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STRENGTH, RUNNING SPEED, AGILITY AND BALANCE PROFILES OF 9- TO 10-YEAR-OLD LEARNERS: NW-CHILD STUDY

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ABSTRACT

The purpose of this study was to determine the strength, running speed and agility, and balance profiles of 9- to 10-year old learners and the relation between these skills of the learners. Using a stratified random selection from 20 schools with different socio-economic backgrounds, 862 9- to 10-year-old learners (457 boys; 405 girls) were tested in four educational districts. The Bruininks-Oseretsky test of Motor-Proficiency, second edition, was used to evaluate the learners. The results showed statistical ($p \leq 0.05$) and practical ($d \geq 0.5$) significant gender differences with regard to strength, running speed and agility and balance skills. The boys preformed significantly better than the girls did in the standing long jump, push-ups, sit-ups, V-sit, shuttle run, walking heel-to-toe forward on a line, while the girls outperformed the boys in the stepping sideways over a balance beam and walking heel-to-toe forward on a line. The majority of the total group were categorised as average for strength (76.59%), agility (63.38%) and balance skills (55.85%), while 34.88% of the group showed below-average balance skills. Significant correlations ($r \approx 0.1$) were found among the different skills.

Key words: Strength; Running speed and agility; Balance; Motor performance; Children.

INTRODUCTION

Satisfactory motor development plays an important role in a child's life and enables the child to participate in kinetic activities that contribute to physical and cognitive growth (Barton *et al.*, 1999; Goudas & Giannoudis, 2008). Strength, agility and balance are important components of motor development and are regarded as prerequisites for effective movement (Pienaar, 2012). Several research studies have found that children nowadays show an insufficient level of physical fitness skills when considering components such as aerobic fitness, strength, agility, perseverance and balance (Volbekiene & Griciute, 2007; Keller, 2008; Mak *et al*., 2010; Fjørtoft *et al*., 2011; Pienaar *et al*., 2012; Ross *et al*., 2014). Children with inadequate motor skills also display low levels of physical fitness skills (Okely *et al*., 2001; Cairney *et al.*, 2006; Haga, 2008; Hands, 2008; Fjørtoft *et al*., 2011).

Muscle strength is a primary component of physical fitness skills and increases commensurate with age from the early childhood years up to adolescence (Winnick, 2005). This linear relationship continues to about the age of 15 years in girls, while a marked increase can be observed in the strength of boys during puberty, which continues at a slower rate during the late teens (Pienaar, 2012). The research of Wang and Chen (1999), on 9- to

12-year-old Taiwanese children, found gender differences in muscle strength, as the boys performed better compared to the girls. Pienaar (2012) supports this finding by pointing out that gender differences with regard to strength can be better observed in the upper limbs and core, where boys showed significantly greater strength than girls did.

Although boys seem to be stronger than girls are, muscle and strength development occurs at the same rate in both genders up to about age 11 (Gallahue & Ozmun, 2006). There is controversy in literature with regard to gender differences. The results of a study by Lazzer *et al*. (2009) on 8- to 12-year-old Italian children contradict the above as they found that boys had a higher count for absolute peak strength compared to girls. A study by Holm *et al*. (2008) found no meaningful gender differences in the strength skills of 7- to 12-year-old children in Norway. Chad *et al*. (1999) and Kraemer and Fleck (2004), in turn are of the opinion that strength skills are important to improve the general fitness and health of sportspeople and to prevent injury. Additionally, it seems that if children's strength skills are inadequately developed, their freedom of movement is limited, which may possibly influence motor skills negatively (Payne & Isaacs, 2008).

According to Annesi *et al*. (2005) *agility* is the ability to change body position quickly and accurately with ease and flow, while maintaining control and balance. Agility can further be seen as a combination of speed, balance, strength and coordination (Sherrill, 2004). Agility skills are responsible for the combination of reaction time, acceleration and explosiveness (Ball *et al*., 1992; Lori *et al*., 1998; Baker & Newton, 2008), which are central to sport performance (Bullock *et al*., 2012). When it comes to gender differences, Saygin *et al*. (2007) could not find any with regard to agility in their study on 853 (436 boys, 417 girls) children between 9 and 13 years of age in Turkey.

There is, however, controversy in the literature on the matter of gender differences related to agility as well, because some researchers did find differences (Malina *et al*., 2004; Gallahue & Ozmun, 2006). In this regard, Gallahue and Ozmun (2006) revealed that the running speed and agility of boys and girls are similar up to the age of 7 years, after which the boys improve their performance significantly between the ages of 8 and 12 years. The research of Moneyki *et al*. (2003) on disadvantaged South African children found significant gender differences related to strength, agility and balance. Malina *et al*. (2004) also highlight the fact that boys do better in activities that require speed and strength, while girls do better in activities that require balance and fine motor skills. Yet, several research studies point out that 12- to 18-year-old children these days show insufficient strength and agility skills for their age (Volbekiene & Griciute, 2007; Mak *et al*., 2010).

Stability skills form part of a fundamental group of skills that can be divided into two types, namely *stationary balance* (the ability to maintain a stable support base with minimal disturbance of the movement), and *dynamic balance* (the ability to maintain a stable bodily position while moving) (Winter *et al*., 1990; Pienaar, 2012). Several researchers (Al-Haroun, 1988; Malina *et al*., 2004; Lam, 2008), indicate that girls do markedly better than boys in activities that require balance. According to Gallahue and Ozmun (2006), there is a commensurate improvement in balance among all children between the ages of 2 and 12 years. In addition, these researchers show that girls have better balance skills than boys up to the age of 8 or 9 years approximately, after which boys start to catch up. Although literature seems to posit that balance skills improve with age, the study in Kaohsing City on 99 (58 boys and 41 girls), children between 9 and 12 years found no meaningful improvement (Wang & Chen, 1999). The findings of these researchers indicate that age and gender are not necessarily decisive factors when considering the balance skills of boys and girls (Wang & Chen, 1999). However, the inability to balance may lead to scholastic problems, because adequate balance enables a child to sit still (Cheatum & Hammond, 2000).

The literature is also inconsistent regarding the relationships between strength, agility and balance. A study by Kin-İşler *et al*. (2008) on 25-year-old professional American basketball players did not find any relationship between strength, agility and balance, whereas Katic *et al*. (2012) offer findings of research conducted in Croatia with 10- to 14-year-old learners that show a positive relationship between intelligence, the speed of simple movements, balance, agility and strength. The literature does show that there is a direct link between sufficient strength and agility skills and sport achievement (Ball *et al*., 1992; Baker & Newton, 2008). Wang and Chen (1999) measured the relationship between balance and muscular strength in children aged 9 to 10 years and found that there was a positive relationship between dynamic strength and balance, as well as between dynamic and static strength, while a strong negative relationship was found between static strength and balance. According to research by Muelhbauer *et al*. (2013) on 7- to 10-year-old children in Germany, no meaningful relationships between strength, balance and mobility were found.

After an examination of the literature available on strength, running speed and agility and balance skills, it seems that there is a lack of research for these skill profiles of 9- to 10-year-old boys and girls in the North-West Province of South Africa. Moreover, there seems to be a shortcoming in the availability of literature that addresses the relationship between strength, agility and balance in 9- to 10-year-old learners.

PURPOSE OF RESEARCH

The research questions are firstly: What are the current strength, running speed and agility, and balance profiles of 9- to 10-year-old boys and girls from the North-West Province? Secondly, what is the relationship between strength, running speed and agility and the balance skills of 9- to 10-year-old learners from the North-West Province? The answers will establish a profile of these skills for this age group that would be useful for Kinderkineticists and teachers working on these skills of boys and girls. Furthermore, it should provide Kinderkineticists and sport coaches with guidelines on the influence that strength, running speed and agility, and balance skills have on one another and their effect on the improvement of the sport performance of these learners.

METHODOLOGY

Research design

The study was based on a longitudinal research design (NW-CHILD study), stretching over a period of 6 years (2010-2016) and that comprised baseline measurements and 2 follow-up measurements. The baseline data was collected in 2010. The first follow-up measurements were conducted in 2013 on a selected group of learners residing in the different areas of the

North-West Province of South Africa. Only data from the first follow-up measurements (2013), have been utilised for the purpose of this study.

Research group

The research forms part of the NW-CHILD study (Child-Health-Integrated-Learning and Development). The aggregate number of Grade 1 learners in the North-West Province of South Africa that participated in the study as the target population, included 816 learners. The sample was selected by means of a randomised selection from a stratified sample in cooperation with the Statistical Consultation Service of the North-West University.

The sample was selected from a list of schools in the North-West Province that was provided by the Department of Basic Education. The schools in this Province are grouped into 4 education districts. Each of these districts consists of 12 to 22 regions and each region has approximately 20 schools (minimum 12, maximum 47). Regions and schools were randomly selected from this list with regard to population density and school status (Quintile 1 schools from poor economical areas, to Quintile 5 schools from affluent economical areas). Boys and girls in Grade 1 were selected randomly from each school. 20 schools with a minimum of 40 children per school and with an equal division of genders were involved in the study. The follow-up target population for the study in 2013 included learners, who were mainly in Grade 4, yet there were some of the learners who were still in Grade 3. The descriptive data of all the learners that participated in this study are presented in Table 1.

Measuring instruments

The Bruininks-Oseretsky Test of Motor Proficiency-2 (BOT-2)

The 'Bruininks-Oseretsky Test of Motor-Proficiency', second edition (BOT-2) (Bruininks & Bruininks, 2005), was used to evaluate the children's strength, running speed and agility, and balance skills. This test battery is a standardised, norm-based and individual application measurement used to measure the efficiency of children's fundamental movement skills in 4 motor areas (Poulsen *et al.*, 2011). This measuring instrument is suitable for use with 4- to 21-year-olds (Bruininks & Bruininks, 2005).

The strength and the running speed and agility sub-items consist of 5 activities each. The *strength* component includes the following items: standing long jump (cm), push-ups (number performed correctly in a given time), sitting against a wall (seconds the position could be held), sit-ups (number performed correctly in a given time) and the V-sit (seconds the position could be held). The *running speed and agility* component includes the following items: the 15m shuttle run (seconds), side-hop over a balance beam (number performed correctly in a given time), 1-legged standing jumps (number performed correctly in a given time), 1-legged side-hop (number performed correctly in a given time), as well as 2-legged side-hops (number performed correctly in a given time). The *balance* component comprises 9 sub-tests, which include the following: standing on a line with open eyes (seconds), walking forward on a line (number of steps placed on the line correctly), standing on 1 leg on a line with open eyes (seconds), standing on a line with closed eyes (seconds), walking heel-to-toe on a line (number of steps placed on the line correctly), standing on 1 leg on a line with closed eyes (seconds), standing on 1 leg on a balance beam (seconds), standing heel-to-toe on a balance beam (seconds) and lastly standing on a balance beam on 1 leg with closed eyes (seconds).

During the execution of a test component, the child was allowed 2 attempts of which the best raw score was used for processing. The raw score was processed to a standardised score of which the total score of a subtest was used to calculate the scale score. This scale score was used in turn to get a total standard count for the different subtests respectively. The percentile on which the child lies when considering the norms of his/her age group was determined from the compound standard scores. There are 5 categories for the classification of strength, running speed and agility and balance skills based on the scale score, namely far below average (≤5), below average (6 to 10), average (11 to 19), above average (20 to 24) and far above average (≥25). The test battery has a validity value of r=0.75 (Bruininks & Bruininks, 2005).

Procedure

The North-West University Ethics Committee (No. 00070-90-A1) granted ethical approval for the research. Approval was also received from the Department of Basic Education of the North-West Province to perform the research in the schools. The school principals of the identified schools approved collecting the data during school hours. Informed consent forms were sent to the parents of all the learners who participated in the study in 2010 to ensure that a minimum of 40 learners between the ages of 9 and 10 years participated. If some learners moved away or parents did not return the forms, new learners were randomly selected at that school to make up the 40 learners required.

If the learners were not proficient in English as a home language or first additional language, local interpreters that were trained before the commencement of the study, were used to communicate the necessary instructions of the different tests administered to the learners.

Statistical analysis

For data processing, the "STATISTICA for Windows 2012" computer programme was used (StatSoft, 2012). For descriptive purposes, the data was firstly, analysed using means (M), standard deviations (SD), and minimum and maximum values. The independent t-test was applied to determine gender differences with regard to strength, running speed and agility and balance skills. The level of statistical significance was set at $p \leq 0.05$. Effect sizes (d) were calculated to determine the practical significance of the results by dividing the differences in the mean by the largest standard deviation of the test results. For the interpretation of practical significance, the following guidelines were used: $d \geq 0.2$ indicated a small effect, $d \geq 0.5$ a medium effect and $d \geq 0.8$ a large effect (Cohen, 1988).

A 2-way frequency table was used to compare the classifications of the boys and girls. The Pearson Chi-square served to indicate the significance of the results at the accepted level of $p \leq 0.05$. The strength of the correlations were represented by the phi-coefficient with $w>0.1$ indicating a small effect, $w>0.3$ a medium effect and $w>0.5$ a large effect (Steyn, 2002). Lastly, a Spearman rank order correlation was used to determine the relationships between the strength, running speed and agility and balance skills of the boys, girls and aggregate for the group respectively. The strength of the correlations is given with r≥0.1 indicating a small effect, r≥0.3 a medium effect and r≥0.5 a large effect.

RESULTS

Table 1 shows the composition of the study population for age by gender. Of the 862 subjects, 457 were boys and 405 were girls. The group had an average age of 9.90 years (SD=0.42), with the boys showing a slightly higher average age than the girls.

TABLE 1. **DESCRIPTIVE PARAMETERS FOR AGE IN RELATION TO GENDER GROUP**

Subjects	N	Min	Max	Mean	SD
Boys	457	8.65	10.84	9.94	0.41
Girls	405	8.20	11.05	9.86	0.42
Total group	862	8.20	11.05	9.90	0.42

Min=Minimum Max=Maximum SD=Standard Deviation

The independent t-test was conducted to determine the significance of gender differences with regard to strength, running speed and agility and balance skills.

Table 2 shows that statistically ($p \leq 0.05$) and practically significant ($d \geq 0.5$) gender differences were noticeable from the tests of strength skills, where the boys did better with the standing long jump, push-ups, sit-ups and V-sit, while the girls only performed better with the wall sit. The girls did better in 4 (side-hop, standing 1-legged jumps, 1-legged side-hop and 2-legged side-hop), of the running speed and agility skills tests than the boys, although statistically (p≤0.05) and practically (d≥0.5), meaningful differences were only found for the 15m-shuttle run where the boys performed better than the girls, and the side-hop, where the girls did better than the boys.

Table 2 in the last instance reveals that the boys performed better in 6 (standing on 1 leg - eyes open, standing on a line - eyes open, heel-to-toe walking, standing on 1 leg on a balance beam - eyes open, heel-to-toe standing on a balance beam and standing on 1 leg on a balance beam - eyes closed), of the 9 balance components, although there was only a statistically and practically meaningful significance with the heel-to-toe walking (p≤0.01 and d=0.20). The girls only performed better in 2 (walking forward on a line and standing on a line with closed eyes), balance components than the boys, although there was no statistical or practical significance.

Table 3 shows the strength, running speed and agility, as well as the balance skills of the 9- to 10-year-old learners. The results of the strength skills reveal that there were statistically (p<0.05), as well as medium (d≥0.5) and small (d≥0.2) practically significant differences between the raw count, the scale score of boys and girls, the aggregate scale score and aggregate age equivalent. There were statistically (p≤0.05), but not practically significant differences in the age equivalent of the boys and girls. The strength skills of the boys' average

age equivalent are significantly higher than the chronological age of the boys and girls (11.80 compared to 9.94 and 11.28 compared to 9.86).

TABLE 2. **GENDER DIFFERENCES: STRENGTH, RUNNING SPEED, AGILITY AND BALANCE SKILL SCORES FOR EACH SUBTEST**

Variable	**Boys** (n=457) Mean±SD	**Girls** (n=405) Mean±SD	**Significance of differences** df	t	p-Value	d-Value
Strength skills						
Standing long jump	46.58±9.27	42.05±7.83	860	7.69	**<0.001***	**0.49##**
Push-ups	20.85±5.45	16.40±5.24	860	12.19	**<0.001***	**0.82###**
Sit-ups	18.30±6.13	15.81±5.96±	860	6.02	**<0.001***	**0.41#**
Wall sit	55.49±10.78	55.92±9.97	860	0.60	0.551	
V-sit	53.58±12.68	53.09±13.83	860	0.54	0.588	
Running speed & agility skills						
15m-shuttle run	8.48±0.76	9.03±0.92	860	9.59	**<0.001***	**0.60##**
Side-hop	34.88±8.08	36.35±7.43	860	2.78	**<0.006***	**0.18#**
Standing one-legged jumps	41.39±8.28	41.82±8.70	860	0.74	0.459	
One-legged side-hops	24.97±6.90	25.19±7.05	860	0.45	0.649	
Two-legged side-hops	28.86±6.11	29.50±6.34	860	1.49	0.137	
Balance skills						
Standing on a line – open eyes	9.98±0.30	9.98±0.30	860	0.24	0.808	
Walking forward on a line	5.93±0.30	5.95±0.28	860	0.69	0.493	
Standing on one leg – open eyes	9.86±0.83	9.85±1.04	860	0.19	0.846	
Stand on a line – closed eyes	9.56±1.47	9.37±1.77	860	1.69	0.091	
Walking heel-to-toe	5.43±1.00	5.17±1.28	860	3.37	**<0.001***	**0.20#**
Standing on one leg – closed eyes	6.97±3.11	7.22±3.39	860	1.15	0.249	
Standing on one leg on balance beam – eyes open	9.32±1.88	9.28±1.95	860	0.34	0.736	
Standing heel-to-toe on balance beam	9.33±1.81	9.32±1.91	860	0.07	0.946	
Standing on one leg on balance beam – eyes closed	4.55±2.81	4.36±2.97	860	0.96	0.338	

SD=Standard Deviation; df=degrees of freedom; t=t-Value; *p≤0.05; #Practical significance small effect *d*=≥0.2; ## Practical significance, medium effect d=≥0.5; ### Practical significance, large effect d=≥0.8.

TABLE 3. **GENDER DIFFERENCES: STRENGTH, RUNNING SPEED & AGILITY AND BALANCE SKILL FOR COMBINED SUBTEST SCORES**

Variable	**Boys** (n= 457) Mean±SD	**Girls** (n= 405) Mean±SD	**Significance of differences** df	t	p-Value	d-Value
Strength skills						
Raw score	27.77±3.93	25.59±3.51	860	8.55	**<0.001***	**0.55##**
Scale score of boys & girls	17.78±3.04	16.54±2.99	860	6.00	**<0.001***	**0.41#**
Total scale score	17.75±3.38	15.96±3.01	860	8.20	**<0.001***	**0.53##**
Age equivalent of boys & girls (yrs)	11.80±2.09	11.28±2.82	860	3.08	**0.002***	
Combined age equivalent (years)	12.74±3.13	10.80±2.43	860	10.07	**<0.001***	**0.62##**
Running speed & agility skills						
Raw score	37.35±3.62	37.18±3.68	860	0.68	0.494	
Scale score of boys & girls	17.47±2.92	18.12±3.19	860	3.10	**0.002***	**0.20#**
Total scale score	18.04±3.20	17.94±3.26	860	0.45	0.655	
Age equivalent of boys & girls (yrs)	12.90±3.23	13.82±4.42	860	3.54	**<0.001***	**0.21#**
Combined age equivalent (yrs)	13.78±4.07	13.49±4.02	860	1.04	0.299	
Balance skills						
Raw score	31.77±3.16	31.55±3.30	860	1.01	0.311	
Scale score of boys & girls	13.56±4.45	12.30±4.51	860	4.10	**<0.001***	**0.28#**
Combined scale score	13.18±4.55	13.04±4.57	860	0.46	0.642	
Age equivalent of boys & girls (yrs)	9.39±4.32	9.02±4.58	860	1.23	0.219	
Combined age equivalent (yrs)	9.02±4.87	8.82±4.64	860	0.61	0.540	

SD=Standard Deviation df=degrees of freedom t=t-Value *p≤0.05
# Practical significance small effect *d*=≥0.2 ## Practical significance medium effect d=≥0.5.

For the running speed and agility skills, only statistical (p≤0.05) and small practical (d≥0.2) significance were found with regard to the scale score and age equivalent of the boys and girls. From Table 3, it seems that the age equivalent for the boys and girls were significantly higher than their chronological age (12.9 compared to 9.94 and 13.82 compared to 9.86 respectively). In the case of the balance skills, only a statistical (p≤0.5) and small practical (d≥0.2) significance were found in the scale score of the boys and girls. The age equivalent of the boys and girls was lower than their chronological age (9.39 compared to 9.94 and 9.02 compared to 9.86) (Table 3).

TABLE 4. **STRENGTH, RUNNING SPEED AND AGILITY, AND BALANCE SKILLS ACCORDING TO SKILLS CATEGORY**

Variable	**1**		**2**		**3**		**4**		**5**	
	n	%	n	%	n	%	n	%	n	%
Strength skills										
Boys (n=457)	0	0	11	2.41	312	68.27	127	27.79	7	1.53
Girls (n=405)	0	0	15	3.69	349	85.96	41	10.10	1	0.25
Group (N=862)	0	0	26	3.01	661	76.59	168	19.47	8	0.93
Running speed & agility skills										
Boys (n=457)	0	0	1	0.22	294	64.33	157	34.35	5	1.09
Girls (n=405)	0	0	4	0.99	253	62.32	147	36.21	2	0.49
Group (N=862)	0	0	5	0.58	547	63.38	304	35.23	7	0.81
Balance skills										
Boys (n=457)	0	0	152	33.26	257	56.24	48	10.50	0	0
Girls (n=405)	0	0	149	36.70	225	55.42	32	7.88	0	0
Group (N=862)	0	0	301	34.88	482	55.85	80	9.27	0	0

1=Far below average; 2=Below average; 3=Average; 4=Above average; 5=Far above average
Strength skills: w=0.24, p≤0.001; Running speed & agility skills: w=0.06, p=0.322; Balance skills: w=0.05, p=0.309

Two-way frequency tables were used to show the strength, running speed and agility and balance skills according to skill categories. Table 4 shows the tested skills and the different skills categories for the aggregate group, as well as boys and girls separately. For these different skills categories, there were no learners in the far below average category, while for balance no learners were in the far above average skills category. The majority of the learners were in the average skills category for strength (n=661, 76.59%), running speed and agility (n=547, 63.38%) and balance (n=482, 55.85%).

The second largest number of learners were in the above average category for strength (n=168, 19.47%) and running speed and agility (n=304, 35.23%), while 301 (34.88%) learners were in the below average category for balance skills. There was no statistical or practical significant difference between boys and girls in the *running speed and agility skills* (p=0.322 & w=0.06) and *balance skills* (p=0.309 & w=0.05). However, the boys performed statistically (p≤0.001 & w=0.24) and practically better than the girls in the *strength skills*.

Lastly, a Spearman rank order correlation was used to determine the relationships between the strength, running speed and agility and balance skills of the boys, girls and the aggregate group respectively. Relationships with a small to large practical significance can be observed in Table 5 between strength, running speed and agility and balance skills.

TABLE 5. **RELATIONSHIP BETWEEN STRENGTH, RUNNING SPEED AND AGILITY, AND BALANCE SKILLS**

Variables	**Strength** Raw score	**Strength** Scale score	**R-S-A** Raw score	**R-S-A** Scale score	**Balance** Raw score	**Balance** Scale score
Boys **(n=457)**						
Strength raw score	—	0.94***	0.37**	0.36**	0.09	0.08
Strength scale score	0.94***	—	0.33**	0.38**	0.10*	0.12*
RSA raw score	0.37**	0.33**	—	0.93***	0.23*	0.20*
RSA scale score	0.36**	0.38**	0.93***	—	0.22*	0.23*
Balance raw score	0.09	0.10*	0.23*	0.22*	—	0.99***
Balance scale score	0.08	0.12*	0.20*	0.23*	0.99***	—
Girls **(n=405)**						
Strength raw score	—	0.94***	0.29*	0.29*	0.20*	0.20*
Strength scale score	0.94***	—	0.27*	0.33**	0.20*	0.23*
RSA raw score	0.29*	0.27*	—	0.95***	0.20*	0.19*
RSA scale score	0.29*	0.33**	0.95***	—	0.20*	0.21*
Balance raw score	0.20*	0.20*	0.20*	0.20*	—	0.99***
Balance scale score	0.20*	0.23*	0.19*	0.21*	0.99***	—
Group **(N=862)**						
Strength raw score	—	0.95***	0.33**	0.32**	0.14*	0.13*
Strength scale score	0.95***	—	0.30**	0.35**	0.15*	0.17*
RSA raw score	0.33**	0.30**	—	0.94***	0.21*	0.19*
RSA scale score	0.32**	0.35**	0.94***	—	0.21*	0.22*
Balance raw score	0.14*	0.14*	0.21*	0.21*	—	0.99***
Balance scale score	0.13*	0.17*	0.19*	0.22*	0.99***	—

RSA=Running speed & agility; *=r≈0.1 small correlation, **=r≈0.3 medium correlation, ***=r≈0.5 large correlation

For the boys, strength and running speed and agility showed a medium correlation (r≈0.3), while there was only a small correlation (r≈0.1) between running speed and agility and balance. In the case of the girls, there was only a small correlation (r≈0.1) between strength and running speed and agility skills, strength and balance skills, as well as running speed and agility and balance skills. The whole group showed a medium correlation (r≈0.3) between strength, running speed and agility skills. Lastly, a small correlation was found between strength and balance skills; and running speed, agility and balance skills.

DISCUSSION

This study firstly aimed to determine the strength, balance and running speed and agility profiles of 9- to 10-year-old learners in the North-West Province and secondly, to determine the relationships between strength, balance and running speed and agility for this group.

It seems from the results that the average age equivalent of the boys and girls for strength skills was 11.80 and 11.28 respectively and for running speed and agility it was 12.90 and 13.82 respectively. These were above average, while the average age equivalent for balance was only 9.02 and 8.82 respectively. It can be deduced from this that the strength and agility skills of the boys and girls were above average, while their balance skills were below average. The possible reason for the high average age equivalent for the strength and agility skills of the 9- to 10-year-old learners is that during the growth and development phase of these children, they tend to be more physically active (Saygin *et al*., 2007).

Another explanation could possibly be that the stature of boys and girls decrease gradually during the prepubertal period and that girls reach their stage of peak height velocity earlier than boys do (Monyeki *et al*., 2005; Marta *et al*., 2012). However, there are contradictions in the literature, where, amongst others, researchers have reported that 12- to 18-year-old children nowadays have insufficient strength, running speed and agility skills for their age (Volbekiene & Griciute, 2007; Mak *et al*., 2010). The results of this study do not support this conclusion, since it found that 9- to 10-year-old learners do have sufficient strength and agility skills for their age.

Furthermore, this study found statistically and practically significant gender differences regarding strength, running speed and agility and balance skills. The study results revealed that boys did better in four (standing long jump, push-ups and sit-ups, V-sit), of the five strength skills when compared to girls. This finding is supported by the research of Wang and Chen (1999), who found that there were gender differences when measuring the muscle strength of 9- to 12-year-old children. Pienaar (2012) also indicated that boys are somewhat stronger in their upper limbs compared to girls, which supports the results found in this study. In this regard, strength skills in boys are promoted as parents place more emphasis on the gross motor skills of boys, which leads to rougher play among boys.

The current findings contradict the findings of Holm *et al*. (2008), who reported no meaningful gender differences in the strength skills of 7- to 12-year-old children, which means that boys and girls will perform the same in the different test components. However, when it comes to sit-ups, the boys performed statistically and practically significantly better than the girls in the current study ($p<0.001$, $d=0.41$). The studies of Monyeki *et al*. (2003) and Milanese *et al*. (2010), reported similar results since the first-mentioned study on 7- to 14-year-old learners, boys jumped further than girls of the same ages, while the last-mentioned research on 6- to 12-year-old learners, showed that boys jumped further when performing the standing long jump. However, these findings are contrary to the study of Marta *et al*. (2012)

where boys did practically, but not statistically, significantly better in the push-ups ($p<0.001$) and sit-ups ($p<0.001$), as well as for the research of Prista (1998), where it was reported that girls did better than boys in sit-ups.

With regard to the running speed and agility skills, this study revealed gender differences as well, since the girls performed better in four (the side-hop, standing one-legged jumps, one-legged side-hops and two-legged side-hops), of the five subtests, while the boys only performed better in the 15m-shuttle run. However, the findings of this study are not reflected in the studies of several researchers. Yanci *et al*. (2012) found that there were meaningful gender differences at the age of 9- to 10-years and that the agility skills of boys and girls improved proportionately to their increase in age, but that boys had significantly greater improvement than girls did. In the study of Lam and Shiller (2001) on 5- to 6-year-old children in Hong Kong, boys performed markedly better in all the components for running speed and agility. Malina *et al*. (2004) and Gallahue and Ozmun (2006) argue that there are gender differences with running speed and agility because they found that 8- to 12-year-old boys performed better in these skills than the girls.

In contrast to the results from the present study, the study of Saygin *et al*. (2007) on 853 Turkish school children comprising pre-pubertal (212 boys, 199 girls), and pubertal (222 boys, 218 girls), found no gender differences for running speed and agility skills. A study by Amusa *et al*. (2010) of Grade 1 to Grade 5 learners in South Africa, reported that there were no meaningful gender differences for running speed and agility skills, but that gender differences did occur among Grade 6-learners. A possible reason why the girls could have done better than the boys in running speed and agility skills in the present study could be due to genetic and maturation factors, because speed and agility is a specific skill and is influenced by genetic factors (Marta *et al.*, 2012). The running speed and agility skills of the boys could still be developing and for this reason the girls performed better (Gallahue & Ozmun, 2006; Pienaar, 2012).

Gender differences were shown with regard to balance skills in this study, where boys performed better in six (standing on one leg with open eyes, standing on a line with eyes shut, heel-to-toe walking, standing on one leg on a balance beam with open eyes, standing heel-to-toe on a balance beam and standing on one leg on a balance beam with eyes closed), of the nine balance skills. Several researchers (Al-Haroun, 1988; Malina *et al.*, 2004; Lam, 2008) have indicated that girls do markedly better in activities that require balance than boys. The literature seems to suggest that gender differences already occur as early as age four to six in relation to balance, where girls also performed better (Toóle & Kretzschmar, 1993; Fjørtoft, 2000; Lejarraga *et al*., 2002; Lam *et al.*, 2003; Sigmundsson & Rostoft, 2003; Venetsanou & Kambas, 2011). However, there are also contradictions in literature, since several researchers found no gender differences (Du Toit & Pienaar, 2002; Venetsanou, 2007; Kourtessis *et al*., 2008; Waelvelde *et al*., 2008).

The results furthermore indicated that most of the total number of learners sorted into the average skills category for strength (n=661, 76.59%), agility skills (n=547, 63.38%) and balance (n=482, 55.85%), while the second largest number of learners sorted into the above average category for strength (n=168, 19.47%) and running speed and agility (n=304, 35.23%), while 301 (34.88%) learners were in the below average category for balance skills.

These results are in contrast to the research of Mak *et al*. (2010) on 12- to 18-year-old children and the research of Volbekiene and Griciute (2007) on 12- to 16-year-old children that found that children have insufficient strength and agility skills. However, the mentioned research was conducted on older children and these researchers are of the opinion that a decrease in daily physical activity is the main contributing factor to these insufficient skills (Volbekiene & Griciute, 2007; Mak *et al.*, 2010). A possible reason why the children in the present study performed better in the strength and agility skills items could be because several everyday activities rely on strength and agility skills to be executed (Fjørtoft *et al*., 2011).

Finally, the results of the present study show that there are relationships with small and large practical significance when considering strength, agility and balance skills. These findings are supported by the results of several researchers, who also found a relationship between strength, agility and balance skills (Ball *et al*., 1992; Wang & Chen, 1999; Baker & Newton, 2008; Katic *et al*., 2012). Research by Katic *et al*. (2012), involving Croatian 10- to 14-year-old learners, found a positive relationship between balance, agility and strength, while Wang and Chen (1999) found a positive relationship between dynamic strength and balance, as well as dynamic and static strength in their research on 9- to 12-year-old learners.

In spite of these findings, there are contradicting findings in the literature on the matter of the relationship between strength, agility and balance. Kin-İşler *et al*. (2008), who studied 25-year-old professional basketball players, found no relationships between strength, agility and balance, while Muehlbauer *et al*. (2013) reported no meaningful relationship between strength, balance and mobility for 7- to 10-year-old children.

CONCLUSION AND RECOMMENDATIONS

The results of this study should be evaluated in the light of a few shortcomings picked up during the course of the study. The BOT-2 only evaluates certain aspects of physical fitness. A recommendation would, therefore, be that other test batteries be used as well to compile a complete physical fitness profile of the 9- to 10-year-old learners. A second recommendation is that body composition and socio-economic class differences be taken into account, since these factors could have an effect on the physical fitness of children (Duncan *et al*., 2008; McVeigh & Meiring, 2014; White *et al*., 2014).

Although the study had some shortcomings, the results showed that 9- to 10-year-old learners in the North-West Province had sufficient strength and agility skills, although this was not the case for balance skills. The study also revealed that there were gender differences with regard to strength, running speed and agility, as well as in the balance skills. Boys in general performed better than girls do with strength and balance skills, while girls did better in running speed and agility skills. It also came to the fore that there were relationships between the strength, running speed and agility and balance skills of these children. A follow-up study is recommended to determine whether the strength, running speed and agility and balance skills of these children will change with age.

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