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# Does running performance in small-sided games have a relation with postural control in youth soccer players?

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**Abstract**

Running speeds of and the distances covered by footballers during matches or small-sided games have been well determined. However, there is no study associating the properties of these parameters with the postural control properties in small-sided games (SSG). The aim of the present study was to determine the relationships between parameters designating postural control levels and running speeds in SSG. Sixteen youth players (age 17.2 ± 1.02, height 176.25 ± 0.072 cm, body mass 67.67 ± 13.27 kg) voluntarily participated in all the tests. Postural control was evaluated using one and both leg stance positions by measuring postural sway specify according to Center of Pressure (CoP) at anterior – posterior (ap) and medial – lateral directions. Movement data were collected using a 10-Hz global positioning system from games during the 1vs1, 2vs2, 3vs3 SSG, including measures of speed and the distance covered at those speeds. The main findings of our study showed a significant relationship between the running speeds of 0-6 km · h$^{-1}$, 6-10 km · h$^{-1}$ and 10-16 km · h$^{-1}$ which can be defined as the velocities used in acceleration and direction changes and the postural parameters of $CoP_{dap}$, $CoP_{dvel}$, $CoP_{ndvel}$ and $CoP_{ndvar}$ (r-values ranging from 0.503 to 0.639) levels in 2vs2 and 3vs3 games.In conclusion, when improvement of postural control, which is a variable that can lead to an increase in athletes' competing performances, is desired, combining practices that are designed to work out postural control parameters separately with football specific exercises (combined training) in a single training session would make significant contributions to competing performances of athletes.

**Key words:** Balance, football, running, pedobarography, football match.

## INTRODUCTION

One of the world's most popular sports, football, has a complex structure requiring the combined practice of technical, tactical and physical skills (20). When the aspect of the physical skills included in this complex structure is examined during a match, it is seen that athletes end a football match by using 90% of their aerobic capacities actively and at levels of approximately 75% of their $VO_{2max}$ values (3,20). Within these intensities, players cover an approximately 10-12km distance during a match and 3% to 7% of this distance consists of high intensity activities (13). High intensity activities are usually performed as multiple sprints and at different speeds (37). High intensity activities at different intensities can be categorized as acceleration, maximal velocity and agility performance. Since agility performance includes runs of direction change when compared to acceleration and maximal velocity, unlike flat runs like sprint, it is affected by strength, motor learning processes and biomechanical factors (46). Being one of the biomechanical factors, agility performance is also related to balancing ability due to the complex components it includes such as sudden stops and accelerations (29).

Balancing or postural control consists of audio-visual and proprioceptive elements included in the peripheral nervous system. Responses to external stimuli contribute significantly to the body in maintaining postural control (19) by sending stimuli to the joint capsules, muscle spindles and golgi tendon organs within the concerning proprioceptive system in a certain period of time based on the athletes' muscular activations and the coordination of these structures (15). For these reasons, it is stated that balancing is an important factor for agility performance (34) and that balancing ability is one of the auxiliary elements in finalizing agility performance in the best way by providing athletes with the correct posture position (45). Among the studies carried out on agility performance, while Pauole et al. (42) found low relationships (0.27–0.32)between velocity and agility performance, Salaj & Markovic (44) showed medium level correlations (0.52–0.73) between these features and Markovic et al. (32) and Young et al. (52) clearly reported that there were low correlations between leg extensor strength and agility performance. However, Sekulic et al. (45) claim that all these studies cannot sufficiently explain the relationships between agility performance and other physical mechanisms and state that these relationships must be examined in different environments as well.

As they reflect the high intensity parts of a football match and allows for the performance of the branch specific property of endurance and tactical exercises within the same training session, SSGs have been a frequently used training method in football training sessions (25). Studies have shown that SSGs produce an effect of volume equal to the maximal heart rate($HR_{max}$) levels of 80-90% observed during a football match and that this volume varies by the game field, number of players, duration of the game and performance levels of the opponents (10,22,24,49). In addition, depending on the changes in the game intensity in SSGs, differences are observed particularly in sprints and distances covered by high volume runs which are among the time- motion characteristics (23). The rate of these high running velocities to the total distance covered in the match and their effective use occur at higher levels (1,8 – 16,3%) in SSGs than in matches (11,12). These movement profiles prove that small sided games constitute the highest volume parts of football matches and imply that athletes with better balancing levels can perform acceleration and high volume activities at higher levels.

In this respect, the aim of the present study was to examine possible relationships between the parameters of footballers' postural control properties and their different running velocities during SSGs played with a varied number or players. It was hypothesized that footballers who have higher postural control levels (postural sway velocity, right-left postural sway, front-back postural sway) while standing on single foot and both feet (eyes open and eyes closed) would be better at using high volume activities and movements like sudden stops and re-acceleration during the game.

## MATERIAL & METHODS

Eighteen football players competing in the youth amateur league participated in the study voluntarily (the data of the goal keepers in SSGs and the 2 athletes who failed to meet the criteria of participation were excluded from records and evaluations) (age 17.2 ± 1.02, height 176.25 ± 0.072 cm, body mass 67.67 ± 13.27 kg). The study sample consisted of athletes who have been playing football for at least six years, join 4 training sessions a week on a regular basis (2±0.5 hours per training) and play in 1 official match each week.The Institutional Ethical Committee of the University approved (13/07/2015, 15-6/4) the study and written informed consent form was obtained from all the players before participation.

On a predetermined day prior to the tests to be applied in the study, the athletes and their families were informed about the topic, purpose, possible damages and benefits of the study. Voluntary consent forms were read and signed by the athletes and their families (for athletes under 18). On the same day, a familiarization session was held by performing two sets of each movement concerning the procedures to be applied for the athletes' adaptation to postural control tests and test team. On the day after the regeneration training, athletes' body height and body mass were measured and skinfold measures were taken to determine their body fat ratios. Upon completion of these measurements, postural control tests were initiated. One week after these measurements (every other day following the recovery training), 1vs1, 2vs2 and 3vs3 small sided games were performed respectively. After the warm-up part of the 1vs1 games session 5-20 m sprint tests of the athletes were implemented 3 times with 3minute-resting intervals.

### Anthropometric measurements

The athletes' body mass and height were measured in shorts and with no shoes. Body fat ratios were determined with Harpender caliper using skinfold method in which the thickness of skinfold from concerning parts of the right side of the body is measured (Holtain Ltd., UK). Skinfold measurement was taken from 7 parts of the body namely the triceps, subscapular, axilla, chest, suprailiac, abdomen and thigh. All anthropometric measurements were taken by the same researcher. Estimated body density was calculated using the equation developed by Durnin & Rahaman (14) for men. The data obtained from this equation were put on formula and body fat ratios were found for each athlete (48).

**Sprint test**

Tests for determining the participants' 5 and 20 metre sprint times were performed in the same field and at the same time as the small sided games to be played. Testing was carried out on the 2nd day following the recovery training held on the 1st day after the official matches played by the participants. Prior to the sprint test, the athletes were given a dynamic stretching warm-up protocol which was performed onsome footballers of the similar age group to the study sample and had a positive effect on short distance sprint times (36). Following the warm-up session, 3×20 metre sprint testwas performed with 3 minute-resting periods after each sprint. Sprint test results were recorded by the gates with infrared sensors (Newtest Oy, Oulu, Finland) placed on the start, 5 m and 20 m finish lines.

**Postural control test protocols**

Prior to the test, the athletes were given the injury preventive "HarmoKnee" exercise procedure, which provides a planned warm-up program and causes less forcing on the knee joint (8). Postural control was calculated using the center of pressure (CoP) deviations in anterior- posterior (ap) and medial- lateral (ml) direction while standing on one leg and two legs. To obtain a quantitative description of postural control, the following CoP parameters, dominant (d) and non-dominant (nd) leg; anterior-posterior sway ($CoP_{dap}$ and $CoP_{ndap}$), medial-lateral sway ($CoP_{dml}$ and $CoP_{ndml}$), sway velocity ($CoP_{dvel}$) and sway average ($CoP_{dvar}$), both feeteyes closed right-left postural sway ($CoP_{ecml}$), both feet eyes closed right-left postural sway velocity ($CoP_{ecvel}$) and sway average ($CoP_{ecvar}$) were computed. Postural sway measurements were taken using HR Mat (TekScanInc, Soth Boston, MA, USA) pedobarography device (area of perception 487.7 x 447.0 mm, 4 sensors per $cm^2$, pressure rate 862 kPa, mat height 0.57 cm). The procedure for calibration was conducted according to the manufacturer's directions prior to each measurement. One practice trial was allowed before the beginning of data collection and all subjects were tested barefoot. Foot standing positions for both feet was standardized on HR Mat according to the pre-designed scheme so as to arrange intermalleolar distance as 5 cm and feet opening angle as 30°. The same scheme was used for one feet posture and while the dominant foot was on the mat, the other foot was bent 90°from the knee and standardized with the sole pointing to the back and tibia parallel to the ground (16). The effects of joint kinetics that were likely to change upon these arrangements were tried to be eliminated. The dominant leg was specified by asking the athletes which leg they use to kick a ball (13 right-legged and 3 left-legged persons).The participants were told to stand upright looking at the visual target placed at eye level in 2m distance and measurements were started 5 seconds after they said they were ready. Measurements were taken in 2 × 30 seconds with 3 min. rests between repeated measures for each posture position, with eyes open (EO) and eyes closed (EC).Data from the measurements were recorded as 1500 points in total with 50 Hz frequency. The Sway Analysis Module (SAM™) software was used to analyze the data.

As an important note, the fact that values of postural control variable calculated from the center of pressure deviations were lower means that the variable belonging to this value is better.

**Small-sided games**

Small sided games took place in 3 different formats in which official competition rules were used and the number of players differed. For 1vs1, 2vs2, 3vs3 games, common pitch sizes in the literature and methods of practice (game times, resting periods, number of repetitions) used for these games were preferred (14,15). In this respect, games 1vs1, 2vs2 and 3vs3 were played in pitches of 15×10 m = 150 $m^2$ (1:38 $m^2$ pitch ratio per player), 18×24 m =432 $m^2$ (1:72 $m^2$ pitch ratio per player), 30×40 m pitch sizes =1200 $m^2$ (1:150 $m^2$ pitch ratio per player), for 4×1 min, 4×2 min, 4×3 min and with 1 – 2 – 3 min recovery periods between games respectively. Player matches in SSGs were done through randomization and the players were supported with continuous verbal motivation by the practitioner to allow them to make maximum effort during games.

**Total distance and running velocities**

Maximum running velocities of the athletes and the total distances covered at these velocities were obtained with vest-attached devices that have global positioning system (GPS) and could make measurements at 10Hz (GPS Team Sports, SPI Pro, GPSports, Canberra, Australia). The data obtained during the game were recorded on a computer and were analysed with Logan Plus version 4.5.1 (Catapult Innovations, 2010). The analysis specified total running distances of each athlete and the times and velocities at which these distances were covered.

**Maximal heart rate**

HR values of the players during small sided games were measured on a GPS adapted telemetric measurement system that can take measurements every 5 seconds and values of each athlete were recorded on the program (GPS Team Sports, SPI Pro, GPSports, Canberra, Australia).

**Statistical analyses**

The data were tested for compliance with normal distribution using "Shapiro-Wilk Test". Since the data did not comply with the assumption of normal distribution, non-parametric analysis methods were employed and data were reported as median. In addition, Friedman's test was used for repeated dependent variables (HR, running speeds) in 3 different SSGs. When this test was significant, Pairwise comparisons were performed for HR and technical parameters in 1vs1, 2vs2 and 3vs3 games by Wilcoxon's signed rank test. Levels of relationship between postural control levels and SSG running speeds were fulfilled using "Spearman rank-order correlation analysis". All the statistical analyses were performed using SPSS 20.0 for Windows (SPSS Inc., Chicago, IL, USA).Level of significance was taken as $p < 0.05$.

**RESULTS**

The assumption of normality for '5 -10m sprint time, running speed and HR in SSG' values were satisfied for postural control scores, as assessed by Shapiro-Wilk's test ($p > .05$).After the performance of 12 exercises in 3 different SSGs, expressed as the 1vs1, 2vs2 and 3vs3 stages mean heart rates (HR) for the overall games were 195.18±7.35, 197.35±8.75, 198.43±5.85 beats·min$^{-1}$ respectively. A Friedman test was run to determine if there were differences in HR during 3 different SSGs. HR was statistically significantly different at the 3 types of SSGs during the exercise, $\chi^2 = 5.746$, $p < .05$. Post hoc analysis revealed statistically significant differences in HR from 1vs1 (Mdn = 143.00) to 2vs2 game (Mdn = 173.00) (p = .017), 1vs1 to 3vs3 game (Mdn = 162.00) (p = .024), but not 2vs2 and 3vs3 game.

Sixteen participants were recruited to understand the running speed of different player numbers on game performance as measured by the GPS system. Figure 1 shows the differences in the average speed, peak speed and total distance parameters during 4 games and 3 type of SSGand the data specified as medians. A Wilcoxon signed-rank test determined that there was a statistically significant median increase in peak speed (PS) when 1:1 games were compared with 2:2 (Mdn=2.70, z= -3.258, p= .001) and 3:3 games (Mdn= 6.45, z= -3,516, p= .000) and 2:2 between 3:3 (Mdn=3.75, z= -3.336, p= .001).Furthermore, significant increase in median values appeared in average speed (AS) parameter between 1:1 and 2:2 (Mdn= 1.46, z= -2,767, p= .006), 1:1and 3:3 (Mdn= 2.23, z= -3.518, p= .000), 2:2 and 3:3 (Mdn= 0.76, z= -3.468, p= .001) SSGs, in the total distance (TD) parameter between 1:1and 2:2 (Mdn= 124.55, z= -3.516, p= .000), 1:1 –3:3 (Mdn= 262.5, z= -3.516, p= .000) and2:2 - 3:3 SSGs (Mdn= 137.95, z= -3.516, p= .000).

When relations of training age and postural control parameters were examined, no significant relationship was found between any of the postural control parameters and (one leg dominant/non-dominant, both leg eyes closed/open) training experience (r-values ranging from; 0.010 to 0.470).

Results of the Spearman's rank-order correlation analysis, demonstrating the relationship between 5 – 20m sprint times and running speed parameters in 3 type of SSG. No significant correlation was found between speed parameters and 5-20m sprint times ($p > 0.05$).

Table 1 shows the results of the Spearman's rank-order correlation analysis, demonstrating the relationship between postural control (dominant leg, non-dominant leg) and the distance covered at different speeds in 1vs1 SSG. There were no significant relations between the postural parameters belonging to the dominant/non-dominant legend distance covered at different speed parameters(r-values ranging from 0.000 to 0.479, $p > 0.05$).

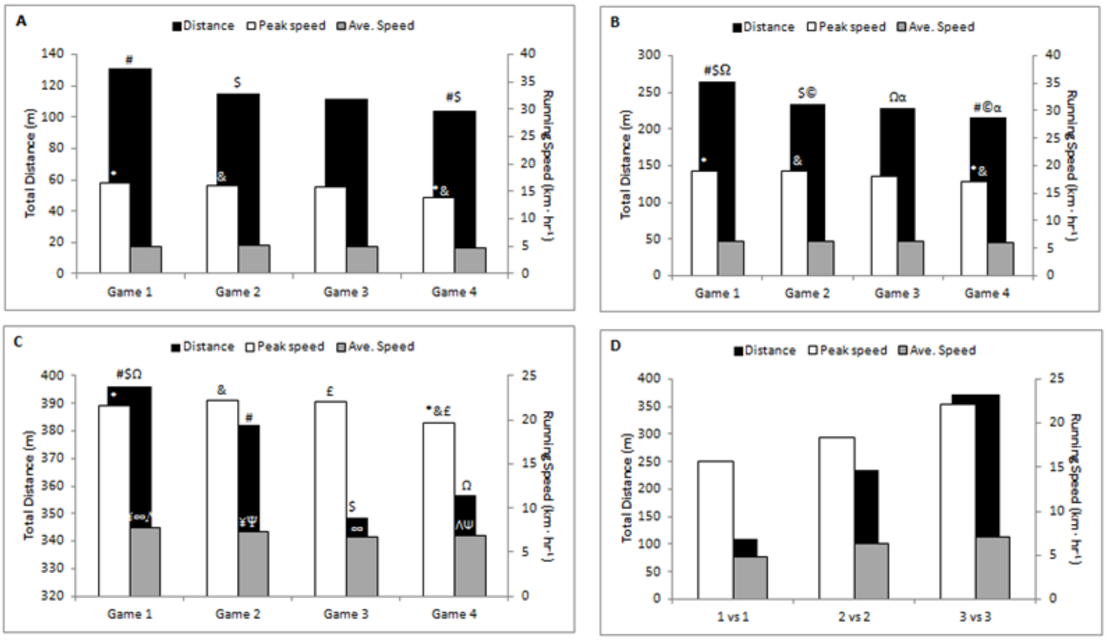


Figure 1. Differences in the distance, peak speed and average speed during 3 type of SSG.
A) 1 vs 1 SSG, B) 2 vs 2 SSG, C) 3 vs 3 SSG, D) Between SSG. *#$&Ω©£ΛΨ∞¥$p < 0.05$

Table 1. Correlations between 1vs1 SSG running speed data and $CoP_d$ and $CoP_{nd}$ levels.

| | $CoP_{dap}$ | $CoP_{dml}$ | $CoP_{dvel}$ | $CoP_{dvar}$ | $CoP_{ndap}$ | $CoP_{ndml}$ | $CoP_{ndvel}$ | $CoP_{ndvar}$ |
|---|---|---|---|---|---|---|---|---|
| 0 - 6 km·hr$^{-1}$ | r=-0,059 | r=-0.085 | r=0.088 | r=0.000 | r=-0.303 | r=-0.431 | r=-0.265 | r=-0.447 |
| | p=0.829 | p=0.753 | p=0.745 | p=1.000 | p=0.254 | p=0.095 | p=0.321 | p=0.083 |
| 6 – 10 km·hr$^{-1}$ | r=0.479 | r=-0.115 | r=0.121 | r=-0.069 | r=0.312 | r=0.402 | r=0.411 | r=0.475 |
| | p=0.060 | p=0.672 | p=0.656 | p=0.799 | p=0.240 | p=0.123 | p=0.114 | p=0.060 |
| 10 – 16 km·hr$^{-1}$ | r=0.306 | r=-0.068 | r=-0.076 | r=-0.110 | r=0.076 | r=0.162 | r=0.155 | r=0.262 |
| | p=0.249 | p=0.803 | p=0.778 | p=0.684 | p=0.778 | p=0.549 | p=0.568 | p=0.327 |
| 16 – 23 km·hr$^{-1}$ | r=0.345 | r=0.319 | r=0.050 | r=0.245 | r=-0.171 | r=0.003 | r=-0.112 | r=-0.062 |
| | p=0.190 | p=0.229 | p=0.854 | p=0.360 | p=0.526 | p=0.991 | p=0.679 | p=0.820 |

CoP: center of pressure, dap:dominant leg anterior-posterior sway, dml: dominant leg medial-lateral sway, dvel: dominant leg sway velocity, dvar: dominant leg sway average, ndap: non-dominant leg anterior-posterior sway, ndml: non-dominant leg medial-lateral sway, ndvel: non-dominant leg sway velocity, ndvar: non-dominant leg sway average.

Table 2. Correlations between 2vs2 SSG running speed data and $CoP_d$ and $CoP_{nd}$ levels.

| | $CoP_{dap}$ | $CoP_{dml}$ | $CoP_{dvel}$ | $CoP_{dvar}$ | $CoP_{ndap}$ | $CoP_{ndml}$ | $CoP_{ndvel}$ | $CoP_{ndvar}$ |
|---|---|---|---|---|---|---|---|---|
| 0 - 6 km·hr$^{-1}$ | r=-0.600 | r=-0.109 | r=-0.503 | r=-0.492 | r=-0.216 | r=-0.052 | r=-0.425 | r=-0.509 |
| | p=0.014 | p=0.688 | p=0.047 | p=0.053 | p=0.421 | p=0.848 | p=0.101 | p=0.044 |
| 6 – 10 km·hr$^{-1}$ | r=0.456 | r=0.056 | r=0.194 | r=0.300 | r=0.225 | r=0.204 | r=0.258 | r=0.300 |
| | p=0.076 | p=0.837 | p=0.471 | p=0.258 | p=0.402 | p=0.449 | p=0.334 | p=0.259 |
| 10 – 16 km·hr$^{-1}$ | r=0.383 | r=-0.212 | r=-0.350 | r=0.215 | r=0.408 | r=0.360 | r=0.522 | r=0.639 |
| | p=0.144 | p=0.431 | p=0.184 | p=0.424 | p=0.117 | p=0.171 | p=0.038 | p=0.008 |
| 16 – 23 km·hr$^{-1}$ | r=-0.074 | r=0.018 | r=-0.062 | r=-0.065 | r=-0.003 | r=0.025 | r=-0.022 | r=-0.050 |
| | p=0.787 | p=0.948 | p=0.820 | p=0.799 | p=0.991 | p=0.927 | p=0.935 | p=0.854 |

CoP: center of pressure, dap:dominant leg anterior-posterior sway, dml: dominant leg medial-lateral sway, dvel: dominant leg sway velocity, dvar: dominant leg sway average, ndap: non-dominant leg anterior-posterior sway, ndml: non-dominant leg medial-lateral sway, ndvel: non-dominant leg sway velocity, ndvar: non-dominant leg sway average

Table 3. Correlations between 3vs3 SSG running speed data and $CoP_d$ and $CoP_{nd}$ levels.

| | $CoP_{dap}$ | $CoP_{dml}$ | $CoP_{dvel}$ | $CoP_{dvar}$ | $CoP_{ndap}$ | $CoP_{ndml}$ | $CoP_{ndvel}$ | $CoP_{ndvar}$ |
|---|---|---|---|---|---|---|---|---|
| 0 - 6 km·hr$^{-1}$ | r=-0.197 | r=-0.021 | r=-0.100 | r=-0.137 | r=-0.224 | r=-0.416 | r=-0.281 | r=-0.388 |
| | p=0.464 | p=0.940 | p=0.713 | p=0.613 | p=0.405 | p=0.109 | p=0.292 | p=0.197 |
| 6 – 10 km·hr$^{-1}$ | r=0.362 | r=0.103 | r=0.226 | r=0.262 | r=0.394 | r=0.442 | r=-0.505 | r=-0.562 |
| | p=0.169 | p=0.704 | p=0.399 | p=0.327 | p=0.131 | p=0.087 | p=0.046 | p=0.024 |
| 10 – 16 km·hr$^{-1}$ | r=0.326 | r=0.085 | r=0.106 | r=0.140 | r=0.121 | r=0.405 | r=0.258 | r=0.238 |
| | p=0.217 | p=0.753 | p=0.696 | p=0.606 | p=0.656 | p=0.120 | p=0.336 | p=0.374 |
| 16 – 23 km·hr$^{-1}$ | r=0.276 | r=0.203 | r=0.232 | r=0.230 | r=0.026 | r=0.166 | r=0.081 | r=-0.044 |
| | p=0.300 | p=0.451 | p=0.387 | p=0.392 | p=0.922 | p=0.538 | p=0.766 | p=0.871 |

CoP: center of pressure, dap:dominant leg anterior-posterior sway, dml: dominant leg medial-lateral sway, dvel: dominant leg sway velocity, dvar: dominant leg sway average, ndap: non-dominant leg anterior-posterior sway, ndml: non-dominant leg medial-lateral sway, ndvel: non-dominant leg sway velocity, ndvar: non-dominant leg sway average.

Dominant leg and non-dominant leg, except $CoP_{ndap}$, $CoP_{dml}$, $CoP_{ndml}$, $CoP_{dvar}$, significantly correlated with walking (0-6.9 km·h$^{-1}$) and medium-intensity running (13.0-17.9 km·h$^{-1}$) parameters for the 2vs2 SSG, with r-values ranging from 0.503 to 0.639 (Table 2). However, other running speed parameters, low-intensity and high- intensity running speed, did not significantly correlate with postural control measures for the 2vs2 SSG, with r-values ranging from 0.003 to 1.000.In addition, standing on both legs with eyes open and eyes closed, there were no correlation between any of the running speed parameters (r-values ranging from 0.003 to 0.350).

The correlations between the technical variables of the 3vs3 SSG and $CoF_{dap}$, $CoF_{dml}$, $CoP_{dvel}$, $CoP_{dvar}$, $CoP_{ndml}$, $CoP_{ndvel}$, $CoP_{ndvar}$, $CoP_{ndap}$ are illustrated in Table 3. Significant correlations were found between running speeds (low and medium intensity running) and non-dominant leg postural control parameters with r-values ranging from 0.505 to 0.562(Table 3).On the other hand, no significant relation was found between the other running speed parameters and other postural control variables of the dominant leg, standing on both legs with eyes open and eyes closed position (r-values ranging from 0.015 to 444).

## DISCUSSION

The aim of the present study was to examine the relationship between postural control variables and running speeds in small sided games played using different game fields. The primary feature that distinguishes the present study from others is that postural control levels that reflect balance were associated with football specific games. The main findings obtained from our study show that there is a statistical relationship between runs at speeds from walking to jogging in small sided games and several postural control parameters while no significant correlation was observed between maximal running velocities and postural control parameters in the games.

Running speeds within running distances in football are classified as; standing (0–0.6 km · s -1), walking (0.7–7.1 km · s -1), jogging (7.2–14.3 km · s -1), running (14.4–19.7 km · s -1), high intensity running (19.8–25.1 km · s -1) and sprint (>25.1 km · s -1) (21). In studies concerning running velocities in SSGs; Hill-Haas et al. (2009) stated that during a SSG with 2vs2 players and 28×21 m field, average running speeds of the players were 18 km · h$^{-1}$and higher, whereas Castellano, Casamichana & Dellal (5) reported that in 3vs3 SSGs in different field sizes of 33×20 m, the footballers had an average running speed of18.4±2.4 km · h$^{-1}$. Mean running speeds obtained in our study were found as 18.03±2.63 km · h$^{-1}$for 1vs1 games, 21.48±3.48 km · h$^{-1}$for 2vs2 games and 24.25±2.78 km · h$^{-1}$for 3vs3 games. Considering the running speeds and the distances covered, it is stated that having a goalkeeper in the games would create higher motivation for the players to keep their own goal area and to throw the ball into the opponent's goal and that this could result in better results in terms of the athletes' physiological parameters and movement profiles (1). Therefore, it is likely that our study and others reveal different results considering the differences that the changes in game targets can cause in the variables examined.

In studies carried out on small-sided games, it is seen that results have been found which do and do not reveal relationships between performance parameters depending on the variances in game volumes caused by changes that would be made in such variables as the game field, number of players, number of repeated sets, game duration and game target (goal scoring or maintaining ball possession) (2,3,31,39). In our study which used score as the target and different numbers of players, different results were obtained, which is considered to have caused by these variables. Significant relations were found between $CoP_{dap}$, $CoP_{dvel}$, $CoP_{ndvel}$ and $CoP_{ndvar}$ levels among the postural control parameters and running speeds of 2vs2 and 3vs3 SSGs played with different numbers of players. In addition to these parameters, a significant relation was expected between SSG and the medial to lateral sway (M/L) in particular because football is stated to require proper postural control primarily on the M/L plane and low intensity training systematically done by the athletes competing in regional leagues is known to improve postural performance (especially on the M/L plane)(4, 41).As the player group doing the same training, finding different levels of postural sway at unipedal stance position and obtaining different results from other studies might have been caused by some other factors that can be associated with postural control such as injuries (17,26), pathologies (51), age (28,33,43), difficulty of postural tasks (27,51) and the presence of sensory information (43, 47). The failure to examine all of these factors and obtain findings that can explain postural control property more clearly constitutes the limitation of the present study.

In team sports like football, while using visual information to cooperate with their teammates and to prevent the opponent, players have to maintain their postures and perform necessary motor skills during the game (40). In order to attain perfection in this course, training sessions performed by using branch specific movements are reported to improve postural regulation (9,18,50). In this context, studies have mainly found that specializing in sports affect postural control parameters (6,38,40). For these reasons, training experience of the athlete (skills s/he has learnt and the rate of repeating them) is a factor that can explain the relationships found. This is because of the fact that differences to be observed between athletes in terms of skill levels would lead to differences among athletes in terms of performing the required skills in the exercised to be done. The main factors that create the difference in skills and help the skill to be automated are the age of starting to learn the skill and the amount of training time to improve these skills. As a result of the increased automation levels in performing skills, a new postural activity can be learnt with a better performance (4). In addition to this, a better level of automation is associated with the fact that the postural system needs resources related with attention less (30,35). At this point, athletes with better postural control levels would adapt to the necessity to make continuous speed changes for the dribbles with the ball and runs to the empty areas to successfully get past an opponent and take passes and to use attention-related resources more particularly in small sided games and they would have a better performance. The significant relationships found in our study between postural control parameters and the 0-6 km · $h^{-1}$, 6-10 km · $h^{-1}$ and 10-16 km · $h^{-1}$ running speeds that can be defined as the running speeds used in sudden stops, accelerations and direction changes in 2 vs 2 – 3 vs 3 games also support our opinion in this respect.

The fact that the relationships which were found in 2vs2 and 3vs3 games were not found in 1vs1 games in terms of game properties may be because a) since 1vs1 games are played in smaller fields, players have to be in one on one tackles more often and have rather limited movement opportunities due to the continuous opponent pressure; b) goal areas with goalkeepers are used as the target in the games and in 1vs1 games which uses the smallest sized fields, players shoot without covering any distances causing the game to be finalized very quickly and movement patterns that could be associated with postural control cannot be used. On the other hand, in larger sized fields, the necessity for the players of the team having the ball to have high velocity runs to different areas of the field in order to create opportunities of passes and shots to each other would lead the players to cover larger distances and to use more changeable running speeds. As a result, the increased need for movement elements (stopping and reacceleration sprints, high volume runs with direction changes and velocity runs) associated with balancing ability can be explained as the reason for the relationships between postural control parameters and 2vs2 and 3vs3 games.

The methodologies of the balancing and high volume runs included in the related literature show that similar to the studies mentioned above, high volume runs are performed in specially designed testing areas different from the practice areas of branches. Moreover, it must be remembered in the tests to be carried out that static balancing tests and dynamic balancing tests would bear different results (7). These differences in measurement methods can be addressed as the most important factor explaining that the relationship levels between high volume running speeds and balance were found differently from our study. For this reason, our study would make significant practical contribution to the literature as it reveals the relationships between the athletes' postural control levels and the speed parameters in small sided games that reflect the highest volume part of a football game.

In conclusion, the results show that postural control properties can affect the success of performance of the frequently used movements such as stopping and accelerating in order to create an empty area by getting past the opponent during a game of football. It can be seen that postural control parameters can be related with speed characteristics particularly in situations when the number of player's increases and the playing area is enlarged rather than the 1vs1 positions where close contact is made with the opponent. Therefore, trainers' combining practices that are designed to work out postural control parameters separately (M-L, A-P) with football specific exercises (combined training) in a single training session would make significant contributions to competing performances of athletes.

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