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Activity profiles in U17, U20 and senior women's Brazilian National soccer teams during international competitions: Are there meaningful differences?

Match activity of top-level female soccer players

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Abstract

The aim of this study was to compare locomotor activity profiles of Brazilian top-class female soccer players competing at distinct age brackets (U17, U20, and Senior). External match load of 14 U17, 14 U20, and 17 Senior female soccer players competing in 6-7 full official international matches were assessed using global positioning systems (GPS). Total distance covered, distance covered in high intensity (HID:15.6-20 $km \cdot h^{-1}$), distance covered in sprints (sprint:>20 $km \cdot h^{-1}$), number of accelerations (Acc)>1 $m \cdot s^{-2}$, decelerations (Dec) >-1 $m \cdot s^{-2}$, and Player Load® generally increased across the age brackets (U17<U20<Senior). For all playing positions, Senior athletes presented greater total distance, accelerations, and decelerations than U20 players. For high-intensity distance and sprints, only central defender and midfielder senior players presented greater values than U20 players. Senior players demonstrated higher values in all locomotor activities in comparison to U17 players, irrespective of playing positions. Except for central defenders that presented similar total distance, sprint distance, and number of accelerations between U20 and U17, the majority of match external loads evaluated in all playing positions were greater in U20 than in U17 players. These results provide useful information for player development and should be used to establish appropriate match-specific conditioning drills according to age categories.

Key words: Time-motion, football, female athletes, fitness.

Introduction

Scientific interest in women's soccer has increased during the last few years (14). One of the topics attracting more attention in the literature relates to match analysis of locomotor activities performed across different velocity bands (especially at high-intensity) that, to a great extent, reflect the physical demands of competition. Several contextual factors (e.g., team formation and match status) (11) influence the player's work rate during the game; nonetheless, fitness level (25) and playing standard (33) have been considered of great relevance. For instance, Mohr et al. (29) compared top-class and high-level female soccer players during competitive matches and showed that the former accumulated longer high-intensity running and sprinting distances, indicating that competitive level is an intervening factor of physical performance. Furthermore, international competitions demanded more repeated-sprint bouts than national-league competitions in elite female Australian soccer players (15). However, the competitive demand differences between age categories in players competing at top-level (i.e., top-ranked National teams during international tournaments) is still a critical gap in the current knowledge. Highlighting meaningful performance dissimilarities would support technical staff responsible for prospective training plans in choosing appropriate and age-specific physical training strategies to optimize players' ability to cope with current women's competition requirements. Additionally, description of current match physical performance would be helpful in establishing standards for comparisons with upcoming evolutions in player kinematics (4).

More recently, a great effort has been made to increase the knowledge related to match physical demands in different team sports due to the possibility of quantifying acceleration/deceleration actions (i.e., changes in velocity), which are calculated via changes in location as measured by global positioning systems (GPS), and Player Load (i.e., sum of all accelerations performed in the three axes of movement: *x*, *y*, and *z*; measured by the GPS-embedded accelerometer) (13). When analyzing solely the "traditional" movement patterns (i.e., distance covered in different velocity bands), a great deal of the energetic demand is neglected due to the inability of this type of analysis to detect some high-intensity short actions (32). For instance, Aughey (2), demonstrated that the number of maximal accelerations is much higher than the number of maximal sprints performed during an Australian rules football match (2). Accordingly, a more detailed analysis of acceleration profiles in elite female soccer matches is necessary due to the high energetic demand and muscle power requirement related to this specific locomotor activity (32).

To date, one previous study (37) has evidenced some activity profile differences between female U15, U16, and U17 age brackets competing at national championships. The U15 players presented lower total distance and distances covered across several velocity bands (jogging, moderate speed, and sprinting) than U16 and U17 players. It is still unknown whether and to what extent locomotor activities evolve after the U17 bracket in female players, especially in athletes involved in international competitions and representing their respective age-specific National teams.

Therefore, we aimed to compare the distances covered by top-class female soccer players pertaining to the Brazilian National teams in the U17, U20, and Senior categories during their participation in international tournament matches. Furthermore, owing to the recent interest in the acceleration/deceleration and Player Load profiles of soccer players during official matches (13,35), we also compared these variables among the three different age categories. The working hypothesis was that there would be a progressive increase in high-intensity activities across the age categories due to maturation and, principally, the players' strict commitment to prospective training programs involving soccer-specific fitness development.

Methods

Experimental approach to the problem

A prospective and observational, between-group, study was conducted to characterize and compare the game activity profiles of Brazilian National female soccer teams of different age brackets (under 17, under 20, and Senior players), during official international competitions. Comparisons involved GPS derived variables, including distances run at different speed ranges, including high-intensity activities, accelerations and decelerations, and Player Load. The age brackets and playing positions were considered independent variables, while physical performance indices during the matches were considered as dependent variables.

Subjects

Fourteen under 17 (U17: 15.6 ± 0.5 years, 164.6 ± 6.4cm, 58.0 ± 4.3 kg and 14.0 ± 1.9 % fat), 14 under 20 (U20: 18.1 ± 0.8 years, 165.9 ± 6.8 cm, 59.9 ± 6.2 kg and 14.0± 2.2 % fat), and 17 senior (Senior: 27 ± 4.5 years, 186.9 ± 4.8 cm, 60.7 ± 4.5kg and 13.0 ± 2.0% fat) players from the respective age-specific female Brazilian National teams participated in the study. Data were collected during the 2015 South American Championship in Brazil for the U20 team and during the 2016 South American Championship in Venezuela for the U17 team, in which the former investigated team was the winner and the latter finished in 2nd place. Senior group data were obtained during the Rio 2016 Olympic Games in which the team finished in 4th place. While approval to conduct the study was granted by the Brazilian Football Confederation and an Institutional Ethics Committee, the present data arose as a condition of playing for the National team in which players are routinely monitored over the course of a tournament (39). Therefore, because of the *a posteriori* nature of the analyses, signature of the informed consent form was not required; nevertheless, to ensure player confidentiality, all physical performance data were anonymized before analyses.

Procedures

Game movement pattern data were obtained from a total of 7 official matches in youth groups and 6 matches during the Olympic Games, players only being included in the analysis if they completed the entire 90-min of each match. This resulted in 43 player-games for the U17 group (7 for central defenders [CD]; 10 for full-backs [FB]; 17 for midfielders [MD]; and 9 for forwards [FW]), 54 player-games for the U20 group (7 for CD; 10 for FB; 26 for MD; and 11 for FW), and 47 player-games for the Senior group (13 for CD; 8 for FB; 9 for MD; and 17 for FW). All matches were held on outdoor pitches with official dimensions (i.e., 100 × 75 m). GPS units were switched on prior to the warm-up to enable the devices to locate the necessary satellites and the units were fitted to the players' backs (between the shoulder blades) prior to each match.

Match analysis

Match physical activity profiles were obtained using GPS units operating at 10 Hz (MinimaxX GPS units; Team S5, Catapult Innovations, Melbourne, Australia). The GPS contained a tri-axial accelerometer system (100 Hz) which was used to quantify tri-axial body accelerations (Player Load®). Units were fitted to the upper back of each player using an adjustable neoprene harness and were switched on 60 min prior to match commencement. This procedure allowed the connection and acquisition of >12 satellites and horizontal dilution of precision (HDOP) not greater than 1.0 (26). More specifically, the average number of satellites and HDOP (mean ±SD) during match data collection were 12.4 ± 0.5 (range 12 - 15) and 0.75 ± 0.3 (range 0.5 - 1.0), respectively. In addition, the same unit was used by each player in all matches to reduce inter-unit measurement error. Openfield™ software was used for data acquisition, which filters the raw GPS velocity data using an exponential filter, and GPS acceleration was derived from the GPS using the software data and then filtered further using an exponential filter. Both measurements of acceleration and velocity data acquisition time (dwell time) were fixed at 0.5 sec The velocity and linear acceleration/deceleration categories were defined based on a previous study in female soccer players (37). Therefore, the match activities were divided into the following categories: total distance covered (TD), distance covered in high-intensity (HID: 15.6-20 $km \cdot h^{-1}$), distance covered in sprints (sprint: >20 $km \cdot h^{-1}$), and number of accelerations (Acc) >1 $m \cdot s^{-2}$ and decelerations (Dec) >-1 $m \cdot s^{-2}$. The validity and reliability of the GPS units used have been extensively reported (29).

The accumulated acceleration data from all three axes (anterior-posterior [front to back], medio-lateral [side to side], and cranio-caudal [up and down]) were integrated to formulate the acceleration vector magnitude. The manufacturers of the MinimaxX accelerometers name this parameter Player Load® (PL). The reliability of the PL measure has been previously reported (CV = 1.6 %) (8).

Statistical analysis

Data are presented as mean ± standard deviation. Due to the large inter-individual variability in all dependent variables of this study, data were log-transformed for the analysis and then back-transformed to facilitate its presentation and interpretation in the results section. The magnitude-based inference (7) method was used to compare the locomotor variables among the three different age categories. The quantitative chances of finding differences in the variables tested among the three different age categories were assessed qualitatively as follows: <1%, almost certainly not; 1% to 5%, very unlikely; 5% to 25%, unlikely; 25% to 75%, possible; 75% to 95%, likely; 95% to 99%, very likely; >99%, almost certain. If the chances of having better and poorer results were both >5%, the true difference was assessed as unclear. A *likely* difference (>75%) was considered as the minimum threshold to detect meaningful differences due to the lower probability of an error occurring in this range of probabilities to find positive/negative effects (18). The magnitudes of the differences for the comparisons across all variables were analyzed using the standardized differences based on Cohen's *d* effect sizes (ES) (12). The magnitudes of the ES were qualitatively interpreted using the following thresholds: <0.2, trivial; 0.2 – 0.6, small; 0.6 – 1.2, moderate; 1.2 – 2.0, large; 2.0 – 4.0, very large and; >4.0, nearly perfect (19). To be interpreted as meaningful, besides the qualitative change >75%, the associated ES of the difference was required to be >0.2.

Results

The standardized differences in match physical activities among the three age categories are displayed in figure 1. *Likely* to *almost certainly* differences among all age brackets for the TD, HID, sprint, number of Acc and Dec, and PL were found (Senior > U20 > U17, ES varying from 0.41 [-0.23- 1.06] to 3.69 [2.63- 4.76]), except for the comparison between U17 and U20 for sprint and between senior and U20 for PL, where the differences were rated as *unclear*.

*** INSERT FIGURE 1 HERE ***

Table 1 shows the TD, HID, and sprint among the three distinct age categories for the different playing positions. Senior players presented *likely* to *almost certainly* higher values of TD, HID, and sprint than U20 for CD and MD (ES varying from 0.75 [0.06- 1.44] to 2.04 [1.42- 2.66] and 1.14 [0.52- 1.76] to 1.92 [1.28- 2.56], for CD and MD, respectively). The FB and FW Senior players covered *very likely* to *almost certainly* higher TD than their U20 counterparts (ES = 1.63 [0.95- 2.32] and 0.82 [0.35- 1.29] for FB and FW, respectively). In addition, the Senior players demonstrated *likely* to *almost certainly* higher values in all locomotor activities presented in table 1 in comparison to U17 players in all playing positions (ES varying from 0.88 [-0.15- 1.91] to 2.77 [2.04- 3.50] for CD, 0.90 [0.09- 1.71] to 2.46 [1.55- 3.37] for FB, 1.62 [0.97- 2.26] to 1.94 [1.29- 2.59] for MD, and 1.07 [-0.01- 2.13] to 2.17 [1.20- 3.15] for FW). Finally, U20 players presented *likely* to *almost certainly* differences for TD, HID, and sprint in comparison to U17 in the different playing positions, excepting TD in the CD and MD, and sprint in the CD, where the differences were rated as *unclear* (ES = 2.26 [1.39- 3.13] for HID in the CD; ES varying from 0.73 [-0.16- 1.63] to 2.74 [1.35- 4.13] for FB, ES = 1.25 [0.68- 1.81] and 0.80 [0.22- 1.37] for HID and sprint in the MD, and ES varying from 0.83 [0.02- 1.63] to 2.32 [0.70- 3.95] for FW).

*** INSERT TABLE 1 HERE ***

Table 2 presents the comparisons of the number of Acc and Dec, and the PL among the three different age categories for the distinct playing positions. Except for the comparison of the PL between Senior and U20 players in the CD, where the difference was rated as *unclear*, Senior players demonstrated *likely* to *almost certainly* differences in the analyzed variables in comparison to U20 and U17 players in all playing positions (ES varying from 0.30 [-0.68- 1.28] to 4.04 [3.33- 4.75] for the comparison with U20, and ES varying from 0.39 [-0.31- 1.10] to 5.57 [4.87- 6.28] for the comparison with U17). Excepting the comparison in the number of Acc between U20 and U17 in the CD and FB, where the difference was rated as *unclear*, U20 players demonstrated *likely* to *almost certainly* higher values of Acc, Dec, and PL than the U17 in all playing positions (ES varying from 0.70 [0.07- 1.34] to 3.69 [2.63- 4.76]).

*** INSERT TABLE 2 HERE ***

Discussion

This study aimed to compare the locomotor activity profiles of top-level U17, U20, and Senior players from the Brazilian National women's teams competing in international tournaments. As expected, there was a general trend to a progressive increase in TD, high-intensity activities (e.g., high speed running and sprints), and total number of accelerations and decelerations (i.e., >1.0 m.s^{-2} and >-1.0 m.s^{-2}, respectively) across the age categories, supporting the notion that training practices need to target increments in soccer-specific fitness components as the players become older.

The TD covered by the Senior players was *almost certainly* greater than attained by the U17 and U20 players, respectively. In the same way, an *almost certainly* difference in HID was found between Senior and U17, and between U20 and U17 players. We did not find any study comparing the activity profiles of players encompassing the age categories investigated herein (U17, U20, and senior) during official matches in female soccer. However, the differences observed in TD and HID found in our study are in accordance with previous studies that investigated only youth (37) or only professional female players (29). Vescovi et al. (37) showed that U17 players performed higher TD and HID than younger players (e.g., U15) and Mohr et al. (29) showed higher values of the same parameters for top-level than high-level female soccer players. In addition, the differences found between the age categories in TD and HID are consistent with an increase in aerobic test performance with age reported in the literature, such as the Yo-Yo Intermittent Recovery Test, level 2 (Yo-Yo IR2) (9), 30-15 Intermittent Fitness Test ($30\text{-}15_{IFT}$) (27), and Yo-Yo Intermittent Recovery Test, level 1 (Yo-Yo IR1) (unpublished observations of our research group). Notably, performance in intermittent physical tests (e.g., Yo-Yo IR1) has previously been shown to be significantly correlated to match TD and HID in male (22) and female (23) soccer athletes.

Our findings are also consistent with the results described by Bangsbo et al. (22) showing that 15-16 year old players presented poorer performance in the Yo-Yo IR1 than 17-18 year old players pertaining to the New Zealand National teams. However, in their case, >18 year old players did not display further improvement in the Yo-Yo IR1 compared to the 17-18 year old players. In contrast, larger distances covered in the Yo-Yo IR2 were found for senior compared to U20 elite European players (9) (Bradley et al. 2014). Similar results were also found in Brazilian National players, as the Senior athletes presented better performance in the Yo-Yo IR1 test when compared to the immediately younger age bracket (unpublished observations). The similarities in these results can be attributed to the high competitive level of the players investigated by Bradley et al. (9), who played for two National teams in the top 12 FIFA women's world rankings and competed in the UEFA Champion's League, and the players of the Brazilian National Senior team (top 10 in 2015; 4th place in the 2016 Olympic Games) compared to the New Zealand team (top 20). Besides this, different training backgrounds and long-term player development processes can also play a role, since players involved in the National teams follow training programs designed to improve not only their technical-tactical skills, but also their physical capacities in order to cope with progressive demands as they become older. In Spain, for example, Mujika et al. (30) evidenced significantly better Yo-Yo IR1 in Senior females (23.1 ± 2.9 years) compared to Junior females (17.3 ± 1.6 years). Comparative studies among nations placed in distinct FIFA ranking positions concerning fitness levels and motion characteristics are necessary in the future to elucidate their respective influences on competitive results at the top-level. Nonetheless, it appears that aerobic fitness level is one of the most likely explanations for the evolution of TD and HID observed during matches from the U17 bracket to adulthood.

Interestingly, in most intra-playing position comparisons, the senior players covered greater HID than the younger players (Senior > U20 > U17). The only exceptions were for FB and FW when comparing Senior vs. U20 where the differences were all rated as *unclear*. Of note, these two playing positions presented lower percentage changes in HID from the U17 to the Senior age brackets (31.9 and 50.5%, respectively) than the other positions. Central defenders and MD presented notably higher differences between U17 and Seniors (69.6 and 86.9%, respectively). This means that, besides discriminating playing standards (e.g., international vs. national levels), the ability to engage in high-intensity activities during the match can also differentiate between age categories in women's top-class soccer. Hence, prospective players are required to substantially improve physical fitness components related to the ability to engage in repeated high-intensity efforts with low signs of fatigue (25). A further practical implication of our findings is that the possibility of designating a younger player in the Senior team needs to be carefully examined. This is not an uncommon practice, heavily based on technical considerations. However, if the player does not demonstrate physical conditions to adhere to the tactical scheme proposed by the coach, the potential technical advantage could be lost. With these aspects in mind, we can lend support to the use of tracking technology (e.g., GPS) during soccer matches and training in order to facilitate decision making about the adequacy of a player for the team formation.

Senior players performed *largely* and *moderately* longer distances in the sprinting locomotor category than U17 and U20 athletes, respectively. This increase in the sprint distance during the matches across the investigated youth age categories is in agreement with a previous study that demonstrated an almost 200% increase in sprint distance from 15 to 17 year old players (38). Previous studies have also found an increase in performance in a 5x10 m sprint test with changes of direction from 12 to 16 year old female soccer players (17) and in a 36.6 m sprint speed field test in female soccer players from 12 to 20 years of age (38). These different results between Senior and U17 players are in line with maturational factors involved in 13-16 year old females, as before 17 years old female athletes may not have reached full biological maturation, especially in lower limb strength capacity (24,36), which may justify sprinting ability differences. Although maturation might not explain the differences found in sprint distance covered between senior and U20 players in this study, it is important to highlight that the ability to repeat sprints and high-intensity runs is also related to aerobic performance (14), which can be developed with well-designed training. Furthermore, higher distance covered in the sprinting category from U20 to Senior transition is consistent with the differences between "top-class" (senior National team players) and high level (professional female soccer players) players as previously noted by Mohr et al. (29). More specifically, Mohr et al. (29) showed that National team players covered 24% more distance sprinting than professionals (460 ± 20 m and 380 ± 50 m, for top-class and professionals players, respectively). This is consistent with the differences observed in the present study, since the majority of our U20 players (18-19 years) were professionals competing at the Brazilian National Championship, but without taking part in the senior National squad. Once again, this could reflect the "selective pressure" of playing in the very competitive senior team or the training practices implemented with adults in comparison with youth players in the investigated National team.

Of interest, the intra-position comparisons revealed that sprint distances differed from 34.1% in FB to 210.9% in MD between U17 and Seniors. The differences could have been inflated in all player positions by the use of a fixed speed threshold (20 $km \cdot h^{-1}$) to define a sprint, possibly favoring the faster (i.e., older) players (31). The use of individualized speed zones based on specific physical fitness (e.g., anaerobic threshold) (21) and/or performance characteristics (e.g., maximal sprint speed) (28) has some advantages as the locomotor profile will be representative of specific player status. In fact, Reardon et al. (34) argued that by individualizing speed thresholds athletes can demonstrate different match demands; with this individualization rugby forwards players presented higher match HSD (i.e., 354.72 ± 99.22 m) than with general absolute speed threshold (i.e., 269 ± 172.02 m). However, the lack of consensus in selecting and assessing appropriate fitness attributes as parameters for individualization in speed thresholds, and the difficulties in executing regular fitness tests with large squads of athletes, present significant barriers to its implementation in practice. The choice of only one physical attribute in isolation to individualize speed threshold may also result in erroneous interpretation as it assumes that faster players also have higher transition speeds into all velocity thresholds, which may not always be the case. Beyond the scope of this study, future studies using both arbitrary and individualized speed thresholds are warranted to examine the utility of individualized versus arbitrary speed zones in comparison throughout age brackets and also to predict injury risk with regard to different training loads.

Nonetheless, the results suggest that the ability to repeat sprints needs to be progressively improved in players involved in top-level competitions from the end of adolescence to early adulthood. For instance, U17 players presented more than 3× the sprint distance of U15 players during official matches (37), although, the authors did not cluster the players per role in the field. Our results showed that, compared to the other positions, MD are required to develop game-related repeat sprint ability more substantially from <17 years to adulthood in order to achieve the physical performance levels required to succeed as a Senior. The most suitable training method to enhance repeated-sprint ability is still debatable; however, it appears that high-intensity interval training (10) with directional changes (unpublished observations) constitutes an effective option for female team sports athletes.

Seniors performed substantially more accelerations and decelerations than U17 and U20 players (*large* to *very large* ESs). In addition, U20 players performed more accelerations and decelerations than U17 (*moderate* to *large* ESs). The brief explosive concentric and eccentric muscle actions related to accelerating and decelerating are associated with a significant increase in the metabolic demands of running during intermittent sports matches (32), compared to constant velocity running. In addition, it has been estimated that typical acceleration and deceleration activities during soccer matches result in an increase of 28% and 65% in the mechanical load per meter covered (13), respectively, and that 18% of total distance covered during a soccer match is performed whilst accelerating and decelerating (1). It appears then that the ability to repeatedly perform these demanding actions is a pre-requisite to successful soccer practice. Except for accelerations in the FB, players from distinct positions increased the number of accelerations and decelerations episodes across the age categories from U17 to adulthood, evidencing the need to progressively implement drills in which athletes are required to rapidly increase and decrease running velocity over short distances (16) (i.e., repeated-acceleration ability) (3). In addition, plyometric training can be used as an auxiliary method to enhance not only the number of times players engage in accelerations or decelerations but principally muscle power performance during the acceleration phases of sprints (25,33). Importantly, rapid and repeated decelerations following sprints can be one of the main causes of post-match muscle damage (20). It remains to be established whether Senior players are more prone to post-match delayed recovery, due to the severity of muscle damage signs, than younger players, or if they are well adapted to the increased deceleration loads.

Finally, Seniors (in all playing positions, except for Senior and U20 CD players) presented *large* differences in PL compared to U17 and U20. This might reflect all the aforementioned discussed differences in the distances covered and performance of accelerations and decelerations. Player Load is a reliable (5,6) accelerometry-based measure of the cumulative load on the musculoskeletal system caused by rate of change in acceleration of the body. Our results underline the fact that older players, due to their higher fitness levels and ability to engage in high-intensity actions, are also able to accumulate more external loads as measured by a tri-axial accelerometer during the matches. Unfortunately, this study is limited by the lack of quantification of discrete movements that could substantially contribute to PL (e.g., collisions, tackling, and unorthodox movements). These kinds of movements may have contributed to the higher PL observed in Senior players.

In conclusion, there is a general increase in external match load demand in Brazilian female soccer players across all FIFA age brackets, with greatest loads observed in senior athletes. In general, these differences were observed irrespective of game specific positions analyzed. This information is relevant for team staff and coaches for discriminating player's standards and especially in situations where young athletes are selected to play in different age categories in female top-level soccer teams.

Practical applications

The findings of this study can be used to tailor training practices in top-level female soccer teams. From our results, the need to improve soccer-specific fitness components as the player progresses across the age categories is evident. Since intermittent exercise endurance and repeated-sprint ability are highly correlated with match performance, especially with the ability to perform high-intensity actions, frequent assessment of players using field tests and implementation of training strategies aimed to improve these fitness components (e.g., prescribing high-intensity interval training) is highly recommended. The central defender and midfielder playing positions demand higher improvements in the ability to perform high-intensity activity from U17 to adulthood. Thus, special attention to players from these playing roles needs to be paid in prospective programs in order to allow achievement of top-level performance. Furthermore, since Senior players perform larger distances sprinting during the matches than the players from younger age categories, it is necessary to progressively implement training methods designed to enhance the lower limb power and speed capacities. This is challenging, owing to the frequent occurrence of interference effect between strength-power and endurance training adaptations.

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Table 1. Mean (± SD) of the total distance (TD), high-intensity distance (HIR), and sprint distance for the different playing positions among the three age categories of elite female soccer players.

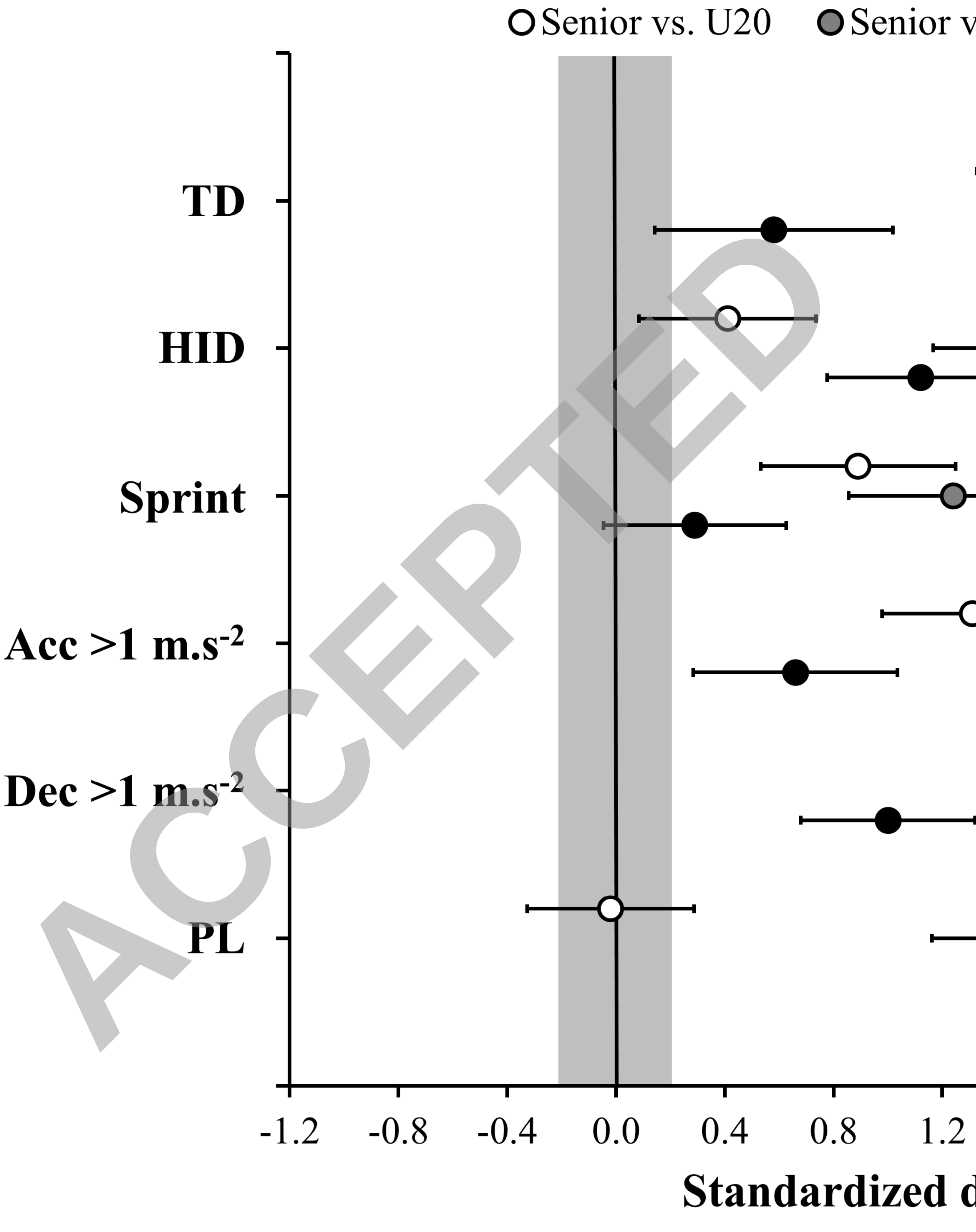
	Playing position	Senior	U20	U17	Senior vs. U20 ES [90% CI]	Senior vs. U17 ES [90% CI]	U20 vs. U17 ES [90% CI]
TD (m)	CD	10003.4 ± 954.0	8201.6 ± 513.6*	7898.9 ± 887.8*	2.04 [1.42; 2.66] *very large*	2.47 [1.63; 3.31] *very large*	0.58 [-0.55; 1.70] *small*
	FB	10237.8 ± 665.1	9072.7 ± 474.5*	8574.7 ± 996.1*#	1.63 [0.95; 2.32] *large*	2.46 [1.55; 3.37] *very large*	1.07 [-0.01; 2.13] *moderate*
	MD	10376.5 ± 981.0	8486.3 ± 702.8*	8545.7 ± 1259.5*	1.92 [1.28; 2.56] *large*	1.91 [1.19; 2.63] *large*	0.01 [-0.65; 0.63] *trivial*
	FW	9825.1 ± 894.2	9055.8 ± 459.7*	8062.3 ± 1407.4*#	0.82 [0.35; 1.29] *moderate*	2.17 [1.20; 3.15] *very large*	2.32 [0.70; 3.95] *very large*
HIR (m)	CD	590.2 ± 103.6	508.8 ± 75.8*	347.9 ± 61.2*#	0.75 [0.06; 1.44] *moderate*	2.77 [2.04; 3.50] *very large*	2.26 [1.39; 3.13] *very large*
	FB	840.1 ± 137.4	859.4 ± 99.1	636.9 ± 226.2*#	0.16 [-0.51; 0.82] *trivial*	1.77 [0.72; 2.82] *large*	2.74 [1.35; 4.13] *very large*
	MD	810.6 ± 207.0	552.4 ± 113.4*	433.8 ± 117.2*#	1.14 [0.52; 1.76] *moderate*	1.94 [1.29; 2.59] *large*	1.25 [0.68; 1.81] *large*
	FW	782.6 ± 250.5	829.8 ± 191.4	520.1 ± 243.0*#	0.23 [-0.31; 0.77] *small*	1.26 [0.58; 1.94] *large*	1.87 [1.02; 2.73] *large*
Sprint (m)	CD	198.8 ± 90.5	113.1 ± 44.1*	138.9 ± 85.0*	1.06 [0.20; 1.91] *moderate*	0.88 [-0.15; 1.91] *moderate*	0.15 [-0.80; 1.09] *trivial*
	FB	379.3 ± 119.4	331.1 ± 94.4	282.8 ± 143.3*#	0.31 [-0.38; 1.00] *small*	0.90 [0.09; 1.71] *moderate*	0.73 [-0.16; 1.63] *moderate*
	MD	298.5 ± 142.0	125.8 ± 47.9*	96.0 ± 46.1*#	1.14 [0.52; 1.76] *moderate*	1.62 [0.97; 2.26] *large*	0.80 [0.22; 1.37] *moderate*
	FW	351.7 ± 124.6	323.1 ± 110.7	247.8 ± 143.3*#	0.20 [-0.43; 0.84] *small*	1.07 [0.28; 1.85] *moderate*	0.83 [0.02; 1.63] *moderate*

Note: CD: central defenders; FB: full-backs; MD: midfielders; FW: forwards; ES: standardized differences based on effect sizes; CI: confidence interval. *Meaningful difference from senior; #meaningful difference from U20.

Table 2. Mean (± SD) of the number of accelerations (Acc) and decelerations (Dec), and player load (PL) for the different playing positions among the three age categories of elite female soccer players.

	Playing position	Senior	U20	U17	Senior vs. U20 ES [90% CI]	Senior vs. U17 ES [90% CI]	U20 vs. U17 ES [90% CI]
Acc > 1 $m.s^{-2}$	CD	217.6 ± 22.4	172.0 ± 10.2*	165.0 ± 21.5*	2.13 [1.56; 2.70] *very large*	2.56 [1.70; 3.43] *very large*	0.71 [-0.65; 2.07] *moderate*
	FB	213.8 ± 34.9	196.8 ± 19.4	199.0 ± 31.8	0.41 [-0.23; 1.06] *small*	0.39 [-0.31; 1.10] *small*	0.03 [-0.82; 0.89] *trivial*
	MD	213.6 ± 16.9	172.0 ± 18.8*	149.7 ± 16.8*#	2.52 [1.83; 3.22] *very large*	4.12 [3.41; 4.84] *nearly perfect*	1.23 [0.76; 1.69] *large*
	FW	209.5 ± 29.4	192.5 ± 29.7*	167.5 ± 34.6*#	0.59 [-0.11; 1.28] *small*	1.58 [0.80; 2.36] *large*	0.83 [0.09; 1.56] *moderate*
Dec > 1 $m.s^{-2}$	CD	161.1 ± 19.0	108.0 ± 14.0*	85.8 ± 14.9*#	3.37 [2.48; 4.26] *very large*	5.36 [4.32; 6.41] *nearly perfect*	1.57 [0.64; 2.50] *large*
	FB	181.9 ± 23.1	137.7 ± 21.2*	122.0 ± 16.3*#	1.96 [1.15; 2.77] *large*	2.79 [2.07; 3.50] *very large*	0.70 [0.07; 1.34] *moderate*
	MD	178.0 ± 18.8	111.0 ± 16.7*	92.5 ± 13.7*#	4.04 [3.33; 4.75] *nearly perfect*	5.57 [4.87; 6.28] *nearly perfect*	1.11 [0.67; 1.56] *moderate*
	FW	176.1 ± 26.9	145.5 ± 24.7*	105.5 ± 26.9*#	1.15 [0.50; 1.79] *moderate*	3.16 [2.37; 3.95] *very large*	1.87 [1.07; 2.67] *large*
PL (a.u.)	CD	892.2 ± 93.8	866.3 ± 132.2	743.6 ± 66.3*#	0.30 [-0.68; 1.28] *small*	1.62 [0.95; 2.29] *large*	0.93 [0.24; 1.63] *moderate*
	FB	1033.2 ± 92.5	987.9 ± 60.9	780.5 ± 48.2*#	0.44 [-0.23; 1.11] *small*	2.83 [2.19; 3.47] *very large*	3.37 [2.72; 4.03] *very large*
	MD	1011.7 ± 98.5	930.7 ± 130.6*	789.3 ± 62.3*#	0.80 [0.10; 1.50] *moderate*	2.23 [1.60; 2.86] *very large*	1.09 [0.71; 1.46] *moderate*
	FW	893.6 ± 145.1	952.0 ± 78.5*	691.6 ± 120.6*#	0.42 [-0.03; 0.88] *small*	1.50 [0.88; 2.13] *large*	3.69 [2.63; 4.76] *very large*

Note: CD: central defenders; FB: full-backs; MD: midfielders; FW: forwards; ES: standardized differences based on effect sizes; CI: confidence interval. *Meaningful difference from senior; #meaningful difference from U20.



Senior vs. U20
Senior v
TD
HID
Sprint
Acc >1 m.s-2
Dec >1 m.s-2
PL
-1.2
-0.8
-0.4
0.0
0.4
0.8
1.2
Standardized d