Repeated-Sprint Sequences During Youth Soccer Matches

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Abstract

This study examined the occurrence and nature of repeated-sprint sequences (RSS) in highly-trained young soccer players, as a function of age, playing position and playing time. Time-motion analyses using a global positioning system (GPS) were performed on 99 highly-trained young soccer (U13, U14, U15, U16, U17 and U18) players during 42 international games. Sprint activities were defined as at least a 1-s run at intensities higher than 61% of the individual peak running velocity; RSS, as a minimum of 2 consecutive sprints interspersed with a maximum of 60s. During the first half of games the younger teams had a greater number of RSS than the older teams ($P<0.001$): U13 > U14 > U16 > U15 > U18 > U17. The younger players also performed more (e.g., U14 vs. U17: 2.8 ± 0.3 vs. 2.6 ± 0.3, $P<0.05$) and longer (e.g., U14 vs. U17: 2.8 ± 0.5 vs. 2.6 ± 0.5 s, $P<0.05$) sprints per sequence than the older players. RSS occurrence was also affected by playing position and decreased throughout the game in most age-groups ($P<0.001$). Both the occurrence and the nature of RSS are affected by age, position and playing time. Present results also question the importance of repeated-sprint ability as a crucial physical component of soccer performance in developing players.

Introduction

Millions of young soccer players enroll every year in the development programs of professional soccer clubs all around the world [19]. In the multi-million dollar soccer industry, the financial benefits associated with the early identification and development of football talent appears obvious, with fierce competition among professional clubs to recruit talented young players. Accordingly, strategies to optimize the early development of young players' technical, tactical and physical skills are implemented in most professional soccer schools [39]. However, little information is available about the physiological demands of elite young soccer players during match play [8,12,22,43]. Understanding the physiological load imposed on soccer players according to age and position during competitive matches is necessary to develop appropriate long-term training interventions to realize a young player's potential.

In top-level adult soccer players, match analyses have demonstrated a requirement to repeatedly produce high-speed actions interspersed with brief recovery periods [4,5]. The ability to recover and reproduce performance in subsequent sprints, termed repeated-sprint ability (RSA), is therefore believed to be a specific fitness requirement of soccer and other team sport athletes [20,40]. In professional soccer players, significant correlations have been reported between distance covered during a match and mean sprint times in RSA test [33]. RSA has also been shown to discriminate professional from amateur players [2,25,36].

Surprisingly, despite the growing interest in RSA, the exact nature and occurrence of repeated-sprint sequences (RSS) during competitive soccer games is presently unknown. Actually, to date, the nature of RSA has only been described in adult field hockey players [41]. Since the extension of these findings to other team sports playing demands is questionable, time motion analyses during competitive soccer matches are needed to identify the specific RSS profile of players according to position and age. Knowledge about RSS during competitive games in developing soccer players is important to guide training and also assist talent identification/development.

Since it is believed that children are better able to reproduce maximal efforts compared with adults [38], it could be hypothesized that younger players would incur more RSS during competitive games than older players. Conversely, since match-related technical or tactical aspects are likely to play a major role in dictating player activities during a game, the profile of RSS in young players remains difficult to predict.

Since physical performance in relation to direct opponents is a critical determinant of success in soccer, speeds used to define game intensities have generally been based on absolute values [5,15,16,34]. In contrast, individualized thresholds based on objective physiological measures (e.g., the second ventilatory threshold [1] to define high-intensity activities) can account for individual capacities and present a more accurate way to examine movement patterns in players of differing physical abilities [18]. Therefore, the examination of (repeated-) sprint patterns during competitive games in highly-trained young soccer players differing in age, and thus performance levels [30,31], would also be improved with the use of individualized speed thresholds. The purpose of this study was therefore to examine the occurrence and nature of relative RSS during friendly international club matches in highly-trained young soccer players as a function of age, playing position and playing time.

Methods

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Participants

Time-motion match analysis data were collected on 99 young football players (14.5 ± 1.7 yrs) in Under 13 (U13, *n* = 13, 149 ± 6 cm and 38.2 ± 5.4 kg), Under 14 (U14, *n* = 20, 158 ± 7 cm and 43.8 ± 5.1 kg), Under 15 (U15, *n* = 16, 161 ± 7 cm and 48.9 ± 10.1 kg), Under 16 (U16, *n* = 17, 164 ± 8 cm and 51.1 ± 6.9 kg), Under 17 (U17, *n* = 16, 171 ± 6 cm and 57.5 ± 4.8 kg) and Under 18 (U18, *n* = 17, 171 ± 9 cm and 56.3 ± 7.5 kg) teams from the same elite soccer academy. All the players participated on average in ~14 h of combined soccer training and competitive play per week (6–8 soccer training sessions, 1 strength training session, 1–2 conditioning sessions, 1 domestic game per week and 2 friendly international club games every 3 weeks). Additionally all players had a minimum of 3 years of prior soccer-specific training.

Experimental procedures

Analyses were performed 1–9 times on each outfield player during a total of 42 friendly international club matches played over a period of 4 months. All matches were performed on 100 × 70 m standard outdoor natural grass fields with 11 players per side. Playing time was 2 × 35 min for U13 and U14, 2 × 40 min for U15, U16 and U17, and 2 × 45 min for U18. Written informed consent was obtained from the players and their parents. The study was performed in accordance with the ethical standards of the IJSM [21] and conformed to the recommendations of the Declaration of Helsinki.

Peak running velocity

Sprinting speed was individualized using each player's peak running velocity (PV). Because of the potentially confounding effect of growth on sprinting performance [31], PV values were reassessed at least once within the 4-month investigation period. PV was defined as the fastest 10-m split time measured during a maximal 40-m sprint using dual-beam electronic timing gates set at 10-m intervals (Swift Performance Equipment, Lismore, Australia). Split times were measured to the nearest 0.01 s. Players commenced each sprint from a standing start with their front foot 0.5 m behind the first timing gate and were instructed to sprint as fast as possible over the 40-m distance. The players started when ready, thus eliminating reaction time and completed 2 trials with the fastest 10-m split time used as the final result.

Activity pattern measurements

A global positioning system (GPS) unit capturing data at 1 Hz (SPI Elite, GPSports, Canberra, Australia) was fitted to the upper back of each player using an adjustable neoprene harness. Despite a possible underestimation of high-intensity running distance with the time-resolution of 1 Hz [37], good accuracy (r = 0.97) was reported for the assessment of short sprints and RSA for this GPS device compared to a infra-red timing system [3]. In the absence of a "gold standard" method, the current system has been reported to be capable of measuring individual movement patterns in soccer [37]. More importantly for this study design, the GPS device utilized has been reported to have good reliability (i.e., CV = 1.7 % [3] and < 5 % [14]).

Match analyses

In total, 635 player-matches were assessed. For between-team and between-position comparisons, time-motion data of all players who participated in the entire first half were used (*n* = 344 files). The use of the first half only was employed to increase sample size and therefore statistical power. As a consequence of the high substitution rate employed with younger players (especially U13 and U14), using data derived only from full-games would have excluded these age-groups from the between-position analyses (e.g., no centre back played a full game in U13). For within-team analysis (i.e., time effect), only data from players who participated in the full game were retained (*n* = 179 files). Tactically, all teams used a 4-4-1-1 formation, a variation of 4-4-2 with 1 of the strikers playing as a "second striker", slightly behind their partner. Since players' roles within the team structure changed little during the games analyzed, all players were assigned to 1 of 6 positional groups; Full Backs (FB, *n* = 72), Centre Backs (CB, *n* = 69), Midfielders (MD, *n* = 67), Wide Midfielders (W, *n* = 64), Second Strikers (2^{nd}S, *n* = 36) and Strikers (S, *n* = 36). All match data were analyzed with a custom-built Microsoft Excel program, which automatically divided the entire match into 6 time periods of equal duration. While analyses based on acceleration might also be of interest, we chose to focus on actual sprint speed to be consistent with the concept of repeated-sprint (i.e., actual maximal running speed) sequences, for which the reliability assessment has been examined with these GPS devices [3,14]. Sprint activities were defined as at least 1-s runs > 19 km.h^{-1} (absolute speed threshold, adapted from Castagna et al. [13] in young soccer players and from Impellizzeri et al. [24] as the mean running speed during < 2-s sprints), or > 61 % of individual PV (individualized threshold). This value is considered, in highly-trained team sport players, as the highest speed likely to be reached in a 1-s standing start sprint [18]. Pilot tests on our players using a laser velocity measurement device (Laveg LDM 300C, Jenoptik AG, Jena, Germany), similar to that used by Impellizzeri et al. [24], yielded comparable values (unpublished data). RSS were defined as a minimum of 2 consecutive ≥ 1-s sprints interspersed with a maximum of 15 (RSS15), 30 (RSS30), 45 (RSS45) or 60 (RSS60) s of recovery (i.e., running speed ≤ 19 km.h^{-1} or ≤ 61 % of

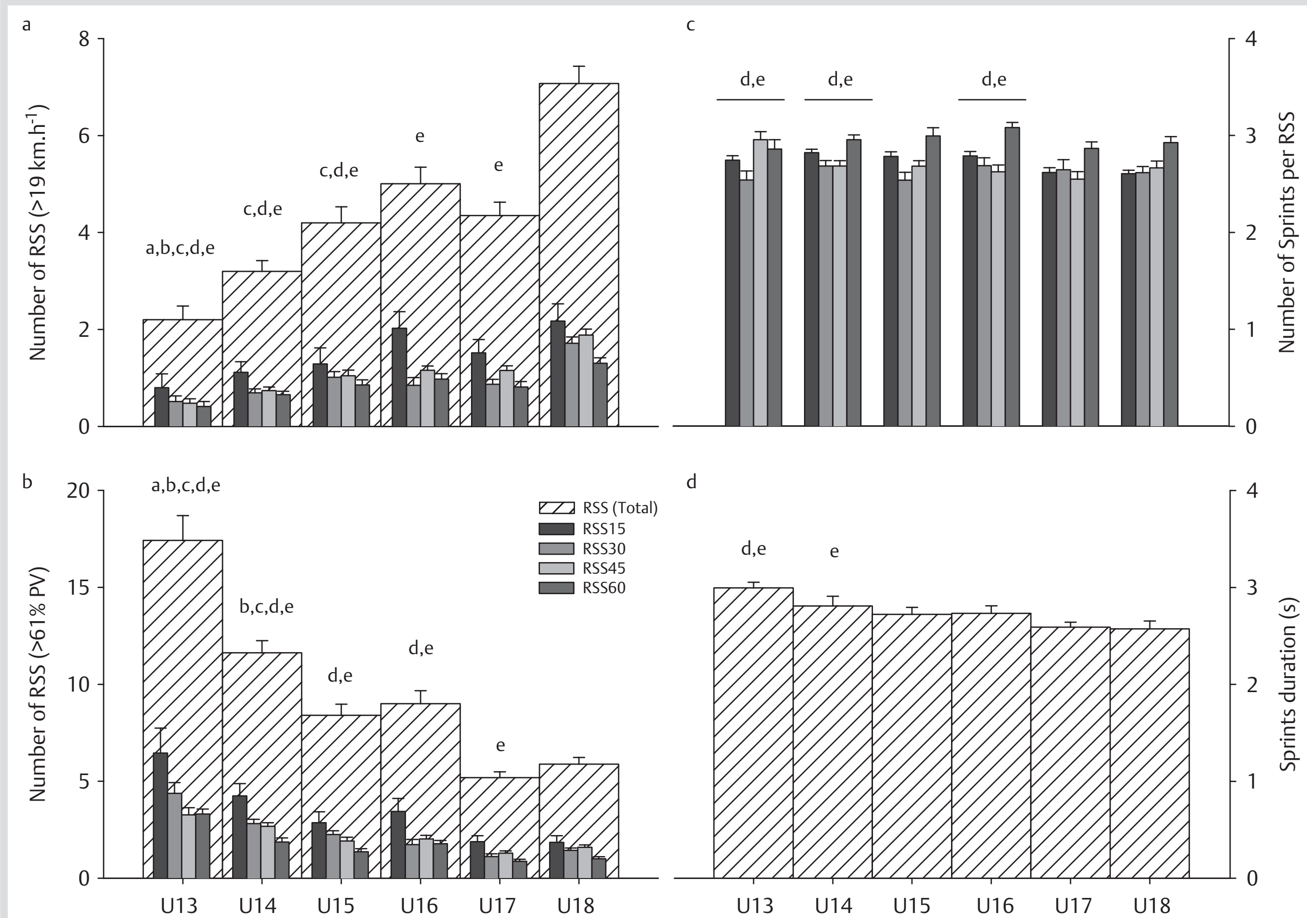

Fig. 1 Number of repeated-sprint sequences (RSS, with RSS15, RSS30, RSS45 and RSS60 for sequences with 15, 30, 45 and 60 s of between-sprint recovery) using an absolute (>19 km.h^{-1}, panel **a**) or a relative (>61 % of individual peak running velocity, panel **b**) speed threshold, number of sprints per RSS (using the relative threshold, panel **c**) and average sprints duration (panel **d**) observed during first halves in U13 (*n*=43 files), U14 (*n*=76 files), U15 (*n*=50 files), U16 (*n*=61 files), U17 (*n*=48 files) and U18 (*n*=66 files). a: significant difference vs. U14 ($P<0.05$), b: vs. U15, c: vs. U16, d: vs. U17, e: vs. U18. Data are mean ± SE.

individual PV). The average number of sprints per sequence was also computed.

Statistical analysis

Data are presented as means ± standard deviations (SD) in the text and for clarity as means ± standard errors (SE) in the figures. The distribution of each variable was examined with the Kolmogorov-Smirnov normality test. Homogeneity of variance was verified with a Levene test. Log-transformations were not applied because of the presence of numerous 0 values. Consequently, for all data having a non-Gaussian distribution, parametric tests could not be used. Data were therefore analyzed using the Kruskal-Wallis' test followed by Mann-Whitney post-hoc tests to assess age- or position-related differences and within-team time effects. While match-play duration could have been included as a covariate with the use of a parametric analysis (i.e., ANCOVA) to accurately examine age-related differences in the occurrence of RSS, this could not be done with non-parametric analyses. Therefore, occurrences of RSS per half were normalized to standardized 40-min halves. While a linear extrapolation may not best reflect a possible fatigue effect on actual RSS occurrences within the last minutes of a game, there is however to our knowledge no alternative model for this data analysis. The linear model was therefore retained for simplicity, with RSS in a standard 40-min half calculated as follows: Extrapolated number of RSS = observed number of RSS × 40/effective playing time per (full) half. Also, as a consequence of low sample sizes for certain age vs. position combinations, possible interactions between ages and positions were not examined. Pearson's correlation coefficients were also calculated to assess the relationships between the number of sprints per sequence, RSS occurrence and sprint durations. All analyses were carried out with Minitab 14.1 Software (Minitab Inc, Paris, France) with the level of significance set at $P \leq 0.05$.

Results
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Nature and distribution of RSS

The number of each RSS type (i.e., RSS15, RSS30, RSS45 and RSS60), during the first half, is presented in ▶ **Fig. 1** (panel **a** and **b**) and 2 (panel **a**) as a function of age and position, respectively. When using absolute or relative speed thresholds, for all players pooled, there was a significant 'recovery time' effect, so that the number of RSS15 > RSS30 > RSS45 > RSS60 ($P<0.001$). The number of sprints per sequence (e.g., ▶ **Fig. 1**, panel **c** or ▶ **Fig. 2** panel **b**) was higher for RSS60, with RSS60 > RSS15 > (RSS30 = RSS45) ($P<0.001$). For clarity however, all statistical analyses (between-age, -positions and time effects) are only

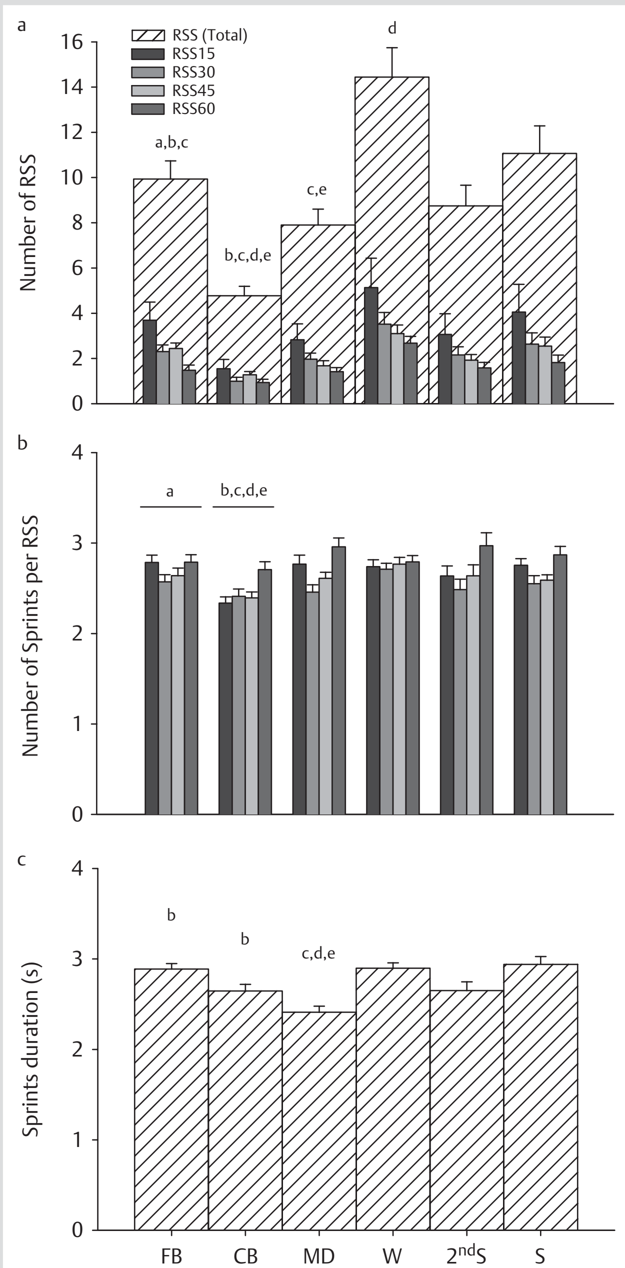

Fig. 2 Number of repeated-sprint sequences (RSS, with RSS15, RSS30, RSS45 and RSS60 for sequences with 15, 30, 45 and 60 s of between-sprint recovery, panel **a**), number of sprints per RSS (using a relative threshold, i. e., >61 % of individual peak velocity, panel **b**) and average sprint duration (panel **c**) as a function of playing position (Full Backs (FB), Centre Backs (CB), Midfielders (MD), Wide Midfielders (W), Second Strikers (2^{nd}S) and Strikers (S)) during the first halves with players from all teams pooled (FB, *n*=72; CB, *n*=69; MD, *n*=67; W, *n*=64; 2^{nd}S, *n*=36 and S, *n*=36). a: significant difference vs. CB ($P<0.05$), b: vs. MD, c: vs. W, d: vs. 2^{nd} S, e: vs. S. Data are mean ± SE.

given for the total number of RSS and for the average number of sprints per sequence (see below).

Age- and position-related differences in RSS

When using absolute speed thresholds, the older teams performed more RSS than the younger teams (**Fig. 1**, panel **a**). However, when individualized speed thresholds were applied, the younger players displayed a greater number of RSS than the older teams (**Fig. 1**, panel **b**). The range of RSS occurrences during a full game (using a relative threshold, irrespective of the positions) was 2–42 for U13, 0 (with 6 % of player-matches displaying no RSS) to 43 for U14, 0 (26 %) to 25 for U15, 1–33 for U16, 0 (27 %) to 14 for U17 and 0 (20 %) to 24 for U18. The average number of sprints per sequence (all between-sprint recovery durations pooled together) was 2.7 ± 0.3 (range; 2–4), with the U17 and U18 teams performing less sprints per sequence than most of the other teams (**Fig. 1**, panel **c**). Sprint duration, which was 2.7 ± 0.5 s on average (range; 1–6 s, irrespective of between-sprint recovery duration), was significantly affected by age (**Fig. 1**, panel **d**). When individualized speed thresholds were employed, RSS occurrence ($P<0.001$ for all teams), the number of sprints per RSS ($P<0.001$ for most teams) and average sprint duration ($P<0.001$ for most teams) were affected by playing position. The number of RSS during a full game (using a relative threshold, all age-group pooled together) ranged from 0 (with 7 % of player-matches displaying no RSS) to 27 for FB, 0 (31 %) to 17 for CB, 0 (9 %) to 30 for MD, 1–47 for W, 0 (11 %) to 19 for 2^{nd}S and 0 (6 %) to 26 for S. Since the positional effects were very similar within each team, pooled data have been presented for all teams (**Fig. 2**).

Playing time effect

As detailed in **Fig. 3**, RSS occurrences decreased throughout the game in all teams (all $P<0.05$), except for U16 ($P=0.28$). The number of sprints per RSS was also reduced during the 3^{rd} and 6^{th} periods and since this was a common effect for most of the teams, data were pooled for presentation (**Fig. 4**, panel **a**). Conversely, the average sprint duration tended to increase with playing time within each half (**Fig. 4**, panel **b**). There was no significant correlation between the number of sprints per sequence or RSS occurrence and sprint duration (all $P > 0.13$).

Discussion

This study is the first to report on the occurrence and nature of RSS during soccer match play. The main findings of the present study were as follows: 1) when employing absolute speed thresholds, older players presented with more RSS than younger players, 2) when using relative speed thresholds, the younger players performed more RSS compared with the older players, 3) the number of sprints per sequence was relatively small (2.7 ± 0.3), with the youngest players performing more sprints than the older players, 4) no RSS activity was observed in 5–30 % of the players, 5) average sprint duration was < 3 s, with the younger players performing longer sprints than the older players, and 6) both RSS occurrence and the number of sprints per sequence were affected by playing position and decreased throughout the game in most age-groups.

Despite the focus on RSA in soccer in recent years (e.g., [6, 9, 25, 33, 36]) a detailed analysis of RSS during competitive games has never been described in soccer. To the best of our knowledge, only one study has reported RSS data in team sports, that being on 14 adult field hockey players using qualitative criteria [41], however these data have limited application to soccer. While absolute distance covered could be underestimated (due to some very short duration/distance sprints being missed) by our 1 Hz GPS devices when compared with other tracking systems [37], we were confident in the results observed since the devices used have previously been reported to have good reliability [3, 14]. This confidence is further supported by the facts

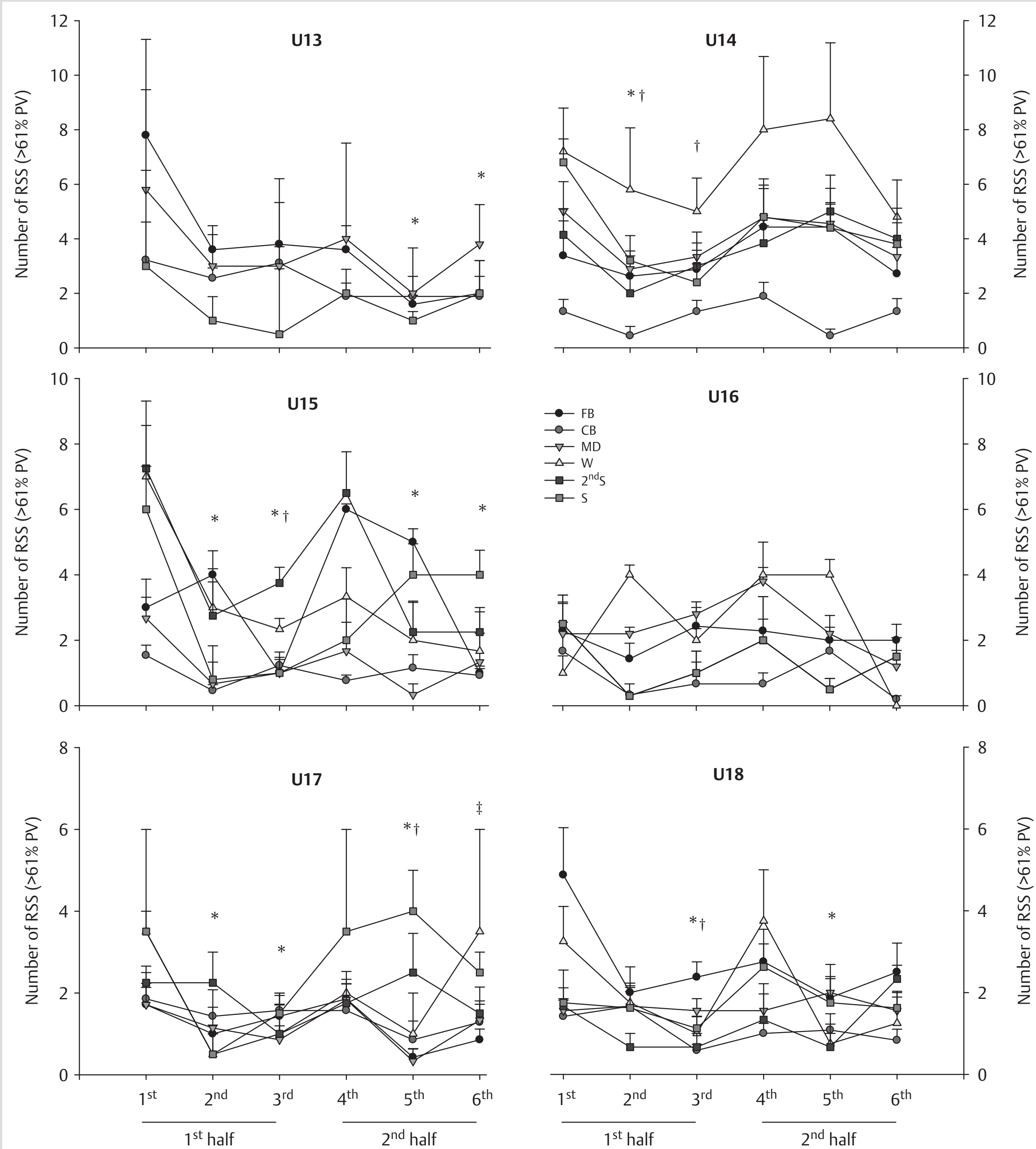

Fig. 3 Number of repeated-sprint sequences (RSS, with a relative speed threshold, i. e., >61 % of individual peak velocity) as a function of playing position (Full Backs (FB), Centre Backs (CB), Midfielders (MD), Wide Midfielders (W), Second Strikers (2nd S) and Strikers (S)) and playing time (i. e., 3 equally divided periods in each half) in U13 (n = 20 files), U14 (n = 43 files), U15 (n = 25 files), U16 (n = 18 files), U17 (n = 29 files) and U18 (n = 44 files) soccer players. * : significantly different from 1st period (P < 0.05).†: significantly different from the 4th period (P < 0.05). ‡: significant different from the 5th period (P < 0.05). Data are mean ± SE.

that: all players wore the same device (for between age- and position- comparisons), the selected thresholds to define sprinting speed were chosen in accordance with both the nature of the short sprints reported in football [24] and the sampling frequency of the device [18] (for absolute sprint duration and RSS assessment). Since absolute sprinting speed increased with age, it is however possible that the error of measurement might have had differing magnitudes of influence on the data collected in each age-category, thus partially confounding the observed results. It is also worth noting that we did not control for between-sprint recovery intensity within each type of RSS, which is also known to affect repeated-sprint performance [7]. Additionally, we acknowledge that the linear extrapolation used to normalize the number of RSS per half may not best reflect a possible fatigue effect on actual RSS occurrences within the last minutes of each half of a game. During the international friendly

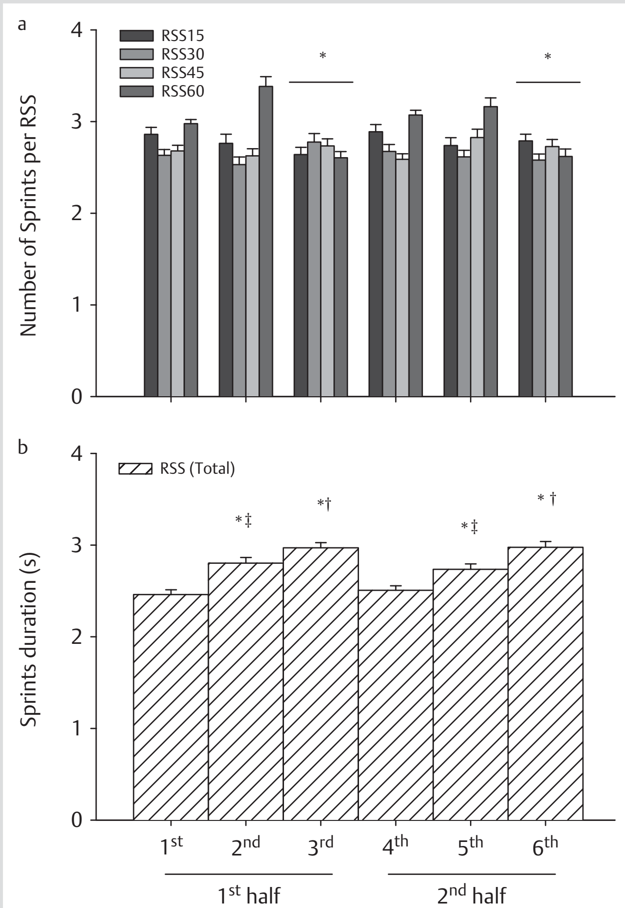

Fig. 4 Number (± SE) of sprints per repeated-sprint sequence (RSS, with RSS15, RSS30, RSS45 and RSS60 for sequences with 15, 30, 45 and 60 s of between-sprint recovery, with a relative threshold, i. e., > 61 % of individual peak velocity, panel **a**) and average sprint duration (panel **b**) as a function of playing time (i. e., 3 equally divided periods in each half) in all young soccer players pooled together (179 files). * : significantly different from 1st and 4th periods (P<0.05). †: significantly different from the 2nd and 5th periods (P<0.05). ‡: significantly different from the 3rd and 6th periods (P<0.05).

games analyzed, the average number of sprints per RSS was 2.7 (based on relative speed thresholds, ranging from 2–4, ▸ **Fig. 1**, panel **c** and ▸ **Fig. 2**, panel **b**), while the average sprint duration was < 3 s, irrespective of age or position (▸ **Fig. 2**, panel **c**). These values were both quite low compared with the data previously reported in adult field hockey players [41]. When considered together with the low occurrence of RSS in some players (e. g., 30 % of the CB or 27 % of the U17 did not even do a RSS during some games), our results question the importance of RSA, as originally defined by Spencer et al. [41], as a crucial component of soccer match-play physical performance [33]. The correlation [33] and group-comparison [2, 25, 36] studies that have previously emphasized the importance of RSA as an essential physical quality in elite soccer may in fact reflect the importance of a high level of overall fitness (i. e., players having both high sprint running speed and aerobic capacities [28]), rather than a specific quality. Indeed, RSA is a compound quality believed to be determined by both neuromuscular (e. g., determinants of maximal sprinting speed such as muscle stiffness or motor unit activation) and metabolic (e. g., determinants of the ability to repeat sprints such as PCr recovery or H+ buffering) [20]. While acknowledging that the application of the present results to other player populations is not always straight forward, they suggest that physical training could possibly emphasize the need to concurrently develop other important determinants of soccer-related physical performance, such as high intensity intermittent aerobic capacity [17, 44] or speed/agility aspects [9, 27, 29]. Although the training strategies [6, 9, 11] and tests [2, 25, 30, 36] previously used have generally been developed to reproduce the most intense RSS likely to be experienced in a game, and not the average RSS activity, the reported average sprint duration (< 3 s) and the number of sprints per RSS (2–4) in this study might also question the content and logical validity [23] of these protocols (e. g., 4- to 6-s sprints repeated at least 6 times [2, 6, 9, 11, 25, 30, 36]). Nevertheless, whether training [42] or testing [23] protocols should obligatory reproduce game-specific movement patterns is still a matter of debate [42]. While there is no doubt that RSA training and testing could (even if not replicating specific-game activity as shown by present data) be implemented to successfully improve [6] and evaluate [2, 25, 36] some important soccer-related physical qualities, some studies have also reported poorer improvements in repeated sprint performance with specific RSA training compared with more aerobic- [11] or speed/agility- [10] oriented training programs in young team-sport athletes. Further studies are therefore still needed to define the best strategies to optimize the development of soccer-specific physical capacities [42]. We also observed greater occurrences of RSS with short (i. e., RSS15) rather than with long recovery periods (i. e., RSS60). The number of sprints per sequence was however greater for the RSS with the longest recovery periods (i. e., RSS60). The respective impacts of specific match times versus physiological mechanisms on the nature of RSS however cannot be deciphered with the present measurements; studies matching time-motion analyses to qualitative (technical/tactical) game examinations [35] are therefore recommended to clarify these observations.

Since peak sprinting velocity improves with growth [31, 32], it was not surprising to observe that the older players in this study reached the selected absolute threshold (i. e., 19 km/h) more often and had more RSS at this intensity than the younger players (▸ **Fig. 1**, panel **b**). However, when individualized speed thresholds (as a fixed percentage of individual PV, ▸ **Fig. 1**, panel **b**, **c**, **d**) were applied, the average sprint duration, as well as the number of sprints per sequence, were higher for the younger (U13 to U16) compared with the older (U17 and U18) players. Along the same line, the occurrence of RSS was greater in younger players. While the potential effect of technical/tactical factors on these results cannot be examined, all teams studied in the present investigation used the same playing style, played on the same pitches against similar level opposition (i. e., international club teams) and under the same rules. These on-field results are therefore consistent with the assumption that the ability to repeat maximal efforts is greater in children compared with adolescents and adults [38].

Irrespective of the age-group, the occurrence and nature (i. e., sprint duration and the number of sprints per sequence) of RSS were also influenced by playing position (▸ **Fig. 2, 3**). In our younger players, attackers (i. e., S, 2ndS and especially W) presented the highest number of RSS (▸ **Fig. 2**, panel **a**), while the CB reported the lowest (▸ **Fig. 2**, panel **b**). MD players displayed the shortest sprint durations compared with the other players (▸ **Fig. 2**, panel **c**). Although this study is the first to report RSS analyses in soccer match-play, our results extend previous findings on positional differences in high-intensity running patterns reported in young [43] and adult soccer players [5, 15, 16, 34]. CBs generally undertake less high intensity running, whereas attackers generally display the most. The greater occurrence of RSS in W is probably related to their need to complete sprints away from defending players in order to generate space or capitalize on goal scoring opportunities [16]. These variations in RSS due to playing position may also be indicative of a mature tactical understanding of the position-specific tasks [43]; this is consistent with the highly-trained player-group examined here. These findings provide new information that can be used to develop new soccer-training strategies and/or position-specific performance tests for developing soccer players, which should be the topic of future investigations.

Regardless of playing position, RSS occurrence decreased over the duration of the game in most teams (▶ **Fig. 3**). The number of sprints per RSS was also reduced during the 3rd and 6th periods (▶ **Fig. 4**). Conversely, the average sprint duration tended to increase with playing time within each half (▶ **Fig. 4**, panel **b**). While the underlying mechanism(s) responsible for this is still unclear, both the reduced RSS occurrence and number of sprints per RSS could be attributed to fatigue accumulating over the course of the game, as previously proposed for high intensity running exercise in young [8] and adult [5, 15, 16, 34] elite soccer players. Therefore, despite a greater short-term ability to reproduce maximal efforts (▶ **Fig. 1**, panel **b**), young players (irrespective of age) are as likely as adults, to experience temporary fatigue towards the end of each half of play. The increase in average sprint duration towards the end of each half contrasts however with this latter observation. With the likelihood of reduced defensive pressure due to accumulated fatigue towards the end of each half, greater sprint distances may have been permitted. It could thus be hypothesized that the increase in sprint duration was compensated by reduced sprint occurrences. Nevertheless, no correlation was found between these parameters; the exact reasons for the increase in sprint duration towards the end of each half therefore remains unclear. Caution is also necessary when interpreting these data, as the tempo of play could be slowing down as a consequence of tactical ploys as the game progresses and thus effective time might be decreased [26]. Further studies are therefore required to investigate if the decrease in RSS occurrence is fatigue or tempo (tactically determined) related.

To conclude, during international club games in highly-trained young soccer players, both the occurrence and the nature of RSS are affected by age, position and playing time. Younger players, as well as wide attackers, display greater repeated-sprint activity. Irrespective of age, players are however likely to experience temporary reduction in repeated-sprint performance towards the end of each half. Nevertheless, a considerable number of players (e.g., 30% U17 and 27% CB) did not do any RSS during games. Finally, the average duration and the number of sprints per RSS during match-play was considerably lower than that usually employed in soccer-specific training strategies or to assess RSA via field testing (i.e., <3 s and <3 repeated sprints vs. ≥ 4 s and ≥ 6 sprints). Overall, in the context of the games examined, as well as with the limitations inherent in the GPS devices used, the present results question the importance of RSA, as originally defined by Spencer et al. [41], as a crucial physical component of soccer performance in developing players.

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