementioned authors using the earlier works on running energetics of Di Prampero et al. (2005) came up with a formula to include acceleration efforts using metabolic power by using the energy cost of running uphill at constant speed for accelerating in soccer. The metabolic power method used by Osgnach et al. (2010) has been criticized by Buchheit et al. (2015) of not having enough validity to measure training loads due to the underestimation of effort when compared to VO_2 readings. The argument brought forward by Buchheit et al. (2015) is that their study is more soccer related due to having the subject running with a ball throughout most of the drill performed. Considering soccer players run with the ball for 191 ± 38 m from the entire 11 km ± 450 m distance covered during a match in the top flight French football, one can question the validity of such argument.

Having the accurate amount of energy costs of training sessions and exercises is essential for the practitioner as this could reduce injuries from over-training and also better prescription of nutritional intake (Reilly & Thomas, 1979). The present study looked into how the difference between aerobic endurance and speed strength themed sessions can be affected when using two methods of measuring training loads. Aerobic endurance and speed strength sessions have been chosen for the study due to their different nature of running and use of energy systems (Stewart & Turner, 2016; Hoff, & Helgerud, 2004). Also, when comparing the aerobic endurance themed session with a reduced rest to work ratio as to compared to the speed strength session having a higher rest to work ratio the distance covered in high-intensity work was expected to be higher in the aerobic endurance themed session as this session had less rest. In this study the findings show that 1202.2 ± 548.2 m and 790.9 ± 239.1 m of distance covered was in high-intensity power for the aerobic endurance session and the speed strength session respectively (Means ± SD).

In the present study metabolic power method for both the aerobic endurance and speed strength session had 4.9% to 1.8% higher energy cost calculation as opposed to when using the speed-zone only method to measure energy cost for both sessions. Although in both cases there was an increase in energy cost when using the metabolic power method, both differences were not significant. The study by Gaudino et al. (2013) has investigated the same two methods used in this study, the traditional approach of measuring training loads using the running speed zones alone within a session to calculate energy cost whereas the other method uses the average metabolic power to calculate energy cost using the findings of Osgnach et al. (2016) and Di Prampero et al. (2005).

The decision to measure the training load of the entire training session was due to the fact that each session was entirely themed aerobic endurance or speed strength. In the present study the high-speed running in the aerobic endurance themed session was 508.9 m more than that in the speed strength session 1092.6 ± 732.6 m and 583.7 ± 211.7 m respectively (Means ± SD). The explanation for such difference is that as argued by Osgnach et al. (2016) accelerations go undetected when using the traditional speed zones system. The speed strength session was composed of 1 vs. 1 and 3 vs. 3 matches with pitch dimensions of 10 m by 15 m and 25 m by 30 m respectively whereas the aerobic endurance session was composed of 5 vs. 5 matches with 40 m by 60 m as pitch dimensions. Various literature confirms how maximal top speed running can be reached post 30 – 40 m of all out running, in which was only possible within the aerobic session (Tønnessen et al., 2011; Little & Williams, 2003; Margaria, Aghemo, & Rovelli, 1966). Thus, the findings of this study by having higher distance covered at high-speed running within the aerobic session than the anaerobic session are in line with previous literature. The mean training load for this study was 1.8 % higher for the anaerobic endurance session when measured using average metabolic power as to when measured using the traditional speed zone only method 1291.2 ± 45.4 kJ and 1268.3 ± 43.6 kJ respectively (Means ± SD). Although the difference found when comparing the traditional speed zone only and average metabolic power in the aerobic endurance and speed strength sessions 4.9 and 1.8 % respectively, the findings were not statistically significant.

The results show a positive trend in line with previous literature having a difference in both sessions when using the speed zone only method against the method using metabolic power, a 4.9 and 1.8 % between methods for the aerobic endurance and speed strength session respectively (Brown et al., 2016; Gaudino et al., 2013). This study was limited to using information from 22 subjects for the following reasons: player availability, injuries (n 5), not enough satellites connected when data was collected (n 4). For method comparison studies the subject number is suggested to be at least that of 40 for acceptable precision of error in estimates (Atkinson et al., 2005). This study was also a homogeneity study as the data collected was from only one squad, therefore the findings cannot be taken into assumption for the rest of the population.

Conclusion:

In conclusion, as better GPS technology is introduced to the market practitioners can have more precise data at hand. As this study has not put forward that the difference of using the speed zone only method over different themed training sessions is not statistically significant, in this case both methods are suggested to be used by the practitioners of this squad for better training planning, prevention of injury and better estimates of nutritional needs.

Acknowledgments: (For Science Medicine Football, this has to be in a separate covering later).

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Figures and Tables

Table 1

The two methods of calculations to compare training load.

Method 1: Training load measured using average speed.	Load = Cost of energy 4.6 J/m/kg * average velocity (m/s) * Duration (s)
Method 2: Training load using average power via instantaneous energy cost (Pmet).	MP = Cost of energy (average instantaneous) (J/m/kg) * average velocity (m/s) Load = Metabolic Power * Duration (s)

Table 2

Training load calculation method 1 and method 2 and % difference across one training session (means ± SD).

	Aerobic endurance session	**Speed strength session**
Method 1 (kJ)	1242.5 ± 289.5	1268.3 ± 43.6
Method 2 (kJ)	1303.4 ± 332.0	1291.2 ± 45.4
Difference between method 1 and 2 (%)	4.9	1.8

Note. * Statistically significant at $p < 0.05$.

Table 3

Sessions duration and distance covered at high-speed running and high-power (mean ± SD).

	Aerobic endurance session	**Speed strength session**
Total Distance (m):	4626.0 ± 601.1	4667.6 ± 974.3*
Session Duration (s):	3600	3600
Distance of high-speed running (> 14.4km/hr) (m):	1092.6 ± 732.6	583.7 ± 211.7*
Duration of high-speed running (> 14.4km/hr) (s):	221.0 ± 159.1	113.1 ± 41.5
Distance of high-power (> 20 W/kg) (m):	1202.2 ± 548.8	790.9 ± 239.1*
Duration of high-power (> 20 W/kg) (s):	281.9 ± 116.3	208.2 ± 58.3

Note. * Statistically significant at $p < 0.05$.

Table 4

Aerobic session duration and distance covered at high-speed and high-power in relation to playing position (mean ± SD).

	Main defender	Full back defender	Main midfielder	Winger midfielder	Forward
Distance (m)	4891.0 ± 423.7	4340.4 ± 916.5	4094.3 ± 509.9	4858.5 ± 570.3	4706.6 ± 463.1
High-speed running (> 14.4 km/hr) (m)	1197.8 ± 653.3	1006.6 ± 1047.4	408.3 ± 189.6	1466.1 ± 739.4*	1155.5 ± 705.8
High-power (> 20 W/kg) (m)	1265.0 ± 418	1280.4 ± 730.7	586.0 ± 224.0	1499.7 ± 575.6*	1207.6 ± 527.6

Note. * Statistically significant at $p < 0.05$.

Table 5

Anaerobic session duration and distance covered at high-speed and high-power in relation to playing position (mean ± SD).

	Central defender	Wide defender	Central midfielder	Wide midfielder	Attacker
Distance (m)	4230.8 ± 1324.8	4865.7 ± 880.6	4754.3 ± 1605.9	4732.7 ± 679.0	4812.4 ± 365.9
High-speed running (>14.4 km/hr) (m)	591.0 ± 114.9	591.5 ± 167.8	658.8 ± 423.1	679.0 ± 265.1*	471.4 ± 145.2
High-power (> 20 W/kg) (m)	738.0 ± 122.0	805.2 ± 249.4	891.8 ± 501.6	896.1 ± 272.9*	704.8 ± 137.1

Note. * Statistically significant at $p < 0.05$.

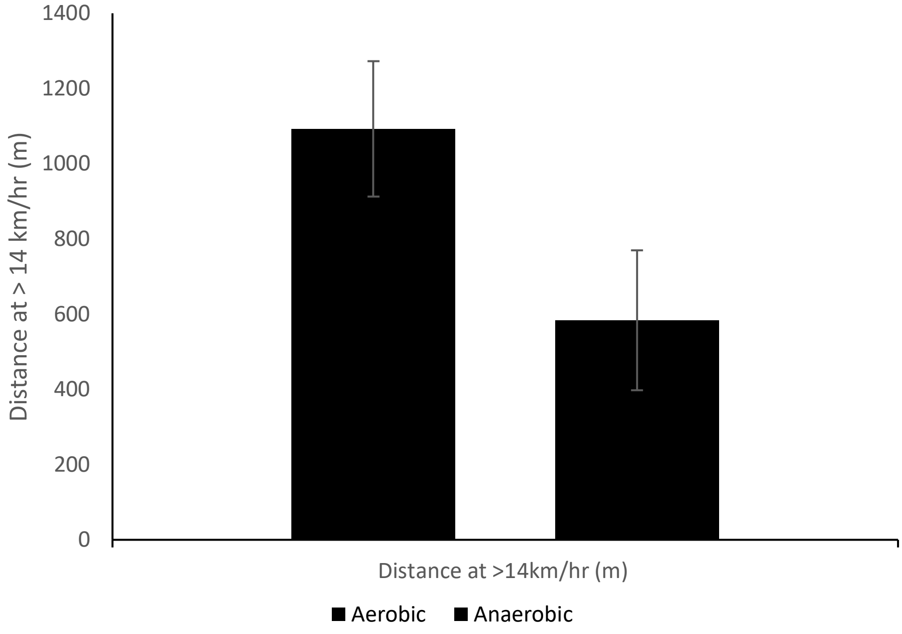

Figure 1. *Mean and ± SD of distance covered at >14 km/hr (m) in aerobic and anaerobic sessions*

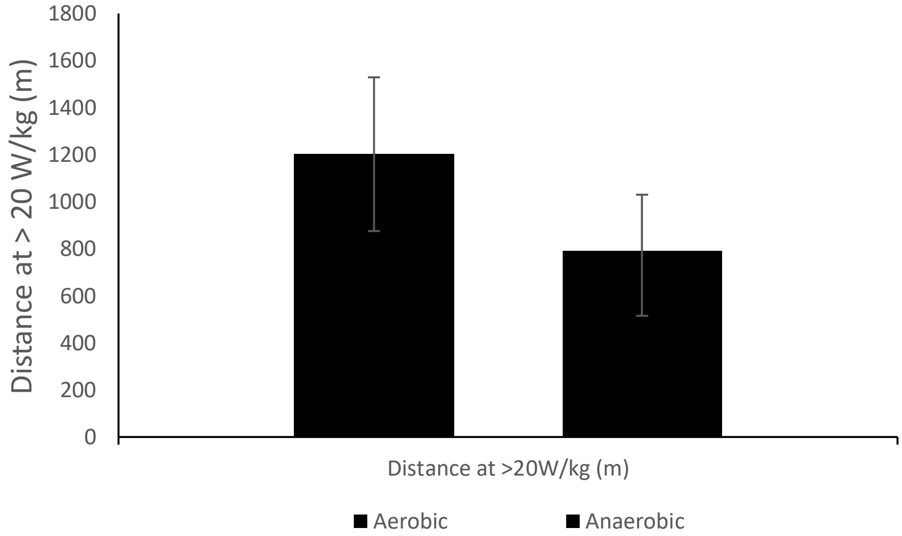

Figure 2. Mean and ± SD of distance covered at > 20 W/kg (m) in aerobic and anaerobic sessions.