Relationship between Match Running Performance and Physical Capacity in Malaysia Young Soccer Players

Original Scientific Paper

Health and Fitness

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Abstract

Monitoring players during match play has become a fundamental approach to gain understanding on soccer demands. Considering there has been growing interest in performances of young players, it is important to understand on young players training requirement. PURPOSE: Therefore, the aim of this study was to examine the relationship between match running performance and physical capacities in U15 young soccer players. METHODS: Twenty outfield players from sports school and academy (n = 20, 1.63 ± 0.8 m, and 56.1 ± 9.5 kg) volunteered to participate in the study. Match running performance was analysed during two matches for each player using 5 Hz global positioning system. The participants performed the Yo-Yo Intermittent Recovery Level 1 (YYIR1), Countermovement Jump (CMJ) and 20 m Sprint to determine the physical capacities. RESULTS: The results showed there were no significant relationship between; total distance covered and YY1R1, sprint distance and leg power, maximum sprint speed during matches ($km.h^{-1}$) with 20 m sprint ($P > 0.05$). CONCLUSION: These results suggest that physical capacity test should not be used as a single factor in recognizing a young player's potential to excel and to predict soccer performance. Young players may not need extraordinary capacity; however, they must possess a reasonably high level within all areas to be a good player.

Keyword: GPS, football, adolescents, motion analysis, fitness

Introduction

The overwhelming popularity of soccer has generated more attention on young soccer players compared with other youth team sports (Atan & Kassim, 2020). In recent years, millions of young soccer players have enrolled within development programs of soccer clubs (Goto & Saward, 2020). Various developmental programs can be found in many countries, some being quite extensive, with the number of clubs increasing and beginning to invest in the recruitment of young football players to facilitate their own team development (Wrigley, Drust, Stratton, Atkinson, & Gregson, 2014). There are several factors that have encouraged coaches and parents to invest in soccer development programs; general popularity, competitiveness and future career prospects are the most common (Atan & Kassim, 2019). Consequently, participation amongst young players is booming globally. Breaking down the numbers, 22 million players are recognised as youth players where 18.7 million are male players and 2.9 million are female players (Atan & Kassim, 2019).

Today, match analysis has become a predominant tool to gain substantial information on players' performance. It could provide information on the physiological and physical demands through noting the distance covered, time spent in each match activity, differences seen between the first and second half's or physical capacities irrespective of playing positions and fluctuations in exercise intensity (Atan, Foskett, & Ali, 2016). The general consensus is that adult soccer players with moderate ability cover distances between 8 to 12 km while elite players have been reported to cover between 9 to 14 km (Atan & Kassim, 2019). Previous studies have discussed the relationship between physical capacity and soccer match performances involving adults. These have shown relatively good correlations between aerobic capacity and distance covered, competitive ranking, quality of play, ability to maintain high intensity activity, number of touches of the ball in the match, maintaining physical condition at an optimum level during a match and ways to accelerate recovery processes (Aquino et al., 2020; Bradley et al., 2013; Slimani, Bragazzi, & Miarka, 2018).

Surprisingly, only a small number of studies have examined children and adolescents on match performance and physical capacity (Bellistri, Marzorati, Sodero, & Sforza, 2017; Impellizzeri et al., 2008). It is important to highlight these young soccer players possess unique characteristics and will undergo several challenges as they passage through distinct phases of physical growth and development (Atan & Kassim 2019; Hannon 2020). It is evident that the term 'youth' is a transition period between childhood and adulthood age, also known as a stage of development characterised by physiological changes in the substrate utilization, aerobic and anaerobic capacity, musculoskeletal, cardiorespiratory and thermoregulatory systems of the body (Atan and Kassim 2019). Therefore, the abilities and characteristics in comparison to adults are very different.

An understanding of the different adaptations during these different growth stages will help coaches or trainers to tailor age specific training that will aid in the optimal performance of these young players (Atan, & Kassim, 2020; Atan, Foskett, & Ali, 2016). Laboratory and field test have been widely used to examine young players especially during talent identification process as predictors of performance that predispose promising players to selection into elite soccer development programmes (Carling, Gall, & Malina, 2011). This information's used to identify individual profiles of their respective strengths and weaknesses. Limited studies have conducted the relationship between match performance and physical capacity in young players especially in Asia Region. Therefore, the aim of this study was to examine the relationship between running match performance with Yo-Yo intermittent Recovery Test Level 1 (YYIR1), Countermovement Jump (CMJ) and 20 m sprint in U15 age-group soccer players.

Methods

Participants

Twenty young soccer players (n=20, Height: 1.57 ± 0.8 m and body mass 57.1 ± 4.5 kg) volunteered to participate. All participants were aged 15 years old based upon their chronological age. The sample size and the statistical power was calculated using the GPower software (Prajapati, Dunne, & Armstrong, 2010). With an alpha = .05 and power = 0.80, GPower displays a proposed sample size of n = 20 to detect this level of effect size (ES = 0.5). This will be adequate for the main objective of this study. The inclusion criteria were outfield players only, currently active in soccer training and competitive in local and international tournament, free from injury and healthy. All participants provided assent and their parents gave their written informed consent. The study was approved by the local institutional ethics committee.

Procedures

Data were collected during the competitive season and took place on natural grass pitches. Anthropometric measurements (height and weight) and field tests were performed on separate occasions to match analysis. Testing took place in the week before the match analysis was conducted and replaced the normal team training sessions. The tests include YYIR1, CMJ and 20 m Sprint. The participants were familiarised with the procedures and wearing running vest for GPS before the testing.

Testing

After a 10 min warm up, the participants performed the testing to measure their physical capacity. To measure the aerobic fitness, the participants performed the YYIR1. In YYIR1, participants repeated 2 x 20-m shuttle runs back and forth between the start and finish line at progressively increasing speed, controlled by audio bleeps from a MP3 player. The test was terminated when the participants failed to reach the starting line twice or unable to complete another shuttle at the dictated speed (Krustrup et al., 2003). Then, participants performed a CMJ using a timing mat (Just Jump System, 7610, Perform Better, USA) to measure the leg power. Participants stood on a mat in an upright standing position and squats down to the 90-degree leg bend position before immediately jumping vertically (see appendix). Jump height is measured which calculates flight height. Highest of all three jumps performed were recorded as maximum jump height. For speed, 20-m Sprint was administered, all participants completed three 20-m maximal sprints. Participants were fitted with the 5-Hz GPS (GPSports) units allowing a maximum sprint speed to be obtained for each individual.

Match Analysis

Each player was analyzed during four competitive matches. Before each game, participants donned the GPS units between their shoulder blades in a custom-made tight-fitting vest. All data were downloaded into the manufacturer's proprietary software (Team AMS; GPSports Systems). This software permits the quantification of total distance (TD) covered, frequency, duration, and distance in each match activity. The TD covered during the match was calculated as the sum of the distance covered during each type of activity. Match speed threshold were set based on Atan, Foskett and Ali (2016) and categorised into Standing, Walking, Low Intensity Running (LIR), Medium Intensity Running (MIR), High Intensity Running (HIR) and Sprinting All games were played in agreement with the rules outlined by the Fédération Internationale de Football Association (FIFA). The participants played 11-a-side games, on a full-sized pitch (60 x 100 m), in a 2 x 40-minute match.

Statistical Analyses

Results are presented as mean ± SD. The assumptions and normality of the data were verified by the Shapiro-Wilks test. Relationship between physical capacity and match running performance was measured by using The Pearson's correlation coefficients (*r*). The magnitude for correlation coefficients were set between 0 and 1, where 1: perfect reliability, ≥ 0.9: excellent reliability, ≥ 0.8 < 0.9: good reliability, ≥ 0.7 < 0.8: acceptable reliability, ≥ 0.6 < 0.7: questionable reliability, ≥ 0.5 < 0.6: poor reliability, < 0.5: unacceptable reliability and 0: no reliability. All statistical analyses were performed with SPSS software (version 21.0; SPSS, Inc., Chicago, IL, USA) with the level of significance set at $p < 0.05$.

Results

Physical Capacities

The mean YYIR1 distance covered by participants was 1,376 ± 308 m with the average speed level being 16.8 ± 0.9. The participants estimated maximum oxygen uptake value ($\dot{V}O_{2max}$) from the YYIR1 was 47.9 ± 2.59 (ml.kg.min^{-1}) (VO_{2max} = distance in meter x 0.0084 + 36.4, from Bangsbo, Iaia, and Krustrup 2008). For the CMJ, the results showed the participants leg power was 46.0 ± 5.2 cm and maximum speed recorded was 25.6 ± 1.93 km.h^{-1}.

Total Distance in Absolute Value (m)

Figure 1 shows distance covered for each age group in terms of absolute values. The mean playing time for the participants was 69.6 ± 12 min with the minimum time exposure being 40 min. The TD covered in absolute values was 6,981.8 ± 1,333 m with the most distance covered in MIR being 2,280.3 ± 795.1 and in LIR, 2,146.6 ± 502.4m followed by walking, 1,659.0 ± 349. 3 m. Less distance was covered in HIR, i.e. 574.0 ± 157.9 m and sprinting, 318.0 ± 134.3 and inactivity or standing was 5.0 ± 1.5 m. The average sprint distance was 16.6 ± 2.9 m and they performed about 18.9 ± 5.8 average number of sprints (NOS). It was observed that the NOS performed during the first half of the game was 10.5 ± 4.1 compared to the second half of the game where it was 8.9 ± 3.6. The match HR_{max} data recorded was 204.6 ± 11.2 bpm.

Match Running Performance and YYIR1

There is a weak relationship though not statistically significant between TD in YYIR1 with TD during match play (r = .115, n = 20, P = .640), LIR (r = .088, n = 20, P = .721), MIR (r = .076, n = 20, P = .758) and HIR (r = .216, n = 20, P = 0.375). There was a negative correlation with sprinting (r = -.135, n = 20, P = 0.581) (see Figure 2). Overall, the p value was greater than the significance level (α =0.05). As such, it can be concluded that there was no significant linear correlation between TD in YYIR1 and TD in match activities. There was no correlation between the sprint distance in match and leg power (r = -.383, n =20, P = 096) and maximum sprint speed in match to 20-m sprint (r = .161, n =20, P = .499).

Discussion

The aim of this study was to examine the relationship between physical match performance with YYIR1, CMJ and 20 m sprint in U15 age-group soccer players. The main findings from this study is there is no relationships found between the physical capacity and match running performance.

The commonest reported for match analysis is the TD covered. The data reported in this present study showed that the research participants covered about 6.9 km, indicating fairly similar distances to the absolute values of the TD that has reported as having been covered by other U15 players in different parts of the world. For instance, in Brazil, U15 soccer who played in the Sao Paulo First Division League covered about 6.9 km (Aquino et.al. 2018), English Premier League Academy players covered about 6.0 - 6.7 km (Goto, Morris, & Nevill, 2015; Harley et al. 2010) and in English Clubs, they covered 6.9 km (Abt & Lovell, 2009). Meanwhile in the Portuguese Football League, players covered about 6.3 km and in the New Zealand, Auckland Football Federation Metropolitan League, players covered about 6.6 km (Atan, Foskett & Ali 2016; Rebelo et al. 2012). Nevertheless, it was typical to see variations in playing time in youth soccer matches due to the use of the rolling substitution policy (Atan, Foskett & Ali 2016; Harley et al. 2010; Lovell et al. 2009). Therefore, it is recommended to use the relative TD ($m.min^{-1}$) to make comparisons between studies without bias.

Previous studies have investigated the relationship between match running performance and physical capacities. The most prominent one is the relationship between VO_{2max} value and TD on the soccer match play. It is known that VO_{2max} is a very important variable of the match performance among soccer players because the vast majority of a game is performed utilising aerobic metabolism. There is some evidence regarding the benefits of the relationship between aerobic capacity and performance in young athletes. One study found a significant correlation between improvement in aerobic capacity and passing ability in young soccer players (n = 26, Height 1.78 ± 5 m, weight 74.5 ± 6.9 kg) (Impellizzeri et al., 2008). Similarly, the findings from the study by Sawczyn et al. (2018) on artistic gymnastic athletes (Age 16.1 ± 0.4 years, Height 1.68 ± 1.5 m, Weight 61 ± 1.1 kg) indicated that the greater the aerobic capacity among these athletes, the less likely the development of coordination fatigue. This finding can be attributed to lower cerebral hypoxia and less central fatigue when performing a gymnastics routine. Moreover, Tota et al. (2015) reported that running economy also improved with an improvement in VO_{2max} in thirty-five (n=35, 15 to 17 yrs. old) track middle and long-distance runners. In contrast, a small correlation was reported between the TD of running in match-play with incremental testing and YYIR1 (r= 0.41). A similar trend was also observed where there was no significant correlation with the majority of field tests and match performance (e.g., zig-zag test, sprint test) (Aquino et al., 2018). In this present study, we found a similar result where there was a weak relationship between YYIR1 with TD covered and distance in each match running intensities.

Taking into account, coaches or sports practitioners should adopt an appropriate training plan that would adequately stress the cardiorespiratory system in soccer players to induce adaptation, with due respect to the players age, competitive level and period in the season. Even though the aerobic capacity in young players is lower than that of adults, it will increase significantly with the advancement of age and/or towards the end of the physical maturation stage (Slimani et al., 2018). Following physical maturation becomes more reliant on training effects. It has also been suggested that young players may not need to have an extraordinary capacity relative to adults within any of the areas of physical performances, but must possess a reasonably high level within all areas to be a good player (Reilly, Williams, Nevill, & Franks, 2010).

Furthermore, our findings found there was no correlation between the sprint distance in the match and leg power and maximum sprint speed in match to 20-m sprint. In contrast to adult’s studies, there was a significant correlation between peak speed during the field test to the high intensity activities and match running performance. In this study, they also highlight the anaerobic activity is also dependant to aerobic capacity (Rampinini et al., 2007). Therefore, it is suggested to use test a specific test battery that replicates the specific demands of soccer. Soccer is characterised by multiple explosive high intensity bursts of activity over a prolonged game duration. Considering that aerobic capacity is the prerequisite to anaerobic capacity performance, it has been suggested to use anaerobic testing procedures that replicates the specific demands in the intermittent nature of football, for instance using a soccer simulation protocol designed specifically for the young soccer players (Atan and Kassim 2020). Using a specific battery of tests has become very common in investigating athletes in different types of sports; ranging from combat to team sports (Brito et al., 2017; Courel-Ibnez & Franchini, 2018; Mancha-Triguero, Garc, & Ant, 2020) but not when investigating their anaerobic capacity. More recently, Mancha-Triguero et al. (2020) used a Specific Battery Fitness Test (SBAFIT) for basketball that includes accelerations and shots to investigate the aerobic and anaerobic capacities in young basketball players. For that reason, a specific performance test that induces physical fatigue is highly recommended as a measure of the anaerobic capacity in football players.

In addition, anaerobic capacity seems to be less developed in youths compared to adults since anaerobic power in young players is 50%, therefore this may also explain the low correlation between the physical capacity and match performance. Even so, anaerobic capacity will progressively improve as their age advances for which the main contributor is their anthropometric maturation (Mancha-Triguero et al., 2020) and after peak height velocity is achieved (Malina, Eisenmann, Cumming, Ribeiro, & Aroso, 2004). In addition, even though young athletes work mainly in aerobic mode, but under the influence of training, their body can adapt to an anaerobic mode, which begins to accumulate larger amounts of glycogen to be used in high intensity activities and better able to tolerate higher lactate concentrations (Hadzhiev & Dzimbova, 2020).

This present finding contributes to understanding of a young soccer player's performances. Young players should not be considered as little adults and there are few factors that may contribute to soccer performances. Compared to adults, young players possess unique characteristics associated with their physiological growth and development (Hannon et al., 2020). The most prominent difference found is the wide spread of biological age and variations in the development stages (Hill, Scott, Mcgee, Cumming, & Hill, 2020). With regards to youth football match play formats, players are always categorised based on their chronological age and not based on their maturity levels (Atan, Foskett, & Ali, 2016; Ballesta, Ramon, & Cruz, 2015; Goto & Saward, 2020; Harley et al., 2010).

In conclusion, physical capacity test should not be used as a single factor in recognizing a young player's potential to excel and to predict soccer performance. Young players may not need extraordinary capacity; however, they must possess a reasonably high level within all areas to be a good player. Future studies could might address the differences capacity in positional, using a soccer specific testing that develops for young players to investigate their physical capacity and have a greater number of participants to investigate the young players.

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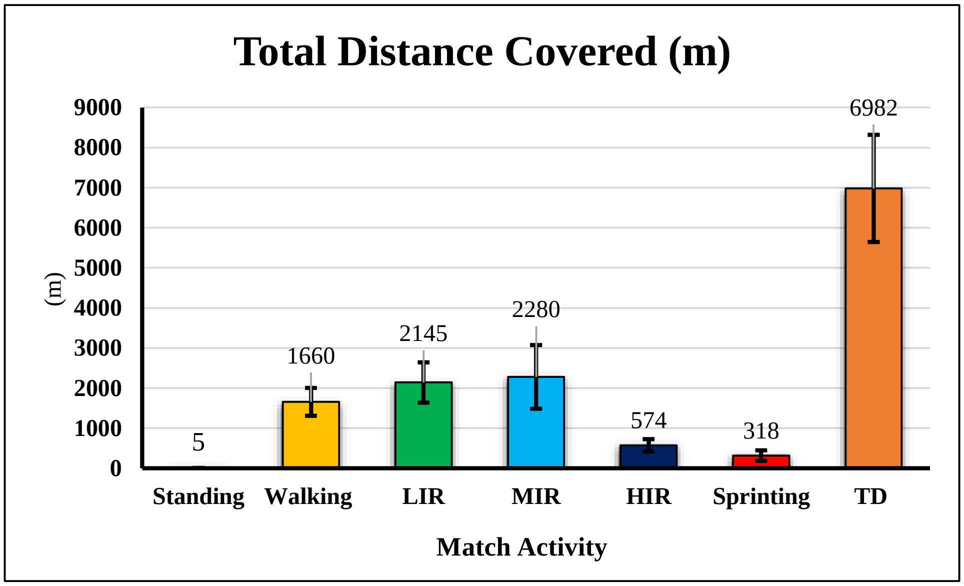
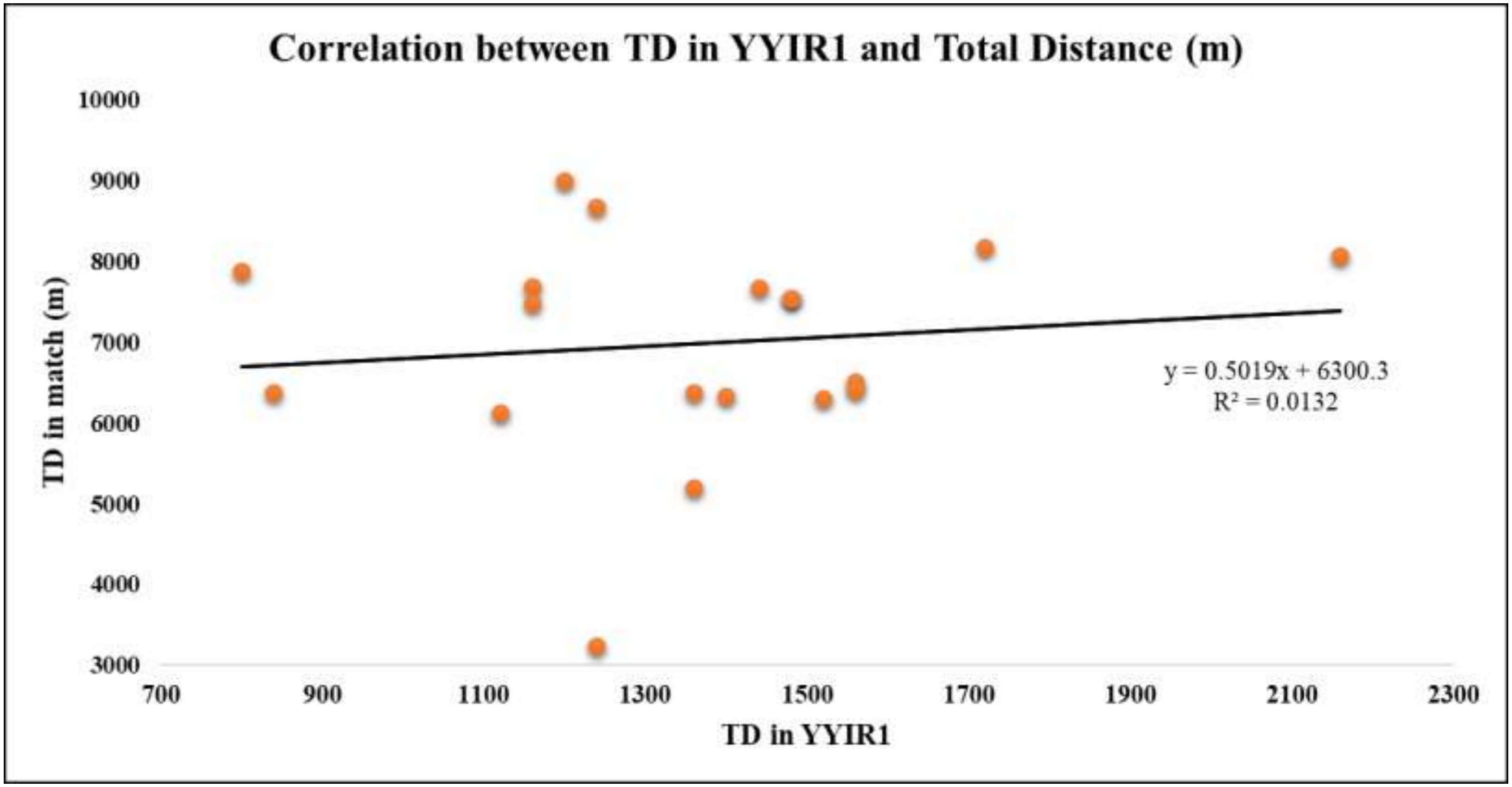
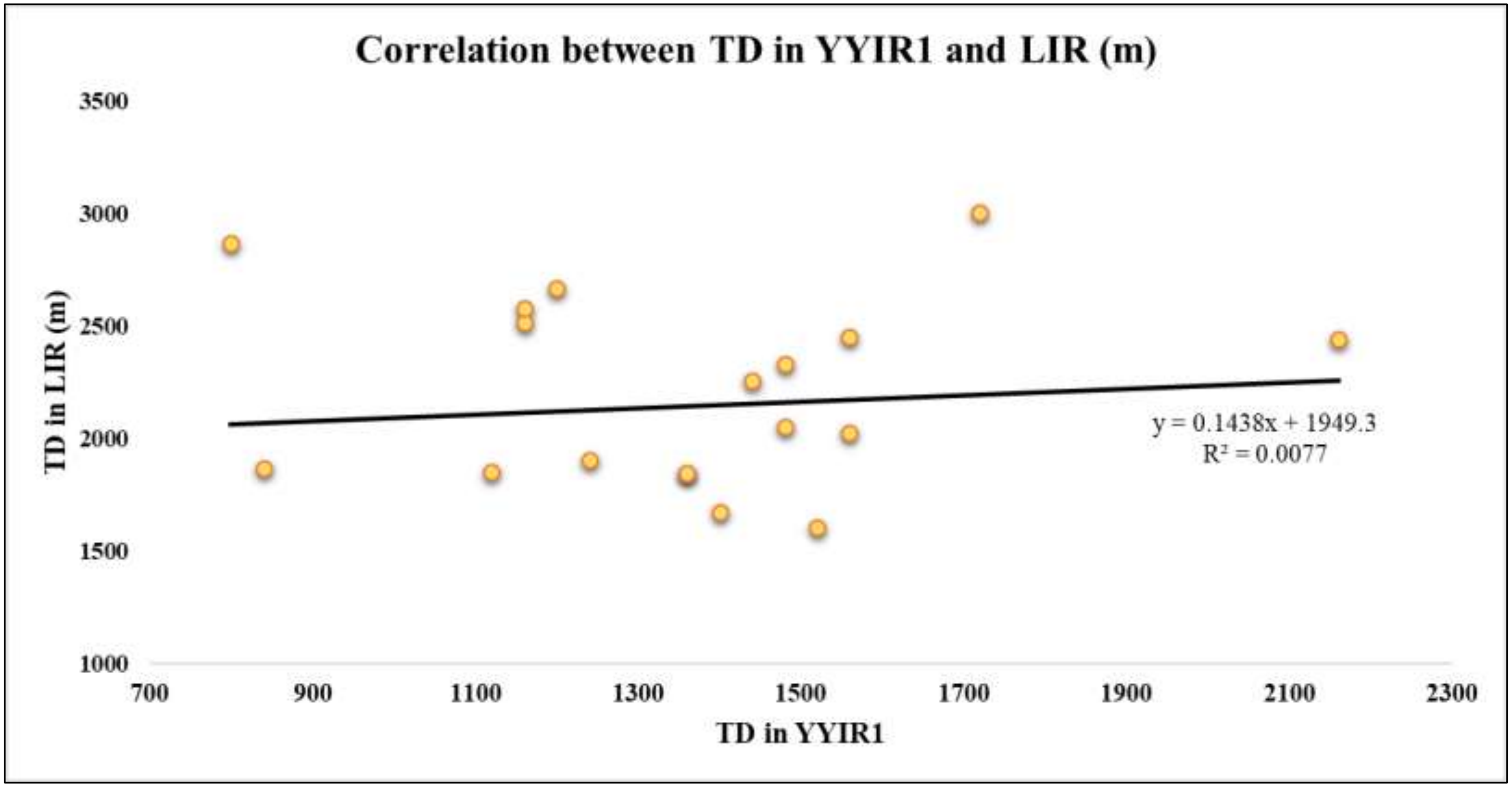
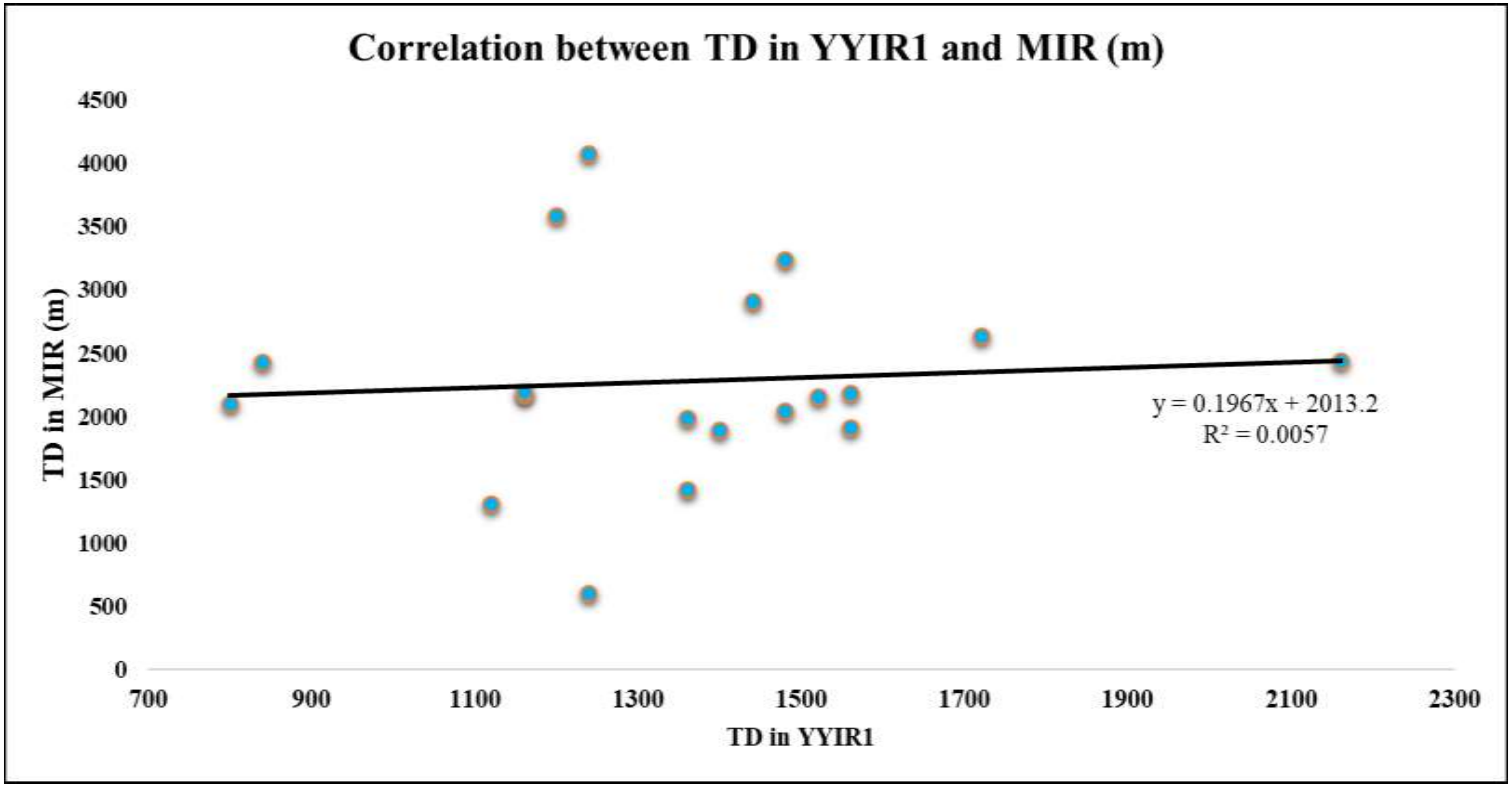
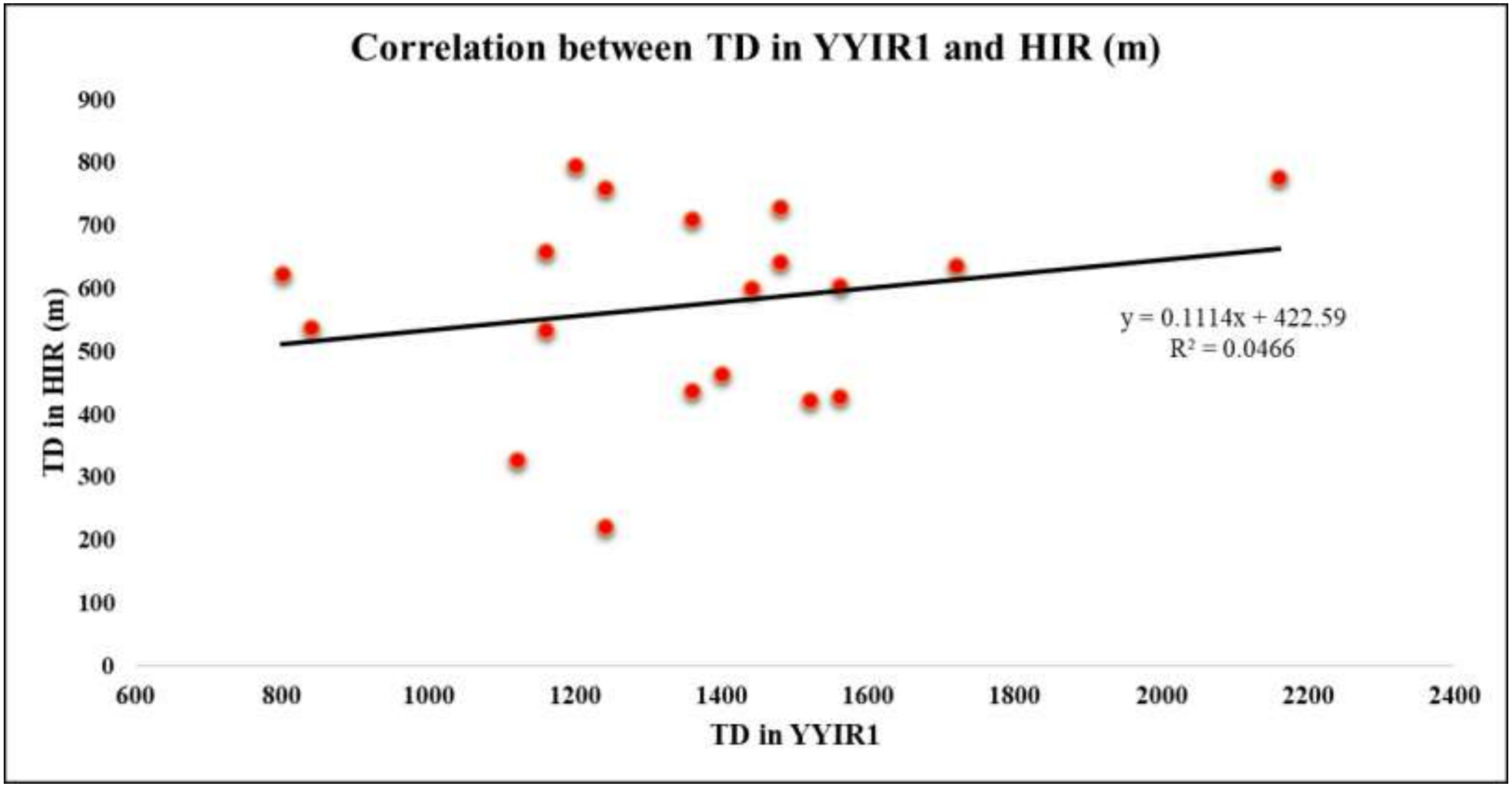


Figure 1 Mean (± SD) total distance covered in absolute values for each match activity in U15 soccer matches


Correlation between TD in YYIR1 and Total Distance (m)
TD in match (m)
10000
9000
8000
7000
6000
5000
4000
3000
700
900
1100
1300
1500
1700
1900
2100
2300
TD in YYIR1
y = 0.5019x + 6300.3
R² = 0.0132


Correlation between TD in YYIR1 and LIR (m)
3500
3000
2500
2000
1500
1000
TD in LIR (m)
700
900
1100
1300
1500
1700
1900
2100
2300
TD in YYIR1
y = 0.1438x + 1949.3
R² = 0.0077


Correlation between TD in YYIR1 and MIR (m)
TD in MIR (m)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
700
900
1100
1300
1500
1700
1900
2100
2300
TD in YYIR1
y = 0.1967x + 2013.2
R² = 0.0057


Correlation between TD in YYIR1 and HIR (m)
900
800
700
600
500
400
300
200
100
0
TD in HIR (m)
y = 0.1114x + 422.59
R² = 0.0466
600
800
1000
1200
1400
1600
1800
2000
2200
2400
TD in YYIR1

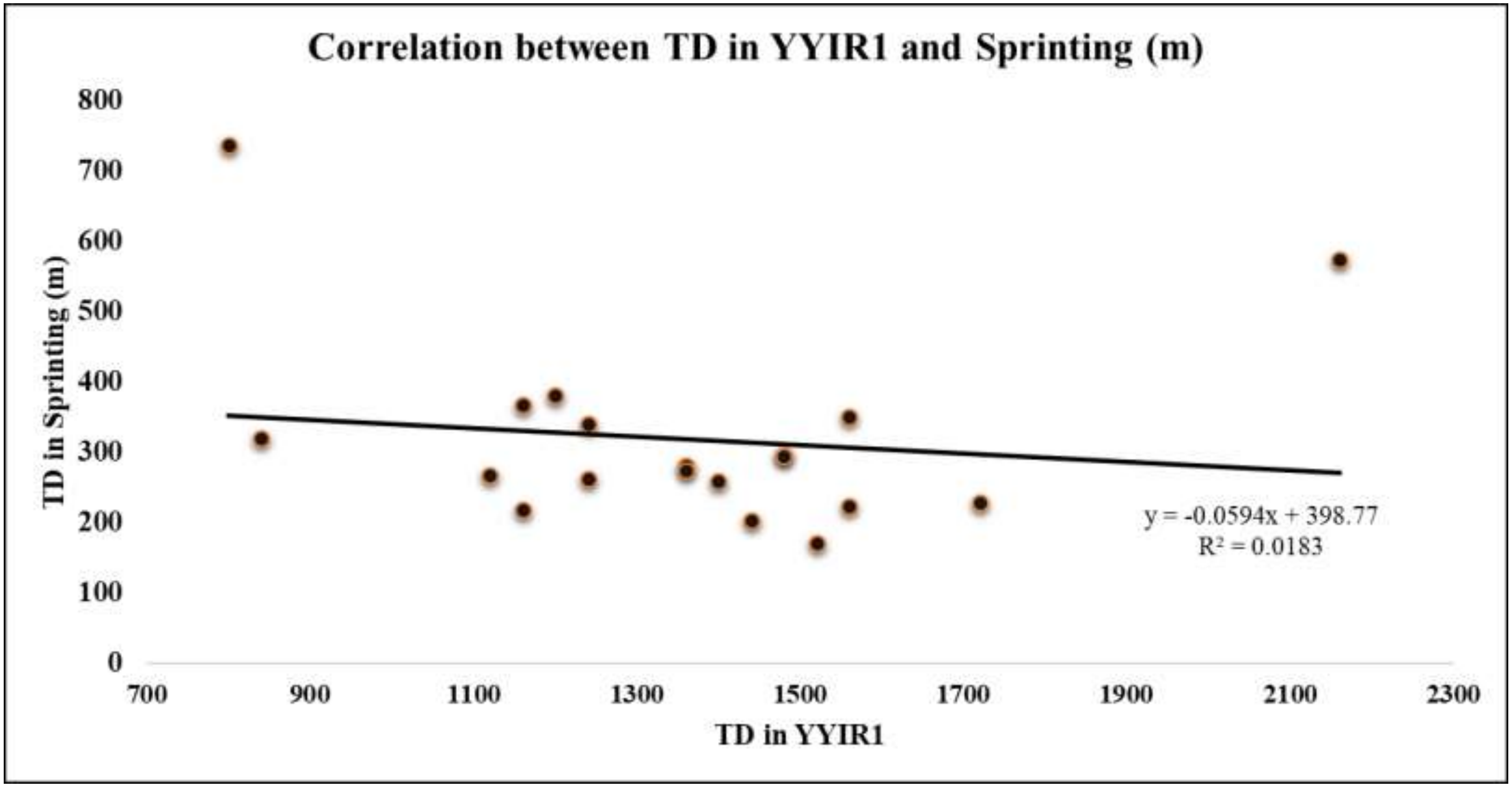


Figure 2 Correlation between total distance in YYIR1 and match activities in U15 match play