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Half soccer season induced physical conditioning adaptations in elite youth players

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ABSTRACT

This study aimed to investigate training-induced fitness changes and their relationship with training-competition load during half soccer season (18-wks). Training load [heart rate (HR) and ratings of perceived exertion (RPE)] and match time were monitored, including 108 training (3223 individuals) and 23 match sessions, in thirty-eight youth elite male soccer players. Fitness variables were assessed before and after the study. Yo-Yo intermittent recovery test 1 (Yo-Yo IRT1) improved (P<0.001; 90%CI: -632418m to -418632m; ES: 2.14). Anthropometrical, jump, sprint and change-of-directionagility measures remained unchanged. Jump test correlated with sprint (r=0.74; P<0.001; SEE=3.38$m \cdot s^{-1}$) and Yo-Yo IRT1 (r=-0.58; P=0.005; SEE=4.11m) tests. Initial sum of 6skinfold was associated with changes in this same measure (r=-0.51; P<0.001; SEE=21%). Initial Yo-Yo IRT1 results were related to Cchanges in Yo-Yo IRT1 were related to initial Yo-Yo IRT1 results (r=-0.84; P<0.001; SEE=10%) and match time played (r=-0.4844; P<=0.001033; SEE=15%445m). Mean RPE records were related to training spent within 75-90% maximal HR (r=0.54; P<0.001; SEE=4%). The half-season was beneficial for endurance running performance but not for lower-limb strength-velocity production capacity. The more aerobic deconditioned players played less minutes of match, although showed the greatest improvements in endurance performance. Soccer non-specific scientific-based and individualized fitness programs in addition to the soccer specific trainings are recommended.

Key words: European football, internal load, soccer match, preseason, small-sided games, CMJ

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Introduction

Soccer is the most popular high intensity intermittent team-sport [1]. During official matches, elite soccer players perform 150-250 short-lasting energy-demanding intense actions interspersed with periods of low-intensity jogging or running [2]. During matches, elite players cover ≈10–12 km [3], at an average intensity of 80–90% maximal heart rate (HR_{max}) [1,4]. Aerobic metabolism provides 75-90% of total energy cost of a soccer match [1,5]. The aerobic energy system plays a critical role to increase the rate of lactate removal during the phases that are performed at low intensities and to spare muscle glycogen stores during running at different speeds [1,6]. Aerobic endurance performance, indeed, discriminates soccer players of different performance levels [2,7] and aerobic endurance performance enhancement increases the number of sprints and distance covered during a match and promotes more ball involvement [4,7]. It is therefore considered that there is an aerobic endurance performance threshold below which an individual player is unlikely to play in top-class soccer [2,7]. Anaerobic energy system plays also an important role. Most crucial events are represented by high-intensity predominantly anaerobic activities [2]. For instance, the majority of the goals are preceded by a linear sprint, vertical jump or change of direction of either the scoring or the assisting player [8]. These actions contribute to 1-11% of total distance covered [9], but constitute the most decisive events of competitive matches [10]. These actions require high strength generation by lower-limb muscles [11]. Functional lower-limb strength indicators such as jump height and 10-30m sprint performance robustly (r = 0.71-0.94) correlated with maximal muscular strength (1RM half-squat) in professional soccer players [12]. Certainly, vertical counter-movement jump (CMJ) height and 10-40m running sprint times distinguish soccer players of varying standards of play [13]. Thus, lower-limb muscle strength and sprint velocity are important factors that give a clear advantage for successful participation in elite soccer [1]. Well-developed and balanced aerobic endurance and lower-limb strength-related conditioning is essential for high-performance in modern soccer [7,9,10]. The conditioning staff of a soccer team needs therefore to be aware of the physical status of each player in order to design proper trainings and adequately interpret the data registered during the monitoring of soccer training and competitions for suitable soccer training guidance.

To the best of our knowledge no study has investigated the relationships between physical conditioning markers before and after the course of half-season in youth soccer players. Examination of these relationships seems of paramount importance [13-19] for optimal construction of the physical and sport-specific conditioning programs aiming to improve soccer performance in youth players. This study, hence, investigated the physical fitness and anthropometrical training-induced changes that took place over half-season in 2 youth elite soccer teams.

Materials and Methods

Participants

Thirty-eight young [age 18.7 ± 1.1 yrs (range: 16.2 to 21.7)] male soccer players from the 3rd and 4th youth teams belonging to a professional elite first division club of the Spanish “La Liga” volunteered to participate in the study. Participants, and when appropriate their parents or legal guardians, acknowledged voluntary participation through written-informed consent. Procedures were approved by the Local Institutional Review Board conformed to the Declaration of Helsinki. The study meets the ethical standards of the journal [20].

Study Design

A longitudinal observational study aiming to examine the effects of a half soccer season on physical conditioning markers was conducted. Thus, training content was not altered for the purposes of this study. Within primary research there are observational and interventional studies. Observational studies have limited control over confounding factors compared to interventional studies. However, they observe the state of the world without manipulating it. Hence, this longitudinal observational field-based study conducted during regular in-season scientific support given to 2 soccer teams might have enhanced the applicability of the results. The abovementioned teams were monitored throughout an 18-wk period, including 108 training (3223 individual) and 23 match sessions (13 friendly plus 10 official match sessions). Anthropometric measures and physical test (vertical jump test, 15-m sprint running test, change-of-direction agility test and endurance running test) were assessed twice, before and after the study. Individual training load [heart rate (HR) and ratings of perceived exertion (RPE)] and match time were quantified. Understanding the effects of periodized training and competition on physical conditioning and anthropometric changes may provide insights to enhance performance in elite youth soccer players.

Testing Procedures

The 18-wks training period consisted of a preparatory (weeks 1-8) and half competitive season (weeks 9-18) periods. During pre-season (weeks 1-8) both teams played 13 friendly (un-official) matches. During in-season period (weeks 9-18) each team played 10 official soccer matches. Participants were tested on two occasions. The first test (T1, 1st of July) was performed on the first day of the preparatory period. The second test (T2, 9th of December) took place 18-wks later. Testing was integrated into weekly training schedules according to teams' staff. Tests were performed after 1 day of minimal physical activity, at the same time of the day to lessen circadian variability, and were conducted on an indoor artificial turf field. Participants were familiarized with the testing procedures as they were previously tested on several occasions in preceding seasons using same procedures for training guidance purposes. Prior to the physical performance assessments, anthropometric evaluation was conducted following procedures recently described [21]. Physical performance tests were conducted after a standardized 15-min warm-up period that included low-intensity running, several acceleration runs, and stretching exercises, in the following predetermined order: 1) maximal jump test, 2) maximal 15-m sprint running test, 3) change-of-direction agility test and 4) endurance running test. Participants were vigorously encouraged to perform maximally in every test.

Vertical jump test

Two sets of 2 maximal CMJ with ≈90º knee flexion, interspersed by 10-sec rests, were performed on a hard flat surface. CMJs heights were registered (Optojump Next, Microgate, Italy) and best readings used for further analysis.

15-m sprint running test

Participants performed 3 maximal 15-m sprints, interspersed by 180-s, on an indoor court. Participants commenced the sprint when ready from a standing start position, 3-m behind the start. Time was automatically activated (Polifemo, Microgate, Italy) as the participant passed the first gate at the 0-m mark and switch off in the 15-m gate. Fifteen meter running was chosen because it is the average sprint length observed during official matches in elite soccer players [3]. The best run was selected for further analysis.

Change-of-direction *~~Agility~~ test*

The modified Barrow zigzag running test [22] was conducted. The test protocol intends to measure players' change-of-direction~~agility~~ of movements following a pre-determined route in a 5x5-m square. Time (s) was measured using electronic timing lights (Polifemo, Microgate, Italy) positioned at the beginning and arrival of the test. Players performed 3 trials, with 3-min rest period between them. Best trials were kept for further analysis.

Endurance running test

The Yo-Yo Intermittent Recovery Test 1 (Yo-Yo IRT1) [15] was conducted on an indoor court. The test consisted of repeated 2x20-m runs back and forth between the starting, turning, and finishing line at a progressively increased speed controlled by audio bleeps emitted from an audio-emitting player [15]. Athletes had a 10-s active rest period between each bout, jogging in a distance of 2x5-m. Players ran until they were no longer able to maintain the required speed. The test ended when participants failed to reach the finish line at the beep signal on two consecutive occasions. HR_{max} was considered the highest HR recorded at 1-s interval using Polar Team Sport System (Polar Electro Oy, Finland).

Following testing procedures above described, sum of 6 skinfold, CMJ height, 15-m sprint velocity, change-of-direction ~~agility~~ test time, and Yo-Yo IRT1 distance have shown intraclass correlation coefficients of 0.87-0.98 and coefficient of variations of 0.7-6.9% in elite soccer players of similar age [13,21,23].

Training and Competition Data Collection and Analyses

Every player attended to >70% of total training sessions and usually performed 4-6 training sessions plus 1 official match per week. Training sessions lasted 60-120 min. Training sessions were always focused on developing playing strategies, and were mainly based on small-sided games (SSGs) with technical and tactical specific objectives. Some other skill activities or soccer tasks, always with ball, were also conducted. Soccer nonspecific endurance or resistance training was never performed.

Training and match sessions' duration were recorded for each player from the start to the end of the sessions, including time spent on warm-up and recovery in the case of the training sessions. Players wore the HR monitors abovementioned during all training sessions to objectively quantify training sessions' individual internal load. Match HR was not registered because wearing HR monitors during official competitive matches was forbidden at the time. All players were regularly asked to check their HR monitors during training sessions. The training sessions' physiological intensity was indicated by both mean absolute (b·min^{-1}) and relative (%HR_{max}) HR values. Time spent within specific HR zones (<75%, 75-90% and >90%) was also computed [14] ~~was also computed~~.

Following procedures previously described [14], ≈10-min after completion of each training session a rating of the difficulty of the whole training session was solicited from each participant using the modified [24] 0–10-point Borg's RPE scale. We explained to participants that we wanted a global rating of the entire training session, using whatever cues they felt appropriate, aiming to get an uncomplicated response reflecting players' global workout impression. We delayed securing session-RPE for 10 min so that particularly difficult or particularly easy segments toward the end of the exercise bouts would not excessively influence participants' ratings [24]. Players' RPE was obtained without the presence of any other player. Participants were familiarized with the use of the 0-10-point scale before data collection.

Statistical analysis

Standard statistical methods were used for the calculation of means, standard deviations (SD), standard errors of the estimates (SEE) and confidence intervals (CI). Data were analyzed using parametric statistics following confirmation of normality (Kolmogorov–Smirnov test) and homoscedasticity (Levene´s test). Student's paired *t*-tests were used to evaluate differences between T1 and T2. The magnitudes of the differences were assessed using 90% CI and Hedges' *g* effect sizes (ES) [25]. Differences were considered non-substantial if the 90% CIs overlapped zero [19]. ES values of 0.2, 0.5, and >0.8 were considered to represent small, moderate and large differences, respectively [26]. Linear regression analyses with *Pearson*'s product-moment correlation coefficients (r) were ~~performed~~ used to determine the direction and magnitude of the relationships between the variables of interest. Evaluation of Cook's distance revealed minimal influence of the individual data points on the correlation magnitudes [27]. The magnitudes of the correlations were interpreted as follows: 0.1–0.3, small; 0.3–0.5, moderate; 0.5–0.7, large; 0.7–0.9, very large; and .0.9, extremely large~~ES and r values were interpreted as described elsewhere~~ [26]. The accuracy of each linear regression was evaluated using the SEEs and the 95% CIs for the slope [27]. ~~Post-hoc power calculation for the linear regressions, assuming type I error of 0.05, indicated a power >99%.~~ Analyses were performed using IMB SPSS Statistics 22 (IBM Corporation, USA). Significance was set at P < 0.05. Descriptive statistics are reported as means (±SD).

Results

Tests results are reported in **Table 1**. Distance covered during the Yo-Yo IRT1 increased 26 ± 18% (range: 0 to 59) from T1 to T2. No other clinically noteworthy changes were detected.

During the 18-wk half soccer season monitored, players performed 92 ± 10 training sessions (range: 72-108), i.e. 5.2 ± 0.6 training sessions per week (range: 4.0-6.0), corresponding to 6132 ± 1168 min of training (range: 3594-8456), i.e. 341 ± 65 min of training per week (range: 200-407). Average min of match played for both teams was 1290 ± 408 min (range: 555-1969), corresponding to 72 ± 23 match min per week (range: 31-109). Non-attended training, match and testing sessions were all due to injury. Total days of injury were 13 ± 9 (range: 0-31).

Players trained 6132 ± 1168 min (range 3594 to 8456). They trained 4677 ± 1034 min (range 2283 to 6830) bellow 75%HR_{max}, 1307 ± 330 min (range: 789 to 2208) within 75-90%HR_{max} and 148 ± 154 min (range 6.5 to 694) above 90%HR_{max}. **Fig. 1A** shows time spent at training within each HR zone relative to total training time. Concerning RPE magnitude (**Fig. 1B**), most (80%) training sessions were perceived with a session RPE magnitude between 5 and 8. Only 12% of total training sessions were perceived as very light to light (RPE 1-4) and 8% as extremely hard sessions (RPE 9-10).

CMJ at T1 very largely correlated with 15-m sprint running speed at T1 [(r = 0.74; P < 0.001; standard errors of the estimates (SEE) = 3.38m·s^{-1}; 95% CI: 9.06 to 22.37],), and negatively with distance covered during the Yo-Yo IRT1 at T1 (r = -0.58; P = 0.005; SEE = 4.11m; 95% CI: -0.14 to -0.003).

Changes (%T1) in sum of 6 skinfold were negatively associated with changes (%T1) in CMJ (r = -0.53; P = 0.014; SEE = 21%; 95% CI: -5.24 to -0.68). Changes in sum of 6 skinfold were, besides, negatively related to initial sum of 6 skinfold values (**Fig. 2**). Similarly, a very large negative relationship was observed between distance covered during the Yo-Yo IRT1 at T1 and changes in this measure observed from T1 to T2 (**Fig. 3A**). Changes in Yo-Yo IRT1 were also negatively correlated with total match time played (**Fig. 3B**). Moreover initial Yo-Yo IRT1 performance at T1 was positively associated with total match time time played (r = 0.44; P = 0.033; SEE = 455m; 95% CI: 0.06 to 1.26). No other relevant meaningful relationship was encountered found between training variables and changes in physical conditioning markers.

Fig. 4 reports the large relationship encountered observed between mean RPE records during training sessions and training time spent within the 75-90% HR_{max} zone.

Discussion

The foremost findings of this study were as follows: (a) the half soccer season studied led to remarkable endurance performance improvements in our youth elite male soccer players; (b) maximal jump, maximal running sprint and change-of-directionagility test performances remained unchanged over the studied period; (c) changes in body fat percentage indicator (sum of 6 skinfold) and endurance performance (Yo-Yo IRT1) were large to very large inversely related with their respective initial values before the commencement of pre-season; (d) changes in sum of 6 skinfold were negatively associated with changes in jumping capacity (CMJ), and (e) changes in endurance test performance were negatively related to total match time played.

Teams' average sum of 6 skinfold thickness, a fairly good representative of body fatty mass, remained unchanged during the half-season. Superfluous body fat is disadvantageous in soccer because it acts as dead weight, thereby decreasing sprint and endurance running performances [28]. The large negative relationship between changes in sum of 6 skinfold and changes in CMJ from T1 to T2 further supports this notion. This relationship shows that players decreasing their sum of 6 skinfold thickness tended to improve their vertical CMJ capacity to a greater extent compared to those players gaining skinfold thickness. A negative correlation was also observed between individual initial skinfold thickness values and individual changes in this measure observed from T1 to T2. This indicates that players with higher initial percentage of body fat tended to lose more fat mass (i.e. improve their initial values) compared to players with lower (i.e. better) initial body fat values. Gradual and reasonable individual body fat reduction programs, supervised by professional guidance, should be recommended in, at least, some soccer players with the aim to improve their physical conditioning. It is worthy to emphasize the importance of the professional supervision guidance throughout the individualized body fat reduction programs. Body fat decrease has been observed to be accompanied by a concomitant decrease in muscle power in elite male team-sport athletes [16] when body fat reduction programs were not professionally supervised.

The non-improvements in the strength-velocity related variables observed are consistent with results reported in youth elite [14] and professional soccer players [28], as well as in other team-sport athletes [16]. A possible reason explaining the minor strength-velocity performance changes might be related to a differed and interfering strength- and endurance-related soccer specific training-induced adaptations among players [29]. In agreement with others [29,30], the remarkable improvements in the Yo-Yo IRT1 performances could have hampered strength-velocity performance improvements. The very large inverse relationship encountered found between CMJ and Yo-Yo IRT1 further supports this suggestion. Lower-limb explosive force production indicators have also been observed to negatively correlate with endurance performance indicators in other elite professional soccer and futsal players [28]. These observations evidenced that within elite soccer teams it is common to find 2 opposed physical players' profiles, 1) players with limited endurance capacity and desirable strength-velocity values, and 2) players with limited strength-velocity values but desirable endurance capacity. This highlights the great need of individualized training programs during pre- and in-season periods [9,16] taking into account the strength-velocity, but also endurance, individual profiles. Nevertheless the most likely explanation is that the soccer specific training performed throughout the half-season was insufficient or inadequate stimulus to induce strength-velocity related positive adaptations, as previously observed in other youth elite players of similar age [31,32] and recently claimed [33].

One of the main findings was the remarkable mean 26 ± 18% increase observed in the Yo-Yo IRT1 during the 18-wk period. Training and competition sessions were, consequently, categorized as relevant stimuli to improve teams' average endurance capacity. These results indicate that in youth elite soccer players with initial average Yo-Yo IRT1 values close to 2200m, 18 weeks of soccer specific training based on SSG with a mean duration per week of 260 min below 75-90%HR_{max}, 73 min within 75-90%HR_{max}, and 8 min above 90%HR_{max}, distributed along 4-6 training sessions per week, is accompanied by a 26% improvement in the capacity to perform intermittent running of increasing speed. The magnitude of improvement was, however, very different across participants. Thereby, a very large negative correlation was observed between the Yo-Yo IRT1 results at T1 and changes in this measure observed from T1 to T2. In concordance with that observed in other young soccer players [34], this indicates that players showing lower initial Yo-Yo IRT1 values tended to improve their endurance performance to a greater extent compared to those players with higher initial endurance level. This could also indicate that the non-individualized soccer specific training based on the same SSGs for every player was an inadequate aerobic training stimulus for players with relatively high initial endurance level. This is a reasonable explanation taking into consideration that common SSGs training (SSGs with individual playing area <100m^2) reduced effective playing time as well as internal (e.g. %HR_{max} and RPE) and external (e.g. distance covered at high intensity, maximum speed or sprint frequency) load [35]. A soccer non-specific high intensity interval training without ball, previously described with successful results [4], or an equivalent aerobic endurance training with ball [36], which is much more difficult to individualize and hence to carried out on real practice, is suggested to overcome this issue in the mentioned high endurance level players. On the other hand, players with higher initial endurance performance level played more match time than those with lower initial level. A well-developed endurance conditioning seems, therefore, pertinent to tolerate training and competition loads in order to play competitive matches in youth elite soccer teams. Further studies are required to determine the appropriate SSG training stimulus required to enhance aerobic conditioning in soccer players with high initial (≈2800m in Yo-Yo IRT1) aerobic performance level.

Three thousand two hundred and twenty-two three individual training session-RPE records were obtained to assess players' global impression of the workouts. An interesting finding was that RPE was ranged 5-8 in >80% of total training sessions. These values are similar to those observed at the end of official matches (average RPE: 6-7.5) in young professional soccer players [12,14] suggesting that the great majority of the training sessions were perceived as "very strong". To validate the RPE as a tool to monitor training intensity, we examined the relationships between RPE and an objective measure of cardiovascular strain. Regression analysis showed that individual average training session-RPE correlated with average time of training spent at 75-90%HR_{max}. The magnitude of the correlation (r = 0.54) is in the lower range (r = 0.50-0.85) compared to that previously reported in different team-sports athletes during different training periods [37,38], but further supports RPE method as a fairly estimator of HR-based method. Both RPE and HR-based methods could be considered appropriate tools to monitor average internal training load in team-sports such as soccer [37]. However, due to the individual nature of the relationship and the low correlation magnitude observed, accounting only for 30% of the variance, calibration of the individual relationships between RPE- and HR-based methods is recommended for a proper evaluation of the exercise sessions.

Practical applications

Based on the results of the regression analyses among physical conditioning markers and training and competition load quantification found in this study, practical on-field applications are as follows: (a) Professionally supervised individual body fat reduction programs aiming to improve physical fitness (e.g. jump capacity) are recommended in some soccer players. (b) Due to the high intensity intermittent nature of soccer and the on-field practical limitation to individualize soccer training with ball, individualized soccer non-specific systematic and scientific physical fitness training programs are advisable to customize for each player and integrate along with soccer specific training. Soccer non-specific low-intensity explosive strength [31,32] and high-intensity interval endurance [4] training sessions consisting of 21-30 min twice a week were successfully integrated to soccer specific training. These training interventions showed positive physical (strength-velocity and endurance), and also soccer specific, performance adaptations. (c) The low correlation magnitude between RPE- and HR-based methods indicated the need to individually calibrate the RPE vs. HR relationships for a more appropriate monitoring of the training and match sessions' load, particularly in teams with limited resources and not enough HR monitors for every player.

Conclusions

The half-season studied produced remarkable beneficial average endurance running improvements, but did not produced any other beneficial anthropometric or strength-velocity improvement in our youth male soccer players. The absence of improvements observed in the anthropometric or strength-velocity variables may be explained by the interfering excessive soccer specific training time [elevated training time spent at low-intensity (<75%HR_{max}) and low training time spent at high-intensity (>90%HR_{max})] together with the lack of customized soccer non-specific fitness programs inducing the appropriate individualized training stimuli. A low-developed initial endurance conditioning was unfavorable to play every weekend. Further studies are required to determine the appropriate training stimuli required to enhance anthropometric and physical conditioning in youth elite soccer players. Careful individualized attention to customized training programs during pre- and in-season soccer periods is warranted.

Conflict of interest

The authors declare no conflict of interest

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Figure legend

Fig. 1. Mean (SD) time spent within each heart rate (HR) zone [<75%, 75-90% and >90% maximal HR (HR_{max})] relative to total training time (A) and session rating of perceived exertion (RPE) records within each RPE range (1-2; 3-4; 5-6; 7-8; 9-10) (B) relative to total number of training sessions (n = 38).

Fig. 2. Linear negative relationship between initial (T1) individual sum of 6 skinfolds values and individual changes in sum of 6 skinfolds (relative to initial values) from the start (T1) to the end (T2) of the half soccer season. Solid line: linear regression. Dashed lines: 95% confidence intervals.

Fig. 3. Linear negative relationships of the individual changes in distance covered during the Yo-Yo Intermittent Recovery Test 1 (Yo-Yo IRT1) from the start (T1) to the end (T2) of the half soccer season with the individual distance covered during the Yo-Yo IRT1 at T1 (A) and the individual match time played (B). Solid lines: linear regressions. Dashed lines: 95% confidence intervals.

Fig. 4. Linear relationship between individual mean session ratings of perceived exertion (RPE) recorded during trainings with training time spent within the 75-90% of maximal heart rate (HR_{max}) zone relative total training time. Solid line: linear regression. Dashed lines: 95% confidence intervals.

Table 1. Anthropometric and physical assessments' results before (T1) and after (T2) the studied 18-wk half soccer season

	n	T1	T2	Δ (%)	90% CI	ES	p
Age (yrs)	38	18.7 ± 1.1	N/A	N/A	N/A	N/A	N/A
Body mass (kg)	35	70.4 ± 6.4	70.6 ± 6.4	0.3 ± 4.2	~~-0.02~~ -0.68 to ~~0.68~~1.02	0.03	0.763
Height (cm)	35	180.4 ± 5.8	180.6 ± 6.1	0.3 ± 0.6	~~-0.88~~0.27 to -0.~~27~~88	0.10	0.003
Sum of 6 skinfolds (mm)	35	49.3 ± 12.0	46.8 ± 11.0	-1.6 ± 25.2	-~~1.05~~6.00 to ~~6.00~~1.05	0.22	0.243
CMJ (cm)	22	44.3 ± 4.9	43.7 ± 4.3	-1.1 ± 4.3	-~~0.17~~1.31 to ~~1.31~~0.17	0.13	0.196
Sprint test (m/s)	22	7.23 ± 0.23	7.19 ± 0.26	-0.4 ± 2.2	-~~0.02~~0.10 to ~~0.10~~0.02	0.13	0.277
~~Agility~~ Change-of-direction test (s)	20	10.37 ± 0.26	10.29 ± 0.25	-0.8 ± 2.4	-~~0.01~~0.18 to ~~1.75~~0.01	0.39	0.134
Endurance test (m)	22	2197 ± 328	2716 ± 242*	26.2 ± 17.6	~~-632~~418 to -~~418~~632	2.14	< 0.001

n: number of participants that completed both T1 and T2 assessments; *Δ*: change from T1 to T2; *90% CI*: 90% confidence intervals; *ES*: effect size; *CMJ*: countermovement jump; *N/A*: not applicable

* Significantly different from T1 (P < 0.001)

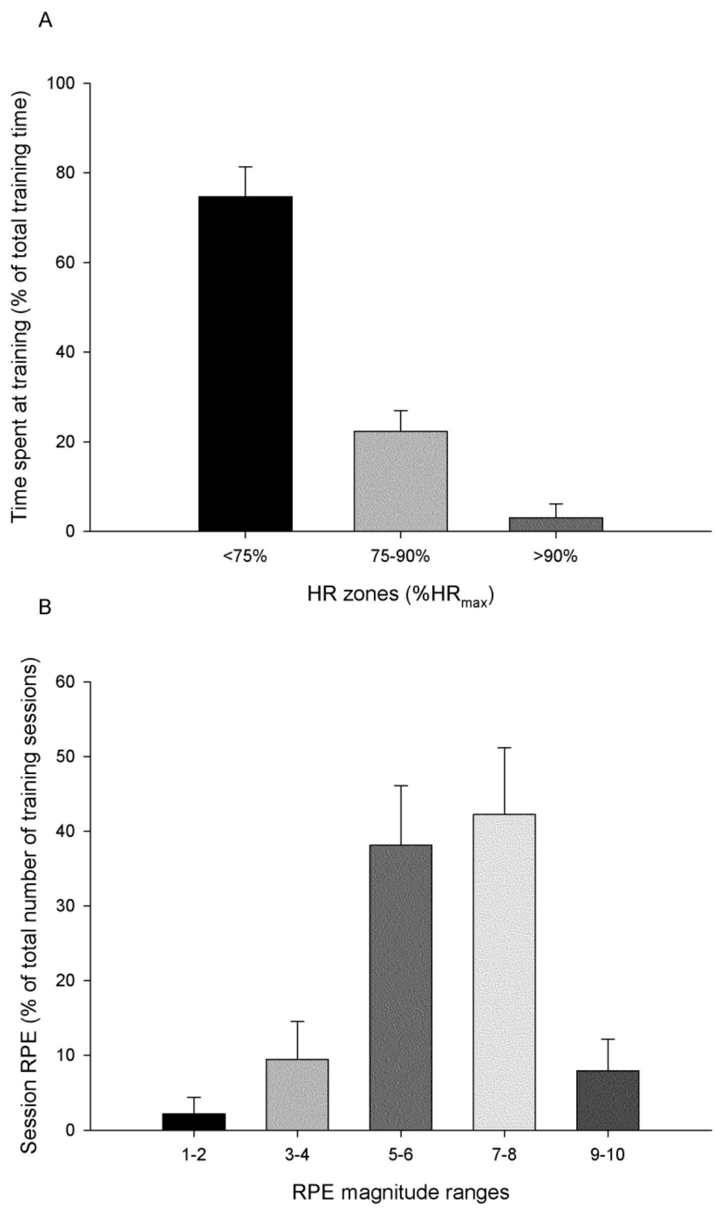

Fig. 1. Mean (SD) time spent within each heart rate (HR) zone [<75%, 75-90% and >90% maximal HR (HRmax)] relative to total training time (A) and session rating of perceived exertion (RPE) records within each RPE range (1-2; 3-4; 5-6; 7-8; 9-10) (B) relative to total number of training sessions (n = 38).

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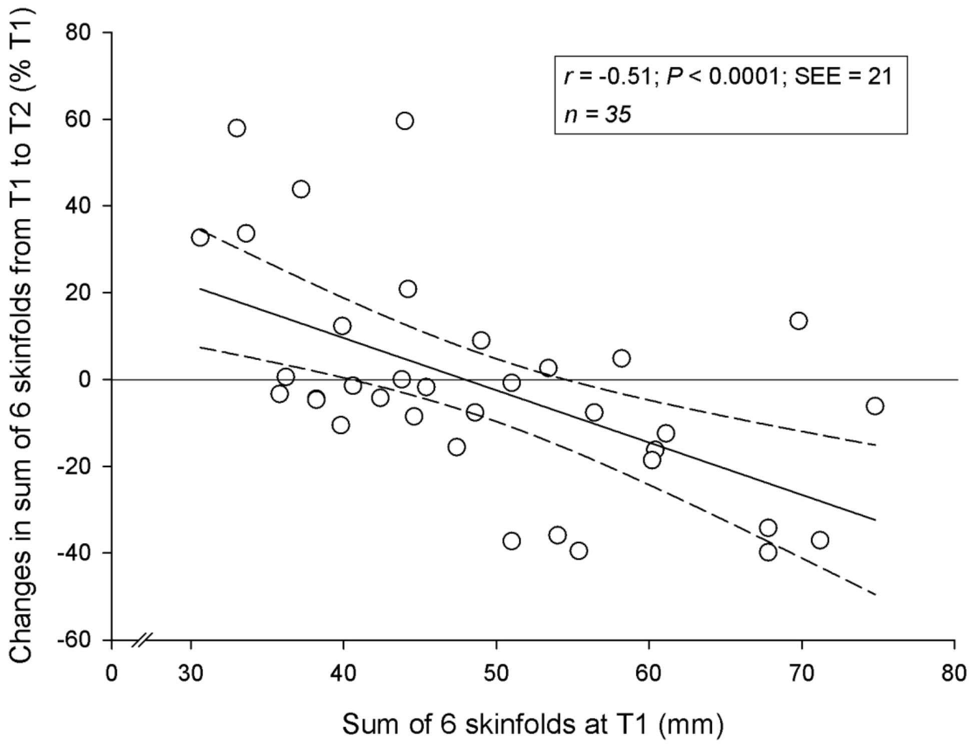

Fig. 2. Linear negative relationship between initial (T1) individual sum of 6 skinfolds values and individual changes in sum of 6 skinfolds (relative to initial values) from the start (T1) to the end (T2) of the half soccer season. Solid line: linear regression. Dashed lines: 95% confidence intervals.

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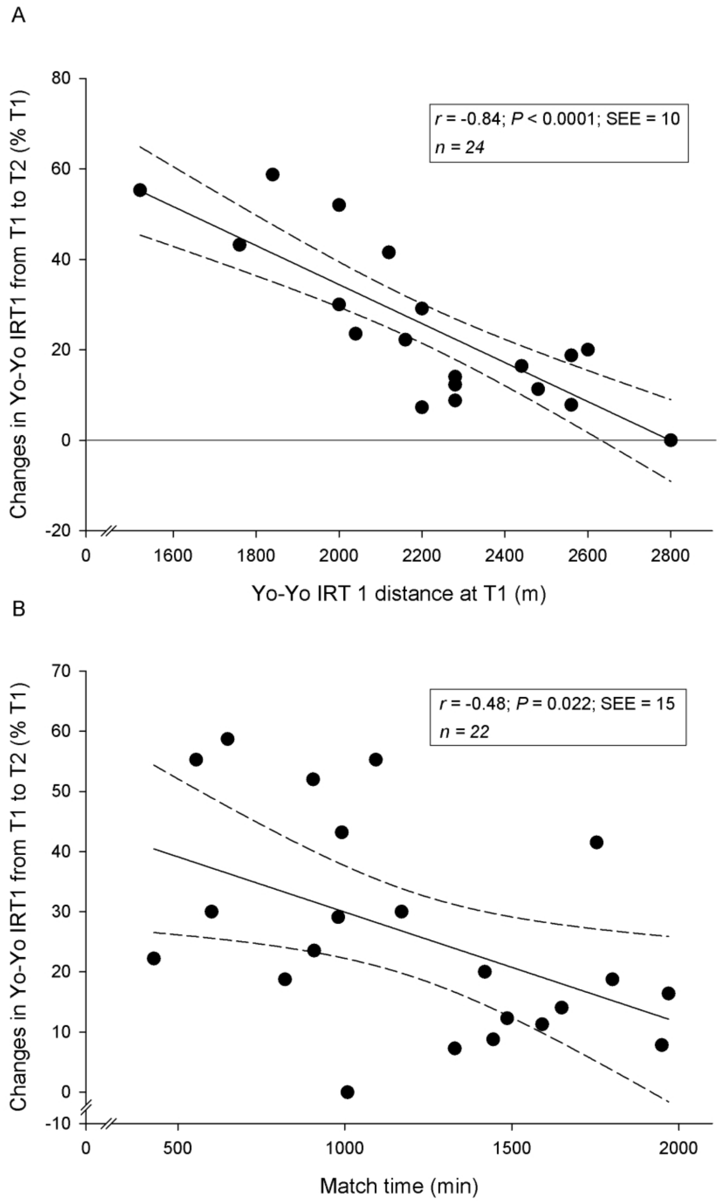

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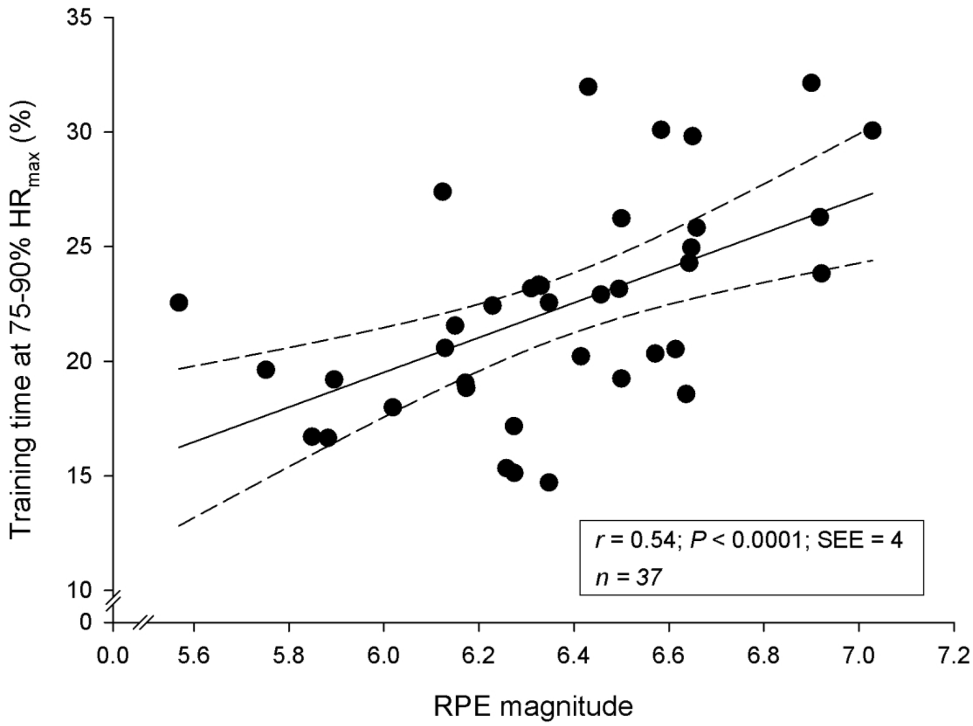

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