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Original Article

Is balance performance associated with basic soccer tasks? An explorative study.

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Abstract
The aim of the study was to explore whether a relationship exists between balance performance and basic soccer skills. To this end, participants (N=263) divided over three age-groups, 11-12 (GR1), 13-14 (GR2), 15-16 (GR3) years of age, performed three balance tasks (i.e., walking forward (WF) and walking backward (WB) on a balance beam, and single leg standing balance (SLB)) and three soccer tasks (i.e., kicking on target (Aim), passing (Pass) and dribbling (Dribble)). The age groups showed different task scores. In addition, significant correlations were found between WF and Aim, and WF and Dribble within GR1; between SLB and Dribble in GR2; and between WF and Dribble, WB and Dribble, WB and Aim in GR3. It is concluded that relationships between balance performance and basic soccer skill exists in youth players between 10 and 16 years of age. The prospects of using balance performance as one of the indicators for identifying young soccer talents are discussed.
Keywords: soccer, talent development, balance, performance, children

Introduction

In various sports, such as tennis, baseball, hockey and football, performance involves a combination of stabilizing and force producing factors (Anderson & Behm, 2005). It is evident that producing force, either to displace oneself or to propel an object, is a key element in sports, but the role of stabilizing or keeping balance in order to maintain orientation in relation to the environment is less distinct and is relatively overlooked in the sport science literature. In this respect, balance is defined as maintaining the body's center of gravity over the base support without losing control over the designated task. It has been described as essential to many motor tasks and with clear improvements over age (Malina, Bouchard, & Bar-Or, 2004). In addition, on average girls have better balance abilities than boys (Malina, Bouchard, & Bar-Or, 2004). That said, for many ball sports the relationship between balance performance and balls skills has not been carefully scrutinized. Yet, it is quite obvious that athletes must be capable of maintaining balance to accurately perform movement skills. Accordingly, in a review Hrysomallis (2011) report that there are skill-related differences in balance between elite and non-elite golf players, rifle shooters and soccer players, while Matsuda, Demura and Uchiyama (2008) found sport-related differences in balance; soccer players show different postural sway characteristic than swimmers, dancers, basketball players and non-athletes. Except differences in balance, Hrysomallis (2011) also indicated significant relationships between balance control and performance-related parameters as diverse as rifle and archery shooting accuracy, ice hockey maximum skating speed and basketball shooting. Furthermore, evidence is provided that basketball practice improves the adaptive effects on standing balance (Hahn, Foldspang, Vestergaard, & Ingemann-Hansen, 1999). Thus, single leg balance performance was positively associated with years of practice in basketball, while in the same study static single leg balance time was not a predictor for swimming performance. Erkmen, Taskin, Sanioglu, Kaplan and Basturk (2010) concluded after examining twenty-two young adult football players that explosive actions (vertical jump) may be related to good balancing performance. In summary, performance accuracy of ballistic actions, including ball interception or aiming, may be constrained by the ability to maintain balance.

Maintaining total or partial body equilibrium while moving is not only important for performance but is also negatively related to injury prevalence (e.g. ankle sprains and ACL injuries) (Abernethy & Bleakley, 2007;

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Quatman-Yates, Quatman, Meszaros, Paterno, & Hewett, 2011; Hrysomallis, 2007). Not being able to control the body in a proper manner under athletic conditions may therefore be a risk factor for injuries.

In the current paper we further investigate the purported relationship between balance control and basic skills in young soccer players. Indirect evidence that a relationship between balance performance and soccer skills exists stems from Smyth and Anderson (2008). They report that participation in soccer among 6- to 10-year-old boys who perform relatively poor on balance tests the Movement ABC is significantly lower than participation of age-matched peers with high scores at the balance tests. They conclude that balance performance may be a marker for social participation in school sports; yet, the presumed relationship between balance performance and soccer skills was not directly investigated.

In sum, except for the work reviewed by Hrysomallis (2011), the literature is relatively mute with respect to ball skills and balancing performance, especially with young children, and the direct assessments of basic soccer skills and balance performance have not been published yet. Hence, the current study aimed to explore the relationship between static and dynamic balance performance and basic soccer skills in children ranging in age from 10-16 years. It was predicted that significant relationships would exist between performance on the balance tasks and performance on soccer tasks within different age groups (i.e., across age groups such a relationship would be self-evident since both balance and ball skills will improve with age).

Material & Methods

Participants

This study was part of a kids-soccer-and-collaboration-program (VU-Amsterdam & UNISA) during the world cup in South Africa. The children all participated voluntarily and the participating schools approved their participation. Two hundred sixty-five South African primarily school children (from the economically impoverished townships of Pretoria, Durban and Cape Town area), ranging in the age between 10 up to 16 years (mean = 13.7 years; SD = 1.77 years) participated in the study. They were divided into three groups of 10-12, 13-14 and 15-16 years of age (Table 1). All participants (girls; n = 63, boys; n = 202) were healthy and active children, but they did not participate in organized sports. They did not play soccer on regular basis.

Table I. Demographics of the study population (boys and girls) in absolute number and percentage (between parenthesis) as function of age groups.

Age group (years)	Participants (N)			Age; mean (SD) (year)		
	Total	Boys (%)	Girls (%)	Total	Boys	Girls
(1) 10 - 12	84	67 (79.7 %)	17 (20.2 %)	11.7 (.63)	11.7 (.64)	11.7 (.59)
(2) 13 - 14	108	79 (73.2 %)	29 (26.9 %)	13.3 (.44)	13.2 (.43)	13.3 (.47)
(3) 15 - 16	71	54 (76.1 %)	17 (23.9 %)	15.9 (.78)	15.8 (.66)	16.3 (.99)

Measure

The performance on three functional balance tasks and three soccer skill tasks was assessed. The balance tasks were walking forward and backward over a balance beam (i.e., dynamic balance) and a single standing on one leg (i.e., static balance). The three soccer skill tasks included, slalom ball dribbling, ball chipping and aiming, and a ball passing task. To this end, the following materials, protocols and procedures were used:

Balance tasks

The dynamic balance tasks consisted of walking forward and walking backward over a balance beam, which was 210 cm in length, 5 cm in width and 2 cm in height. Three wooden plates, 50 cm long and 30 cm, wide at the beginning, middle and end of the beam served as supports. The participants started with their feet behind the first plate and were asked to walk across the balance beam as fast as possible without stepping down or falling of the beam. For walking backwards, the participants started with their heal against the first plate. Time was recorded with a stopwatch with an accuracy of 0.1 s. In the case the participant steps down or fell a re-test was provided.

The static balance task consisted of standing on a solid surface on the forefoot of the preferred leg for as long as possible. The other leg was in a raised position with the knee flexed while the hands and arms were kept alongside the body. The time that the participant stood on one leg without using the non-preferred leg or arms was recorded by stopwatch. Participants were allowed one attempt only.

Soccer performance tasks

In the slalom dribble task, participants were required to complete the course as fast as possible. The 10-meter course consisted of eleven cones placed behind each other on a flat surface with two meters between them. The participants started next to the first cone and slalomed the ball passing each cone. After cone eleven, participants turned around and slalomed back. The trial was completed as soon as the participants reached the first cone Time was recorded with an accuracy of .1 s using a stopwatch.

In the passing task, participants had to score as many points as possible passing the ball through goals of different widths aiming at another participant, completing the task by aiming for a pylon. The five goals were made of two cones separated in distance of 2 m, 1.5 m, 1.0 m, 0.50 m and 0.30 m wide, for the first to fifth goal respectively, while, the cone as 15cm wide and 30cm high. For each hit (kicking the ball in the goal or contacting the pylon) one point was awarded. There was no time limit. Two participants carried out the passing task at the same time. The ball was placed in front of the goal and the participant had to kick the ball over 8.5 m distance into the goal (i.e., between the cones). This procedure was carried out twice. Hence, the total score could amount to 12 points with each target hit.

The chipping and aiming task required the participants to aim and chip the ball at targets 3.5 m wide and 1 m in height and hit one of the targets as many times as possible in eight attempts. Kicking distance was 10 m. For each hit, one point was awarded, resulting in maximum achievable amount of eight points.

Data analysis

The dependent variable for the three balance and the dribble tasks was times in second. For the passing and aiming tasks, it was the number of points. To compare the differences between the age groups one-way ANOVA's were carried out for all six dependent variables separately. Post hoc comparisons were made using Tukey HSD test. Pearson correlations were performed to assess mutual relationships between the outcome scores for each group separately.

Results

The outcomes of 263 out of 265 participants were analyzed. Data for the remaining two children were lost. Because there was only a limited time interval for completing the entire experiment, not all children were always capable of performing each of six tasks. For this reason, the degrees of freedom in the analyses below do vary.

Age-related differences

Table 2 reports the outcome scores as a function of age and task. The three balance tasks showed clear age differences. For the time taken *walking forward* a significant effect of age was found, $F(2, 261) = 6.75$, $P < .01$. Post-hoc analysis indicated that 15-16-year-olds took less time than the 10-12 and the 13-14-year-olds. Also for *walking backwar*d a significant effect of age was revealed, $F(2, 259) = 22.63$, $P < .001$. Post-hoc analysis indicated differences between all groups, the oldest group being fastest. Similarly, the single leg standing test revealed a significant effect for age, $F(2, 261) = 11.30$, $P < .001$. Post hoc analysis indicated that the 15-16-year-olds stood longer on one leg than the10-12 and 13-14-year-olds.

Table II. The mean time and standard deviations in seconds for balancing and soccer performance as function of each age group and number of participants in each group.

	10 - 12 year		13 - 14 year		15 - 16 year	
	N	Mean (SD)	N	Mean (SD)	N	Mean (SD)
Balance Forward (sec)	84	2.9 (1.3)	109	2.7 (1.1)	71	2.1 (1.4)
Balance Backward (sec)	84	5.2 (2.5)	107	4.8 (2.3)	71	2.9 (2.0)
Balance Static (sec)	84	18.1 (16.6)	107	21.6 (23.1)	71	35.3 (30.3)
Aiming (#)	35	2.5 (1.3)	37	2.9 (1.4)	61	3.9 (1.4)
Dribble (sec)	50	21.9 (5.3)	77	22.8 (9.1)	57	19.9 (3.6)
Passing (#)	33	3.3 (1.1)	51	3 (1)	44	3.7 (.9)

Age also affected the three soccer skill tasks. That is, a nonsignificant effect of age was found for the time taken to complete the dribbling task, $F(2, 181) = 2.91$, $P = .057$. The 15-16-year-olds tended to take more time than their 13-14-year-old peers. Significant effects of age were also discerned for the passing, $F(2, 125) = 6.3$, $P = .002$, and the aiming and kicking tasks, $F(2, 130) = 12.35$, $P < .001$. The post-hoc analyses indicated that the 15-16-year-olds passed more successful than the 13-14 years-old, and scored more points for aiming and kicking than both the 10-12 and the 13-14-year-olds.

Within-group correlations

The within-group correlations for each age group separately are reported in Table 3. It shows that for the 10-12 year-olds walking forward showed moderate correlations with the aiming task, $r(35) = -.297$, $P = .041$, and the dribbling tasks, $r(49) = .262$, $P = .035$.

Among the 13-14 year-olds a significant correlation emerged between standing on one leg and dribbling, r(77) = -.247, *P* = .015).

Table III. Correlations for all soccer and balance tasks for each age group. WF = Walking Forward, WB = Walking Backward, Static = Static balance. Significant values (P < .05) are denoted with *.

		10-12 years			13-14 years			15-16 years		
Task		Pass	Aim	Dribble	Pass	Aim	Dribble	Pass	Aim	Dribble
WF	N	32	35	49	51	37	77	44	61	57
	r.	-.121	-.297	.262	-.149	-.095	.060	.136	-.112	.308
	P	.255	.041*	.035*	.149	.288	.303	.189	.196	.010*
WB	N	32	35	49	51	37	76	44	61	57
	r.	-.160	-.192	.171	-.195	-.118	.038	.023	-.304	.413
	P	.191	.135	.120	.085	.244	.371	.441	.009*	.001*
Static	N	32	35	49	51	37	77	44	61	57
	r.	.243	-.012	-.146	.199	.053	-.247	.200	.159	-.058
	P	.090	.474	.158	.080	.378	.015*	.097	.111	.333

The 15-16 year-olds showed significant correlations, that is between walking forward and dribbling, r(57) = .308, *P* = .01), walking backwards and dribbling, r(57) = .413, *P* = .001), and walking backwards and aiming and kicking, r(61) = -.304, *P* = .009).

Discussion

The purpose of this study was to determine whether there exists a relationship between children's balance performance and their basic soccer skills. The three balance and three soccer skill tasks used in the current study show that, firstly, with an increase in age balance performance as well as soccer skills improve. Secondly, and more important, several significant correlations were revealed between the performance on the balancing and soccer tasks. That is, generally speaking and within age-groups, those children that performed well on the balance tasks also tended to do well performing the soccer skills. This relationship was found among all three age groups.

These results are consistent with the main tenets of the review of Hrysomallis (2011) in which it was concluded that good balance ability relates to better specific skills in a variety of sports, ranging from golf, basketball to rifle shooting. The current study adds further evidence to support this conclusion by demonstrating the relationship between balance performance and basic soccer skills in children between 10 and 16 years of age. However, the findings suggest that the details of this relationship differ between age groups. For instance, in the youngest and oldest age-groups, significant correlations between *dynamic* balance and soccer skills were found, while for the middle age group only a relationship with *static* balance emerged. How should these differences be explained? Might the level of maturation (i.e., age relative to the growth spurt) or specific period of development affect balance performance and its integration in soccer skills? Also, soccer specific training experience can influence the performance of balance abilities (Biec & Kuczynski, 2010).

The oldest children (15-16 years) performed better on nearly all the tasks. This is likely due to the effects of ageing and experience over time (Philippaerts et.al., 2006). Furthermore, the oldest age-group is most likely past its growth-spurt which can negatively influence motor performance (Quatman-Yates, et. al., 2011; Malina et al., 2003) and therefore perform better on all tasks relative to age. Philippaerts et.al. (2006) found that the estimated velocities on performance tests in soccer showed a peak around the maximal velocity of growth, however performance continued to increase after maximal growth velocity. Although the players peaked in performance relative to their growth-spurt, their motor performance was significantly lower than the oldest age-group.

The onset of the growth-spurt sets of a phase of accelerated growth and has specific consequences for physical and motor development of the adolescent. Quatman-Yates et al. (2011) argued that the relatively poor motor performance during adolescence, 'adolescent motor awkwardness', is strongly related to the moment the growth-spurt occurs. The timing relative to the peak of the growth-spurt may explain why the 10-12 and 15-16-year-olds, but not the 13-14-year-olds, showed more consistent relationships between performance on the dynamic balance and the soccer skill tasks. Perhaps the peak in growth-spurt around 13-14 years of age particularly disturbs balance or its integration into basic soccer skills. This interpretation is reminiscent of conclusions by Philippaerts et al. (2006). They found that in young Belgium soccer players performance on the Flamingo Balance test performance was affected by the Peak Height Velocity (PHV). The results in this paper did not show a regression of motor performance over time, although they did show that there was a halt in development: there were no significant increases in motor performance up to 14 years of age. It seems reasonable to suggest that due to growth, motor-functions (i.e. balance) will increase in performance over time and that practice may deepen that performance, or stop the decrease in performance.

Nevertheless, correlations are found between balance and sport performance within different age groups. It may therefore be concluded that good balance capacity per age group is an important factor in sports.

As such it should be integrated in training programs to deepen or maintain motor performance during the 'growth spurt' and furthermore, it could be used as a performance indicator for talent identification. However, before classifying 'balance' as a performance indicator for youth, longitudinal research is required to verify the obtained results over time.

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