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STRENGTH AND AGILITY SKILLS OF GRADE 1-LEARNERS: NORTH-WEST CHILD STUDY

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ABSTRACT

The aim of this study was firstly to determine the current profile of strength and agility skills of Grade 1-learners in the North-West Province and, secondly, to establish whether there was gender differences with regard to these skills. The study included 816 Grade 1-learners (419 boys and 397 girls). The Bruininks-Oseretsky Test of Motor-Proficiency, second edition (BOT-2) was used to evaluate the children's strength and agility skills. The results showed meaningful gender differences with respect to the strength skills of the learners, since boys performed better in the standing long jump (p=0.001) and push-ups (p=0.001) and girls did better in the wall-sit (p=0.044). Gender differences were found also when considering agility skills. Boys performed significantly better in the 15m-shuttle run (p=0.001) and the girls did significantly better in the sideways step over a balance beam, and one-legged and two-legged sideways hops. Grade 1-learners exhibit sufficient strength and agility skills while gender differences were noticeable in the strength and agility skills of these learners.

Key words: Motor proficiency; Bruininks-Oseretsky Test; Speed; Agility; Strength; Grade 1-learners.

INTRODUCTION

Motor development plays an important role in a child's life and enables the child to participate in kinetic activities, which help the child not only to be physically active, but also with social interaction and personal growth (Barton *et al.*, 1999; Goudas & Giannoudis, 2008). Furthermore, good motor skills are very important for the young child because these are the building blocks for more complex gross motor skills (Goodway & Savage, 2001; Vidoni & Ignico, 2011). According to Gallahue and Donnelly (2003), children move through four phases of motor development (from birth to adulthood). Children between the ages of seven and 10 years are in the last phase of development, which is known as the sport-related movement phase. Due to the increase in the prevalence of motor delays in children (Okely *et al.*, 2001; Dimitrios *et al.*, 2007) and increased inactivity (Ara *et al.*, 2004; Janssen *et al.*, 2004), many children never reach the sport-related movement phase, which is central to specialisation in sport.

Sport is recognised as an enriching medium for child development (Goudas & Giannoudis, 2008) as it helps the child not only to be physically active, but also with social interaction and personal growth (Barton *et al.*, 1999; Goudas & Giannoudis, 2008). Physical activity is a large part of sport participation, which, according to Pienaar (2009), is not only advantageous

to a child's current health status, but also forms a stronger basis for the maintenance of good health throughout their entire lives. However, it is of central importance to develop the necessary skills and abilities through motor and physical activities at an early age to form an adequate foundation for sport skills.

Physical activity can be defined as all forms of movement associated with an increase in energy consumption (Trudeau & Shephard, 2010). Research has shown that physical activity contributes to an improvement in children's general health (Boreham & Riddoch, 2001; Robert & Zoeller, 2007), as well as their general health status as adults, since there is the trend that active children become active adults (Boreham & Riddoch, 2001). Robert and Zoeller (2007) found that physical activity prevents weight gain and maintains weight loss, and this is an important consideration knowing that the occurrence of overweight and obese children is becoming a general trend these days (Ogden *et al.*, 2002). Physical activity also contributes to the improvement of academic performance (Dwyer *et al.*, 2001) involving learning, memory, concentration and cognitive development (Trudeau & Shephard, 2010). Physical activity further helps to improve self-image (Dwyer *et al*., 2001; Tracey & Erkut, 2002; Piek *et al.*, 2006), socialisation (Trudeau & Shephard, 2010) and increases the development of motor skills and physical fitness (Okely *et al*., 2001).

Sherrill (2004) and Gallahue and Ozmun (2006) define physical fitness as the characteristics that an individual has that are related to the person's ability to perform physical activities. According to Gallahue and Donnelly (2003), physical fitness is sub-divided into physical and motor fitness. Muscle strength and strength are classified as part of physical fitness and increases commensurate with age from the early childhood years up to adolescence (Gallahue & Donnelly, 2003; Sherrill, 2004; Pienaar *et al*., 2012). Agility is a component of motor fitness (Winnick, 2005; Ortega *et al*., 2007; Pienaar *et al*., 2012) and can be seen as the ability to move fast and to change direction, while maintaining control and balance. The combination of speed, balance, strength and coordination is also an important part of agility (Annesi *et al*., 2005). Children's freedom of movement can be limited by inadequate strength as it forms an important part of the execution of all motor skills (Payne & Isaacs, 2008). In addition, strength is important to improve the overall fitness and health of sportspeople and to prevent injury (Chad *et al.*, 1999; Kraemer & Fleck, 2004), while agility is of special importance for the improvement of balance and coordination and is made up of a combination of acceleration, explosiveness and reaction time (Lori *et al*., 1998). The research of Ball *et al.* (1992) and Baker and Newton (2008) have shown that there is a direct relationship between sufficient strength and agility and performance in sport.

According to Haywood and Getchell (2009), strength, speed and agility improve with age during the middle childhood years and adolescence, but the pattern of improvement is influenced by several variables, such as body size, growth, maturation and gender, and to a certain extent motor competence and level of physical activity. Studies in various countries have reported that children now days have inadequate physical and motor fitness skills when considering components, such as aerobic fitness, strength, agility and perseverance (Volbekiene & Griciute, 2007; Keller, 2008; Mak *et al*., 2010).

When it comes to gender differences related to physical fitness, several research studies have found differences (Prista *et al*., 2003; Saygin *et al*., 2007; Volbekiene & Griciute, 2007;

Lazzer *et al*., 2009). A South African study by Monyeki *et al*. (2003) on seven- to 14-year-old children from disadvantaged communities found meaningful gender differences for the following tasks: standing long jump; sit-and-reach; sit-ups, bent arm suspension; agility; and 1600m running. Prinsloo and Pienaar (2005), with their study on four- to eight-year-old South African children of farm workers showed that the performance of standing long jump of girls was better than that of the boys, while the boys had a stronger handgrip than the girls did. Furthermore, gender differences in strength skills can be ascribed to differences in muscle size, segment length and to a certain extent muscle use (Thomas & French, 1985; Castro *et al*., 1995).

The literature indicates that boys do better in activities that require speed and strength, whereas girls do better with balance and fine motor activities (Malina & Bouchard, 1991). However, there are authors that have reported no gender differences regarding strength and agility. In the study of Holm *et al*. (2008), there were no significant gender differences regarding the strength of children, while research of Saygin *et al*. (2007) revealed that there were no gender differences with regard to agility skills.

After an examination of the literature available on the strength and agility skills, it seems that there is a lack of research on the profiles of Grade 1-learners in the North-West Province of South Africa. What is more, there seems to be a scarcity in the availability of literature that addresses the influence of gender on the development of strength and agility skills.

PURPOSE OF STUDY

The purpose of this study was firstly to establish the current profile of the strength and agility skills of Grade 1-learners in the North-West Province and secondly, to investigate gender differences between these Grade 1-learners where strength and agility skills are concerned. The results of the study could contribute to a profile of the strength and agility skills of Grade 1 boys and girls in the North-West Province. These results could provide Kinderkineticists and educators with norms regarding the Grade 1-learners in order to make recommendations on how the learners should spent their time during physical education lessons, as well as which skills need to be improved in these learners to help them perform better during motor skills and school sport. The results of this study could also provide some guidelines for Kinderkineticists to develop motor intervention programmes to improve these skills.

METHODOLOGY

Research design

This research is part of a longitudinal study (the North-West Child-Health-Integrated-Learning and Development Study: NW-CHILD study), stretching over a period of 6 years (2010-2016). This study comprises of baseline measurements (2010) and 2 follow-up measurements (2013 & 2016) on a selected group of learners residing in different areas of the North-West Province of South Africa. For the purpose of the current research, only data from the baseline measurements (2010) of the Grade-1 learners have been incorporated.

Research procedure

The North-West University Ethics Committee (No. 00070- 90-A1) granted ethical approval for the research. The Department of Basic Education of the North-West Province consented to doing the research in the schools. The different school principals of the identified schools gave their permission to collect data during school hours. Sixty Grade 1-learners were selected randomly in each school and the informed consent forms completed by the parents of these learners were collected. The learners whose parents reacted positively participated in the testing.

Participants

The aggregate number of Grade 1-learners in the North-West Province of South Africa that served as the target population and participated in the NW-CHILD study, included 816 learners. The sample was selected by means of a stratified randomised 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 the North-West Province are grouped into 4 education districts with 12 to 22 regions each. In each region there are between 12 and 47 schools. Regions and schools were selected randomly from this list with regard to population density and school economic status (Quintile 1 schools from poor economical areas, to Quintile 5 schools from affluent economical areas). Twenty schools with a minimum of 40 children per school and with an equal division of genders were involved in the study.

All learners with physical disabilities attending these mainstream schools, as well as all physically ill children on the day of the testing were excluded from this study. If the learner was younger than 6 years or older than 7.11 years, he or she was also excluded from the study.

Measuring instrument

The *Bruininks-Oseretsky Test of Motor-Proficiency, second edition (BOT-2)* (Bruininks & Bruininks, 2005), was used to evaluate the children's strength, speed and agility skills. This test battery is a standardised, norm-based and individual application instrument 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, running speed and agility sub-items consist of 5 activities each. The strength component includes the following items: standing long jump (distance in cm); push-ups (number performed correctly in a given time); sitting against a wall (time in seconds the position could be held); sit-ups (number performed correctly in a given time); and the V-sit (time in seconds the position could be held). The running speed and agility component includes the following items: a 15m shuttle run (speed in seconds); side hops over a balance beam; one-legged standing jumps; one-legged side hops; as well as two-legged side hops (number performed correctly in a given time).

During the execution of a test component, the child was allowed 2 attempts, of which the best

raw score was used for further 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, 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).

With the administration of the tests, if the test subjects could not speak English, trained interpreters were used to communicate the instructions of the evaluator to the test subjects. Trained Kinderkineticists administered all the tests, where each Kinderkineticist was responsible for only 1 test. This was done to ensure consistency during data collection.

Statistical analysis

For data processing, the STATISTICA computer package (Statsoft, 2010) of the North-West University was used to analyse the data. Statistical consultation services from the North-West University were asked to help with the data analysis. For descriptive purposes, 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 the learners' strength and agility 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).

Lastly, 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 and the accepted level of statistical significance was set at $p \leq 0.05$. The strength of the correlations are represented by the phi-coefficient with $w > 0.1$ indicating a small effect, $w > 0.3$ a medium effect and $w \geq 0.5$ a large effect (Steyn, 2002).

RESULTS

Table 1 summarises the demographic information of the participants of this study.

TABLE 1. **AGE OF GRADE-1 LEARNERS ACCORDING TO GENDER**

Participants	N	M±SD
Total Group	816	6.84±40.39
Boys	421	6.86±0.39
Girls	395	6.81±0.38

N= Number of test subjects M= Mean SD= Standard Deviation

Independent t-tests were conducted to determine the significance of gender differences with regard to strength and agility skills (Table 2 and Table 3).

Table 2 shows that statistically ($p \leq 0.05$) and practically ($d \geq 0.1$), significant gender differences are noticeable for the tests on strength, where the boys did better in the standing long jump and push-ups, while the girls performed better only in the wall-sit. Although the boys had better scores than the girls in sit-ups and V-sit, there were no statistical or practical differences. For running speed and agility, statistically ($p \leq 0.05$) and practically ($d \geq 0.1$), significant gender differences were once again found where the girls outperformed the boys in 3 of the components (side hop, 1-legged side hop and 2-legged side hop), and the boys performed better than the girls in the 15m shuttle run.

TABLE 2. **GENDER DIFFERENCES REGARDING STRENGTH AND RUNNING SPEED AND AGILITY SKILLS**

Variables	**Boys (n=421) M±SD**	**Girls (n=395) M±SD**	**Significance of differences df**	**t**	**p**	**d**
Strength						
Standing long jump	37.41±8.77	33.29±6.75	814	7.48	<0.001*	0.5##
Push-ups	10.26±5.55	8.76±5.49	814	3.89	<0.001*	0.2#
Sit-ups	3.91±4.31	3.48±4.13	814	1.44	0.150	0.1
Wall-sit	42.98±18.53	45.42±18.18	814	1.90	0.05*	0.1
V-sit	41.29±19.44	39.96±19.81	814	0.96	0.409	0.1
Running speed & agility						
15m-shuttle run	9.48±1.94	9.87±0.90	814	3.70	<0.001*	0.2#
Sideways step	22.55±10.96	26.57±8.56	814	5.83	<0.001*	0.4#
Standing one-legged jump	36.44±7.55	36.21±5.91	814	0.48	0.635	0.03
One-legged sideways jumps	15.42±5.71	16.44±6.57	814	2.38	0.017*	0.2#
Two-legged sideways jumps	18.67±6.13	19.65±6.10	814	2.30	0.022*	0.2#

M= Mean; SD= Standard Deviation; t= t-value; df= Degrees of freedom; p= Significant difference $p<0.05^{*}$; d= Effect size (practical significance when $d= 0.2^{\#}$ small and $d= 0.5^{\#\#}$ medium)

Table 3 shows the strength and agility results of the Grade 1-learners. The results with regard to strength skills reveal that there were statistically ($p \leq 0.05$) and practically ($d \geq 0.2$), significant differences between the aggregate scale score, age equivalent of the boys and girls and aggregate age equivalent. Furthermore, the strength of the boys' average age equivalent is significantly higher than the chronological age of the boys and girls (7.46 compared to 6.86 and 7.01 compared to 6.81 respectively). In the case of agility skills, no statistical ($p \geq 0.05$) or practical ($d \leq 0.2$) significance were found with regard to the scale score and age equivalent of the boys and girls. It seems that the age equivalent of the boys and girls are significantly higher than their chronological age (8.13 compared to 6.86 and 8.29 compared to 6.81

respectively). Lastly, for the strength and agility standard score, statistical significant (p=0.008) differences were found between the boys and girls, where the boys outperformed the girls (54.52 vs. 53.04).

TABLE 3. **GENDER DIFFERENCES REGARDING STRENGTH AND RUNNING SPEED AND AGILITY SKILLS BASED ON SCALE SCORES**

Variables	Boys (n=421) M±SD	Girls (n=395) M±SD	Significance of differences df	t	p	d
Strength						
Total scale score	16.26±3.36	15.34±3.73	814	3.69	<0.0001*	0.25#
Age equivalent of boys and girls (yrs)	7.46±1.53	7.01±1.51	814	4.24	<0.0001*	0.29#
Combined age equivalent (yrs)	7.52±1.55	7.00±1.48	814	4.94	<0.0001*	0.34#
Running speed & agility						
Total scale score	17.54±3.51	17.76±3.52	814	0.45	0.655	0.06
Age equivalent of boys and girls (yrs)	8.13±1.92	8.29±2.25	814	1.04	0.299	0.07
Combined age equivalent (yrs)	8.46±5.01	8.35±2.20	814	0.93	0.695	0.02
Strength & Agility SS	54.52±7.24	53.04±8.81	814	2.64	0.008*	0.17

M= Mean; SD= Standard Deviation; t= t-value; df= Degrees of freedom; p= Significant difference p<0.05*; d= Effect size (practical significance when d=≥0.2# small and d=≥0.5## medium); SS= Standard Score

Lastly a 2-way frequency table was used to show the strength and agility skills according to skill categories (Table 4).

Table 4 shows the strength skills of the Grade 1-learners in the different skill categories for the aggregate group and for the boys and girls separately. For strength, there was 1 girl in the far *below average category* and for running speed and agility there was 1 boy in the far below average category. The majority of the learners were in the *average* skills category for strength (boys: n=320, 76.01%; girls: n=293, 74.18%), and running speed and agility (boys: n=287, 68.17%; girls: n=259, 65.57%). The second largest number of learners were in the *above average* category for strength (boys: n=70, 16.63%; girls: n=54, 13.67%), and running speed and agility (boys: n=115, 27.32%; girls: n=115, 29.11%). Although gender differences occurred regarding the representation of the different strength and agility categories, no statistical or practical significant differences were found between the boys and girls in the *strength skills* (p=0.118; w=0.09) and *running speed* and *agility skills* (p=0.680; w=0.05).

TABLE 4. **STRENGTH AND AGILITY OF BOYS AND GIRLS BASED ON SKILL CATEGORIES**

Variables	1 n (%)	2 n (%)	3 n (%)	4 n (%)	5 n (%)
Strength					
Boys (n=421)	0 (0)	31 (7.36)	320 (76.01)	70 (16.63)	0 (0)
Girls (n=395)	1 (0.25)	46 (11.65)	293 (74.18)	54 (13.67)	1 (0.25)
Group (N=816)	1 (0.12)	77 (9.44)	613 (75.12)	124 (15.20)	1 (0.12)
Agility					
Boys (n=421)	1 (0.24)	13 (3.09)	287 (68.17)	115 (27.32)	5 (1.19)
Girls (n=395)	0 (0)	13 (3.29)	259 (65.57)	115 (29.11)	8 (2.03)
Group (N=816)	1 (0.12)	26 (3.19)	546 (66.91)	230 (28.19)	13 (1.59)

1= Far below average; 2= Below average; 3= Average; 4= Above average; 5= Far above average; Strength: w= 0.09, p=0.118; Running speed & agility: w= 0.05, p=0.6803

DISCUSSION

The study aimed to determine the strength and agility skills of Grade 1-learners in the North-West Province. A further goal was to determine whether there were gender differences regarding the strength and agility skills of these Grade 1-learners.

The results show that the average age equivalent of the total group for the strength skills was 7.27 years and for agility skills, it was 8.41 years. The average age equivalent for the strength and agility skills was statistically significantly ($p<0.05$) higher than the average chronological age of the aggregate group (6.84 years). The results furthermore revealed that most of the aggregate group of participants were in the average skills category for strength (n=613, 75.12%) and agility skills (n=546, 66.91%), while only 77 (9.44%) of the participants were in the below average skill category for strength and 26 (3.19%) for speed and agility. The results of this study are in contrast to the findings of Mak *et al*. (2010) on 12- to 18-year-old children and of Volbekiene and Griciute (2007), on 12- to 16-year-old children where it was posited that children have insufficient strength and agility skills. However, the mentioned research was conducted with older children and the researchers were of the opinion that a decrease in daily activity is possibly the main contributing factor to insufficient skill. It is speculated that a possible reason for the high average age equivalent for strength and agility skills of these Grade 1-learners can be that they were more physically active, play outside more, which could lead to more free play.

Regarding gender differences related to the raw scores of the strength skills of the learners, there were statistically significant differences between the boys and girls, where boys performed better in the standing long jump and push-ups. This corresponds with the findings of Prista *et al*. (2003) and Saygin *et al*. (2007), on 6- to 18-year-old children. The research by Lazzer *et al*. (2009), involving 8- to 12-year-old learners, found that the absolute peak strength values of the boys were higher than that of the girls.

Research by Milanese *et al*. (2010) on 6- to 12-year-old children also shows that boys performed the standing long jump better than the girls did. The results of this study are further confirmed by a South African study conducted by Monyeki *et al*. (2003) on 7- to 14-year-old children who also reported significant gender differences for the standing long jump, where boys did significantly better than the girls did. In a study conducted by Prinsloo and Pienaar (2005), involving 4- to 8-year-old South African children of farm workers, the boys performed better compared to the girls on the standing long jump. The better performance in the push-ups by boys could be explained possibly by the fact that boys are somewhat stronger in their upper extremities than girls are (Pienaar *et al*., 2012).

According to Pfister (1993), boys are more competitive and they make use of a larger play area, which is advantageous for strength development, while girls tend to play in a more collaborative and passive manner. Boys' activities also include more sport elements, while girls' free time activities are more sedentary in nature (Pfister, 1993). Parents tend to emphasise and encourage the gross motor skills of boys more than with girls, and this leads to rougher play, which in turn promotes strength skills (Maccoby & Jacklin, 1974). This study also found that boys and girls performed similarly with the sit-ups and V-sit, which corresponds with the findings of Pienaar *et al*. (2012) who found that muscle and strength development in both genders progress the same up to about the age of 11.

Gender differences also occurred during the agility skills, where the girls did statistically significantly better in the 'sideways step over a balance beam' and 'two-legged sideways jump' when compared to the boys. These agility sub-items require balance, preciseness and accuracy. This corresponds with the research findings of Keogh (1965), who showed that girls do better in hop, skip and jump activities, which require more preciseness and accuracy of movement. However, the boys did statistically significantly better in the 15m shuttle run when compared with the girls, which is in agreement with previous research findings (Monyeki *et al*., 2003; Lazzer *et al*., 2009; Milanese *et al*., 2010), which show that boys do better in activities that require speed.

RECOMMENDATIONS AND CONCLUSIONS

The results of this study should be assessed in light of a few shortcomings picked up during the course of the study. The BOT-2 only evaluates certain aspects of physical fitness and one recommendation is, therefore, that other test batteries be used as well to compile a complete physical fitness profile of the Grade 1-learners. A second recommendation is that socio-economic class differences be taken into account when the strength and agility skills of these learners are evaluated, since these factors could have an effect on children's physical fitness (Duncan *et al*., 2008; McVeigh & Meiring, 2014; White *et al*., 2014). A third recommendation is that educators and professionals in practice who work with this population must be trained to introduce the correct intervention programme to improve the strength and agility skills of these learners. Lastly, a follow-up study is recommended to determine whether the strength and agility skills of these children would change with age because it seems that as the learners get older they seem to participate less in physical activity.

Although the study had a few shortcomings, the results showed that Grade 1-learners in the North-West Province had adequate strength and agility skills. The study also revealed that

there were gender differences with regard to strength and agility skill, where the boys in general performed better with strength skills than the girls, while the girls outperformed the boys regarding the agility skills.

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