J SPORTS MED PHYS FITNESS 2013;53:635-43

Relationship between the body composition and motor and physical competence of Grade 1 learners in South Africa

C. KEMP, A. E. PIENAAR

Physical Activity, Sport and Recreation (PhASRec)
Faculty of Health Sciences,
North West University (Potchefstroom Campus)
Potchefstroom, Republic of South Africa

***Aim*. The objective of this study was to determine relationships between body composition and motor and physical competence of Grade 1 learners living in the North West Province of South Africa.**

***Methods*. Data were collected by means of a stratified random sampling procedure from 816 Grade 1 learners (419 boys, 397 girls) with a mean age of 6.84 years (+ 0.39 SD), in the NW-CHILD-study. Height, weight, skinfolds (subscapular, triceps, calf) and waist circumference were measured. International cut-off values were used to classify the subjects in normal, overweight or obese categories. Motor and physical competence was measured by using the Bruiniks-Oseretsky Test of Motor Proficiency-2 SF and the Test of Gross Motor Development 2.**

***Results*. One out of 10 learners were overweight or obese. Fine motor precision, balance, running speed and agility and strength correlated significantly with BMI with no clear relationships with object control skills and upper limb-coordination.**

***Conclusion*. A clear relationship was found between body composition and most of the motor and physical fitness competencies of Grade 1 learners. Intervention strategies to improve the body composition of overweight children and accompanying motor proficiency back logs and physical fitness deficiencies are recommended.**

KEY WORDS: Body composition - Child - Motor activity - Physical exercise.

Body composition is defined as the relationship between lean body mass and fat body mass [1] and is regarded as an important factor in determining the health status and well-being of children.[2] Researchers have reported a drastic decline in the physical activity of children over the past decade [3] and an increase in sedentary behaviour, which includes watching television and playing computer and television games.[4] This increase in sedentary lifestyle contributes to increased body fat percentages, which cause changes in body composition and increase the incidence of overweight and obesity in children.[1] Overweight and obese children often avoid exercise and participation in sport activities, which could hamper the development of their motor and physical fitness competencies.[4-6] Research further reveals that children with inadequate motor and physical fitness competencies show a decline in physical activity, which could again contribute to the development of obesity.[7] On the other hand, children with good motor skills are more active and less inclined to become overweight or obese.[7] Schwinner *et al.*[8] also reported that severely obese children have lower health-related quality of life than normal weight children and similar quality of life as children diagnosed with cancer.

Several research studies report that the body composition of overweight and obese children has a negative effect on their motor and physical fitness competencies.[9, 10] Such children have to carry a greater body mass, which could influence locomotor skills,[11] as well as causing increased forefoot plantar pressure, which could prevent them from wanting to partici-

Corresponding author: A. E. Pienaar, PhD, School for Biokinetics, Recreation and Sports Science, North West University (Potchefstroom Campus), Private Bag X6001, 2520 Potchefstroom, Republic of South Africa. E-mail: anita.pienaar@nwu.ac.za

pate in physical activity.[12] These children also move in less effective ways, resulting in the expenditure of more energy and causes them to become exhausted sooner as a result of inadequate skills.[7] Overweight and obese children also usually regard themselves as less competent than their peers of normal weight[11] and self-perception with regard to motor competencies is considered to be an important determiner of participation in physical activity.[13, 14]

Milanese *et al.*[15] report a relationship between the sum of 5 skinfolds and agility in males aged 6-7 years and with standing long jump in females aged 8-12 years. Deforche *et al.*[16] reported similar findings in Flemish youth between the ages of 12 and 18 years. The research of McKenzie *et al.*[17] shows an inverse correlation between balancing and jumping skills and the average of 2 skinfolds in 4 to 6-year-old children. Although poorer locomotor skills are reported among overweigth and obese children, less clear differences are reported for object control skills.[11, 18] Morano *et al.*[10] however reported poorer performance in locomotor and object control skills in comparison tor non-overweight peers in a preschool group of children. A study conducted by Graf *et al.*[9] on Grade 1 learners in Germany found that a raised body mass correlates with a poorer execution of gross motor skills. A study by Du Toit and Pienaar [19] on 3 to 4-year-old South African children showed that the overweight and obese 4-year-old children performed significantly poorer in balancing and catching skills than children of normal weight, although a statistically significant difference was not found among 3-year-olds. Another study by Truter *et al.*[20] on 9 to 12-year-old overweight and obese children indicated a significant relationship between body mass index, cardiovascular endurance and strength. In spite of this evidence of relationships, Catenassi *et al.*[6] could not establish a relationship between the motor skills and body mass index in children with a mean age of 5.6 years.

The prevalence of overweight and obesity in children in South Africa corresponds with that of developed countries a decade ago.[21] A recent study by Armstrong *et al.*[21] on 6 to 11-year-old South African children showed that 14% of boys and 17.9% of girls were overweight and that 3.2% of boys and 4.9% of girls were obese. Various environmental factors, which include increased crime and unsafe environments, have resulted in the fact that South African children do not play outside as much as they used to, which contributes to reduced levels of physical activities.[22] Sedentary behavior has also increased due to the absence of Physical Education in several South African schools and increased television viewing of more than 3 hours per day.[23] Joubert *et al.*[24] estimated that overweight and obesity contributed to 36 504 of all deaths in South Africa in 2000.

The Grade 1 year, when the young child enters the formal school system in South Africa, is a period when children are especially vulnerable to become obese, as this is a period when transition occur from the close emotional relationship with parents to the creation of new relationships with friends.[25] Children spend a considerable amount of time in school where obesity affects social skills, school attendance and academic performance.[26, 27] If children struggle to build new relationships or battle with the demands of school work, it can therefore happen that they experience loneliness and unhappines, resulting in 'overeating' and finding comfort in food to compensate for their feelings of unhappiness and loneliness.[25] Children learn social skills and problem solving skills through interaction with peers, which in turn contribute to the coping skills that they need in the stressful school environment.[28, 29] In addition, when children commence with formal schooling in Grade 1, they are also deprived of active playtime and this constraint can have a detrimental effect on their physical activity levels and their motor development, which depends on movement experience. The increased incidence of overweight and obesity in young South African children, which is comparable to worldwide tendencies,[21] therefore compels one to examine the relation between body composition and motor and physical skills in 7-year-old school beginners (Grade 1 learners), not only because of associated health risks, such as cardiovascular diseases, type 2 diabetes and respiratory problems,[30-32] but also because of the impact that it has on the motor development and the over all development of the child at this young age.

From the few comprehensive studies that have analyzed the incidence of overweight and obesity in South African children [21, 33, 34] is evident that the incidence of child obesity amongst South African children is high and that it could possibly have an effect on the motor and physical fitness competencies of these children, identifying a gap in the research with regard to the effect of the body composition of Grade 1 learners on their motor and physical fitness competencies. Previous studies only investigated selected motor and physical compentencies aspects of a young child leaving areas in this regard that still needs answering. Studies that are published in this field, were furthermore conducted on older or younger children than Grade 1 learners and furthermore only involved small groups of participants.[10, 19, 20] In order to plan effective intervention programmes and strategies to improve the motor and physical fitness competencies of overweight and obese children, it is important to determine what the relationship is between the body composition and motor and physical skills of South African children, especially school beginners.

Materials and methods

Study population

Grade 1 learners in the North West Province of South Africa served as the target population for the study. The total number of participants identified for the study was 880 Grade 1 learners. The research group was selected by means of a stratified random sample in conjunction with the Statistical Consultation Service of the North West University. In order to determine the research group, a list of names of schools in the North West Province was obtained from the Department of Education. From the list of schools in the North West Province, which are grouped in 8 education districts, each representing 12-22 regions with approximately 20 schools (minimum 12, maximum 47) per region, regions and schools were randomly selected with regard to population density and school status (quintile 1 - schools from poor economic sectors to quintile 5 – schools from good economic sectors). Boys and girls in Grade 1 were then randomly selected from each school. Twenty schools, from 4 educational districts, with a minimum of 40 children per school and an even gender distribution, were involved in the study.

Measuring instruments

Anthropometric measurements

The anthropometric measurements included the following: height (cm), body mass (kg), 3 skinfolds (subscapular, triceps and medial calf) (mm) and waist circumference (cm) and were carried out by trained post graduate students in Kinderkinetics in accordance with the protocol of the "International Society for the Advancement of Kinantropometry".[35] Height was measured barefoot to the nearest 0.1 cm by means of a portable stadiometer, and body mass was measured with an electronic scale (BF 511, Omron) to the nearest 0.1 kg. From the height and body mass measurement the body mass index (BMI), body mass (kg)/height $(m)^2$, was calculated for each participant. Skinfolds (subscapular, triceps and medical calf) were measured with a pair of Harpenden skinfold callipers and each skinfold was measured twice to obtain the average of the two measurements. These skinfold measurements were specifically taken because, according to Meredith and Welk [36] they show the highest correlation with the overall percentage of fat in the bodies of children. Because the BMI of children changes continually as they get older, Cole *et al*.[37] determined age-specific BMI cut-off points to identify obesity in growing children and these were used in this study to categorise the respondents in a normal weight, overweight or obese group. The cut-off values for 6-year-old overweight and obese children is >17.34 kg/m^2 and >19.65 kg/m^2, while for 7-year-old children it is >17.75 kg/m^2 and >20.51 kg/m^2.[37] Cut-off values for the sum of the triceps and calf skinfolds for 6 to 7-year-old overweight boys are 16-17, for overweight girls 19-22, for 6 to 7-year-old obese boys 20-24 and for obese girls 27-28.[38] Waist circumference, which is measured at the narrowest point between the lower costal (10th rib) border and the crista iliaca, was measured in the standing position with a standard measuring tape (0.1 mm intervals).

Motor measurements

Bruininks-Oseretsky Test of Motor-Proficiency (BOT-2 SF).—The short form of the second edition of the "Bruininks-Oseretsky Test of Motor-Proficiency" (BOT-2),[39] which was validated against the complete version and consisted of 14 items, was used to evaluate the children's motor and physical competence. The test battery is individually evaluated in order to determine the fine motor and gross motor skills of children. This norm-based measuring instrument is suitable for use with children aged from 4 to 21 years.[39] The BOT-2 SF evaluates skills in the following four motor area components: fine motor skills (divided into fine motor precision and fine motor integration); hand co-ordination (divided into manual dexterity and upper limb co-ordination); body co-ordination (divided into bilateral co-ordination and balance); and a strength and agility component (divided into running speed, agility and strength). Each subcomponent is converted to a raw score and then to a point score [fine motor precision (maximum=14), fine motor integration (maximum=10), manual dextertiy (maximum=9), bilateral integration (maximum=7), balance (maximum=8), running speed and agility (maximum=10), upper limb co-ordination (maximum=12) and strength (maximum=18). The total of the different subcomponents is calculated and then converted into a scale score, standard score and a percentile. A high correlation is reported between the complete version and the short version (r=0.80).[39]

Test of gross motor development (TGMD-2).—The "Test of Gross Motor Development" (TGMD-2) [40] was used to determine the qualitative development of object control of the learners. The measuring instrument consists of two main components, namely locomotor and object control skills, and was developed for assessing of children between the ages of 3 and 10 years. During this study only the object control skills component, consisting of six subitems, including throwing, catching, rolling, bouncing, kicking and hitting was used. The standard scores of these sub items were calculated from the raw scores and then combined to obtain a gross motor total that could be calculated as a motor quotient. The learners's performance compared to that of his/her age group can be determined by making use of percentile scales. A standard score between 1 and 3 is interpreted as very poor, while a score between 17 and 20 is regarded as exceptional. The TGMD-2 had a validity coefficient of r=0.89.[40]

Research procedure

The research formed part of the NW-CHILD (Child-Health-Integrated-Learning and Development) study. Grade 1 learners in the North West Province of South Africa served as the target population for the study. The total number of participants identified for the study was 880 Grade 1 learners. The research group was selected by means of a stratified random sample in conjunction with the Statistical Consultation Service of the North West University. In order to determine the research group, a list of names of schools in the North West Province was obtained from the Department of Education. From the list of schools in the North West Province, which are grouped in 4 education districts, each representing 12-22 regions with approximately 20 schools (minimum 12, maximum 47) per region, regions and schools were randomly selected with regard to population density and school status (quintile 1 - schools from poor economic sectors to quintile 5 – schools from good economic sectors). Boys and girls in Grade 1 were then randomly selected from each school. Twenty schools, from 4 districts with a minimum of 40 children per school and with an even gender distribution, were involved in the study. The total group that was measured consisted of 816 learners (419 boys and 397 girls) with a mean age of 6.84 years and a race distribution of 567 black, 218 white, 20 coloured and 11 Indian learners.

Ethical approval for the execution of the study was obtained from the Ethics Committee of the NWU (No. NW 00070 09 A1). Permission was also obtained from the Education Department of the North West Province. The principals of the various identified schools in the project were further asked for permission to collect the data during school hours. If the numbers of learners in the school allowed it, sixty Grade 1 learners were randomly selected and received informed consent forms that had to be completed by their parents. This was done to ensure that informed consent would be granted by the parents of at least 40 learners who need to be measured at each school. The learners whose parents consented to participation to the project underwent the tests. If neither English nor Afrikaans was the first language of the respondents, trained translators were used to interpret the instructions of the assessor to the learners.

Statistical analyses

Statistica for Windows was used to analyse the data.[41] A proportionally stratified sample was drawn with regard to ethnicity by making use of the population constitution data from Statistics South Africa to ensure that the data could be generalised for children in the North West Province. For descriptive purposes, data was analysed by means (M), maximum and minimum values and standard deviations (sd). Relationships between the variables was further analysed by making use of correlation coefficients. The practical significance of a significant relationship (P<0.05) was further analysed by means of effect sizes (d). The following guidelines were used for the interpretation of practical significance: d>0.1 indicates a small practical effect; d>0.3 indicates a medium practical effect and d>0.05 indicates a large practical effect.[42] In addition, use was made of a one-way analysis of variance to determine the significance of differences between the groups (normal weight, overweight and obese).

Results

Table I describes the number of participants, age and gender characteristics of the group. The mean age of the group was 6.84 (SD=0.39), and the boys were slightly older than the girls (6.86 years compared to 6.81 years).

The percentage of participants and gender characteristics of the subjects in the different BMI categories are indicated in Table II. A percentage of 88.36% (N.=721) of the subjects were classified into the normal weight category, 7.84% (N.=64) into the overweight category and 3.80% (N.=31) into the obese category. A smaller percentage of the boys, in comparison to the girls, was classified as overweight (6.44% compared to 9.31%) and obese (3.34% compared to 4.28).

Table III describes the different body composition characteristics of the group in the different BMI categories (normal weight, overweight, obese, overweight and obese). The table shows that the mean body mass of the obese group was 13.43 kg heavier than that of the normal weight group. All the mean scores of the variables that were analysed showed a clear cumulative tendency as BMI increased.

Table IV displays the correlation coefficients that were used to analyse the relationship between the body composition and the motor and the fitness competencies and object control skills of the group. Fine motor precision was the only variable that showed significant relationships with all three body composition characteristics (BMI, body fat % and waist circumference). These correlations were also the highest and indicated small practical significance. Running speed and agility also showed a negative significant correlation with BMI and body fat percentage with a small practical significance. Positive significant relationships were further found between manual dexterity, body fat percentage and waist circumference, while upper limb co-ordination also correlated positively with body fat percentage and waist circumferenc (d>0.1). A negative correlation with a small practical significance is indicated between balance and BMI, while strength showed a positive correlation of small practical significance with waist circumference. No

TABLE I.—*Age and gender characteristics of the group.*

	N.	Age	
		M	SD
Group	816	6.84	0.39
Boys	419	6.86	0.39
Girls	397	6.81	0.38

N: number of learners; M: mean; SD: standard deviation.

TABLE II.—*Number and percentage of participants in the different BMI categories and by gender.*

	Group (N.)	Group (%)	Boys (N.)	Boys (%)	Girls (N.)	Girls (%)
Normal weight	721	88.36	378	90.21	343	86.40
Overweight (BMI >17.34 for 6-year-old; BMI >17.75 for 7-year old)	64	7.84	27	6.44	37	9.31
Obese (BMI >19.65 for 6-year old; BMI >20.51 for 7-year old)	31	3.80	14	3.34	17	4.28
Overweight + Obese	95	11.64	41	9.78	54	13.60

N.: number of learners; %: percentage.

TABLE III.—*Body composition characteristics of the participants according to BMI categories.*

Variables	Normal weight N.=721		Overweight N.=64		Obese N.=31		Overweight + Obese N.=95	
	M	SD	M	SD	M	SD	M	SD
Stature (cm)	117.87	5.79	122.05	6.47	122.44	6.80	122.17	6.58
Body mass (kg)	20.82	2.80	27.78	3.48	34.25	10.73	29.88	7.40
BMI (kg/m²)	14.87	1.13	18.61	0.82	23.17	4.46	20.09	3.39
Waist circumference (cm)	52.43	4.69	60.12	3.90	67.80	10.76	62.62	7.80
Triceps skinfold (mm)	7.37	2.28	13.29	3.21	16.62	5.30	14.37	4.31
Subscapular skinfold (mm)	6.17	1.65	10.46	3.06	16.09	6.82	12.29	5.33
Fat percentage	14.39	3.10	22.50	4.30	28.00	7.14	24.29	5.98

BMI: body mass index; M: mean; SD: standard deviation.

TABLE IV.—*Correlations between the motor and physical skills and BMI, body fat percentage and waist circumference of the total group (N.=816).*

Variables	BMI	Body fat %	Waist circumference
Fine motor skills			
Fine motor precision	-0.24*	-0.21*	-0.15*
Fine motor integration	0.03	0.01	0.04
Hand coordination			
Manual dexterity	0.05	0.11*	0.16*
Bilateral co-ordination	0.06	0.05	0.06
Balance	-0.11*	-0.04	-0.04
Running speed and agility	-0.17*	-0.10*	-0.06
Upper limb coordination	0.05	0.11*	0.11*
Strength	-0.02	0.05	0.16*
Object control standard score	-0.02	0.03	0.05

% - percentage; *d-value >0.1 – small practical significance.

significant correlation was indicated between gender and the different variables that were analyzed, thus relationships of this kind were, therefore, not further analysed.

Table V reports the point score means obtained for the different motor and physical fitness competencies and object control skills in the normal weight (a), overweight (b) and obese groups (c) and significance of differences between the participants classified in these different BMI groups. Fine motor precision, balance, running speed and agility, and strength skills showed a decline in mean standard score values as BMI increased with significant differences between the groups. The overweight learners performed significantly better in balancing and strength skills than the obese group, although they did not differ significantly from the normal weight group in balancing and strength skills. Normal weight children showed significantly better strength and balancing skills than the obese group. No differences were found between the object control skills proficiency of the different BMI groups.

Discussion

The aim of this study was to determine the relationship between the body composition and motor and physical fitness competencies and object control skill proficiency of Grade 1 learners in the North West Province of South Africa.

The results show that 7.84% (N.=64) of the research group with a mean age of 6.84 years were overweight and 3.80% (N.=31) were obese, indicating that 1 in 10 Grade 1 learners were overweight or obese (11.64%). These percentages agree with the findings of another South African study[21] which reports that the prevalence of overweight and obesity amongst children in South Africa agrees with that of developed countries of a decade ago. The incidence of overweight (9.31% compared to 6.44%) and obesity (4.28% compared to 3.34%) was also higher in girls than in boys. These gender statistics coincides with the statistics provided by Armstrong *et al.*[21] on children aged between 6 and 13 years, which showed that 8.7% and 3.6% of the 6 to 7-year-old boys and

TABLE V.—*Significance of differences in the motor proficiency and physical abilities of the participants classified in different BMI categories.*

Variable	Normal weight (a) N.=721		Overweight (b) N.=64		Obese (c) N.=31	
	M	SD	M	SD	M	SD
Fine motor precision point score	7.58[bc]	3.19	4.03[a]	4.14	4.13[a]	4.87
Fine motor integration point score	1.98	1.89	2.25	1.89	2.58	1.78
Manual dexterity point score	4.88	1.04	5.19	1.13	4.71	1.15
Bilateral co-ordination point score	5.00	1.99	5.23	2.04	5.26	1.95
Balance point score	6.85[c]	1.39	6.66[c]	1.53	5.77[ab]	1.91
Running speed and agility point score	8.15[bc]	0.99	7.86[a]	1.72	7.48[a]	1.34
Upper limb co-ordination point score	7.83	2.57	8.42	2.53	8.00	2.37
Strength point score	4.63[c]	2.57	4.91[c]	2.53	3.39[ab]	1.86
Object control standard score	28.9	6.09	29.4	7.19	27.4	5.41

M: mean; SD: standard deviation; P: p-value; significance; (a) – normal weight; (b) – overweight; (c) – obese; mean with superscript – groups differed significantly on a 5% level of significance (P<0.05).

11.8% and 5.3% of the 6 to 7-year-old girls, respectively, were overweight and obese.

Various significant differences were found between the different body composition categories, which indicate that body composition does have an effect on the motor proficiency and physical fitness abilities of Grade 1 learners. The fine motor precision of the normal weight group was significantly better compared to the overweight and obese group, although the overweight and obese group did not differ significantly. Fine motor precision correlated with BMI, body fat percentage and waist circumference. D'Hondt *et al.*[43] reported similar results in 5 to 10-year-old children, and indicates that the maintenance of good posture is important for aquisition of various daily activities. They further report that overweight and obese children find it difficult to maintain posture balance, which could influence their fine motor skills.[44] The fine motor precision activities, such as drawing a line through a crooked path and folding paper, which were assessed as part of our study, required good posture balance. The overweight and obese learners also performed poorer in the balancing skills compared to the normal weight learners (Table V) which could have contributed to their poorer fine motor precision.

The results obtained for balance are also consistent with those of other studies.[17, 19] Goulding *et al.*[45] found that clinical measures of balance of males 10-21 years of age, with the Bruininks-Oseretsky Test of Motor-Proficiency involving a single limb stance on a balance beam, were significantly impaired in the obese males. The findings of D'Hondt *et al.*[43] conducted on 5 to 10-year-old children also showed that the balancing skills of the obese group were the weakest compared to the normal weight and overweight groups. The poorer balancing skills that were found with an increase in BMI, could perhaps be attributed to extra body weight, which has an effect on posture.[44] In obese children the body mass of the different body segments increases which have an affect on body type.[43] Good posture plays an important role in the maintenance of balance. It is therefore possible that posture deviations such as calcaneus valgus, hyper extension and knee valgus, pelvic anteroversion and head protraction in overweight and obese children [46] could influence their balancing skills. Goulding *et al.*[45] also report that inadequate muscular function in obese children contributed to impaired balance. It is therefor clear from our results that inadequate muscular function and posture deviations may already occur at an early age among obese inividuals and could negatively affect balance.

The running speed and agility skills of the BMI groups with more weight and body fat percentage were poorer (Table IV). This result is confirmed by studies that examined the same variables.[9, 15, 47] Studies by Okely *et al.*[18] and Morano *et al.*[10] report lower levels of locomotor skills in obese children compared to normal weight children. This can consequently also be cited as a possible reason for their poorer running speed and agility, because locomotor activities require greater displacement of the body mass than certain other activities.[11] Wearing *et al.*[48] also reported that obese children performed poorly on field tests in which they were required to move their larger body mass against gravity. It also appear that overweight and obese children experience greater forefoot pressure under the plantar surfaces of their feet during the execution of locomotor activities, which could be accompanied with pain and discomfort.[12]

A significant decline in strength skills were also found with a higher BMI. These results also agree with other studies.[16, 20, 49] A possible reason for this could be that during the aquisition of strength skills, an increased body mass, which accompany a higher BMI, have to be displaced. Another explanation could be that obese children may avoid weight-bearing activities, because of the greater energy cost of these activities, compared with their normal-weight peers.[50] Waist circumference showed the greatest relationship with strength skills and this could be due to the fact that the strength skills in this study (push-ups and sit-ups) both required a displacement of the centre of mass against gravity, which is in the waist area.

However, a higher BMI level did not negatively influence the object control or ball skills and upper limb co-ordination of the research group. These results are similar to other studies that also reported that overweight and obesity had no effect on the object control skills of children.[11, 18] A possible reason might be that object control skills and upper limb co-ordination do not require much displacement of body mass, but rather control of an apparatus or a ball. Some studies however did find that body composition had an effect on the object control skills of children.[10, 19] It can consequently be concluded that these skills are not influenced at this young age to the same degree by body composition as locomotor skills where displacement of the body is necessary.[11]

Body composition also showed no significant relationship with manual dexterity and bilateral coordination, although the obese group obtained the lowest score of the three groups for manual dexterity, indicating a tendency towards a possible relationship. This was also the case for object control skills. Hence, a trend is observed for obese children to already show a disposition at this young age towards lower levels of manual dexterity and object control skills. Further research, such as longitudinal follow-up studies, are therefor required in this regard.

Conclusions

This study established clear relationships between body composition and most of the motor and physical fitness competencies of Grade 1 learners. The overweight and, especially, the obese children showed lower motor and physical fitness competencies in all the studied variables, with significant relationships, especially in components where displacement of the body against gravity is needed. Poor balance and body control of obese children can hamper their fine motor precision, and along with poor locomotor skills, their running speed and agility. These deficiencies can hamper school progress and paticipation in sport activities and can contribute to lower physical activity levels at this young age. As childhood obesity became a perturbing health problem with statistics showing higher inactivity levels and that overweight and obese children become overweight and obese adults, it is consequently important to adress the motor and physical fitness competencies of these children. The results of this comprehensive study can be used as a guideline to compile intervention programmes, but also to identify strategies that can be used to improve the motor and physical competence of Grade 1 learners. Follow-up studies are also recommended to determine if the relationships that were established in this study, become stronger over time. The causes of obesity among young children also need further investigation for a better understanding of the problem.

References

1. Gallahue DL, Ozmun JC. Understanding motor development: infants, children, adolescents, adults. 6th ed. Dubuque, Iowa: McGraw-Hill; 2006.
2. Shukla M, Venugopal R, Mitra M. A cross sectional study of body composition somatotype and motor quality of rural and urban boys Chhattisgarh. Int J Fit 2009;5:1-7.
3. Dodd CJ. Energy regulation in young people. J Sports Sci Med 2007;6:327-36.
4. Gillis LJ, Kennedy LC, Bar-Or O. Overweight children reduce their activity levels earlier in life than healthy weight children. Clin J Sport Med 2006;16:51-5.
5. Cairney J, Hay JA, Faught BE, Hawes R. Developmental coordination disorder and overweight and obesity in children aged 9-14y. Int J Obes 2005;29:369-72.
6. Catenassi FZ, Marques I, Bastos CB, Basso L, Vaz Ronque ER, Gerage AM. Relationship between body mass index and gross motor skill in four to six year-old children. Rev Bras Med Esporte 2007;13:203-6.
7. Wrotniak BH, Epstein LH, Dorn JM, Jones KE, Kondilis VA. The relationship between motor proficiency and physical activity in children. Pediatrics 2006;118:e1758-e65.
8. Schwinner JB, Burwinkle TM, Varni JW. Health-Related Quality of life of severely obese children and adolescents. JAMA 2003;289:1813-9.
9. Graf C, Koch B, Kretschmann-Kandel E, Falkowski G, Christ H, Coburger S *et al*. Correlation between BMI, leisure habits and motor abilities in childhood (CHILT-Project). Int J Obes 2004;28:22-6.
10. Morano M, Colella D, Caroli M. Gross motor skill performance in a sample of overweight and non-overweight preschool children. Int J Pediatr Obes 2011;6:473-5.

11. Southall JE, Okely, AD, Steele JR. Actual and perceived physical competence in overweight and nonoverweight children. Pediatr Exerc Sci 2004;16:15-24.
12. Dowling AM, Steele JR, Baur LA. Does obesity influence foot structure and plantar pressure patterns in prepubescent children? Int J Obes 2001;25:845-52.
13. Kemp C, Pienaar AE. The effect of a physical activity, diet and behaviour modification intervention on the self perception of 9 to 12 year-old overweight and obese children. Afr J Phys Health Edu Recreat Dance 2010;16:98-112.
14. Haywood KM, Getchell N. Life span motor development. 5th ed. Champaign, IL: Human Kinetics; 2009.
15. Milanese C, Bortolami O, Bertucco M, Verlato G, Zancanaro C. Anthropometry and motor fitness in children aged 6-12 years. J Hum Sport Exerc 2010;5:265-79.
16. Deforche B, Lefevre J, De Bourdeaudhuij I, Hills AP, Duquet W, Bouckaert J. Physical fitness and physical activity in obese and nonobese Flemish youth. Obes Res 2003;11:434-41.
17. McKenzie TL, Sallis JF, Broyles SL, Zive MM, Nader PR, Berry CC. Childhood movement skills. Predictors of physical activity in Anglo American and Mexican American adolescents. Res Q Exerc Sport 2002;73:238-44.
18. Okely AD, Booth ML, Chey T. Relationship between body composition and fundamental movement skills among children and adolescents. Res Q Exerc Sport 2004;75:238-47.
19. Du Toit D, Pienaar AE. Overweight and obesity and motor proficiency of 3- and 4-year old children. S Afr J Res Sport Phys Educ Recreation 2003;25:37-48.
20. Truter L, Pienaar AE, Du Toit D. Relationships between overweight, obesity and physical fitness of nine- tot twelve-year-old South African children. South African Family Practice 2010;52:227-33.
21. Armstrong MEG, Lambert MI, Sharwood KA, Lambert EV. Obesity and overweight in South African primary school children – the Health of the Nation Study. S Afr Med J 2006;96:439-44.
22. Bourne LT, Lambert EV, Steyn K. Where does the black population of South Africa stand on the nutrition transition? Public Health Nutr 2002;5:157-62.
23. Medical research council. 2002. Umthente uhlaha usamila: The 1st South African National Youth Risk Behaviour Survey. [cited 2013 July, 2]. Available at: http://www.mrc.ac.za/healtpromotion/reports.htm
24. Joubert J, Norman R, Bradshaw D, Goedecke JH, Steyn NP. Estimating the burden of disease attributable to excess body weight in South Africa in 2000. S Afr Med J 2007;97:683-90.
25. Pienaar AE. Kinderkinetics: An investment in the total well-being of children. S Afr J Res Sport Phys Educ Recreation 2009;31:49-67.
26. Datar A, Sturm R, Magnabosco JL. Childhood overweight and academic performance: National study of kindergartners and first-graders. Obes Res 2004:12;58-68.
27. Du Toit D, Pienaar AE, Truter L. Relationship between physical fitness and academic performance in South African children. S Afr Res Sport Phys Educ Recreation 2011;33:23-35.
28. Hartup WW. The company they keep: Friendships and their developmental significance. Child Dev 1996;67:1-13.
29. Dreyer ML, Egan AM. Psychosocial functioning and its impact on implementing behavioral interventions for childhood obesity. Prog Pediatr Cardiol 2008;25:159-66.
30. Daniels SR. The consequences of childhood overweight and obesity. Future Child 2006;16:47-67.
31. Fox CS, Pencina MJ, Meigs JB, Vasan RS, Levitzky YS, D'Agostino RB. Trends in the incidence of type 2 diabetes mellitus from the 1970s to the 1990s: the Framingham Heart Study. Circulation 2006;113:2914-8.
32. Beuther DA, Sutherland ER. Overweight, obesity, and incident asthma: a meta-analysis of prospective epidemiologic studies. Am J Respir Crit Care Med 2007;175;661-6.
33. Monjeki KD, Lenthe FJ, Steyn NP. Obesity: does it occur in African children in a rural community in South Africa? Int J Epidemiol 1999;28;287-92.
34. Steyn NP, Labadarios MB, Mauder E, Nel J, Lombard C. Secondary anthropometric data analysis of the national food consumption survey in South Africa: the double burden. Nutrition 2005;21:4-13.
35. Marfell-Jones, Olds T, Stewart A, Carter JEL. International standards for anthropometric assessment. International Standards for Anthropometric Assessment: Potchefstroom; 2006.
36. Meredith MD, Welk GJ. FITNESSGRAM: Test administration manual: The Cooper institute for aerobics research. 2nd ed. Champaign, IL: Human Kinetics; 2005.
37. Cole TJ, Belizzi MC, Flegal KM, Dietz WH. Establishing a standard definition for child overweight and obesity worldwide: International survey. BMJ 2000;320:1240-3.
38. Lohman TG. Advances in body composition assessment. Champaign, IL: Human Kinetics; 1992.
39. Bruininks RH, Bruininks BD. Bruininks-Oseretsky test of motor proficiency. 2nd ed. Circle Pines, MN: AGS Publishing; 2005.
40. Ulrich DA. Test of gross motor development. 2nd ed. Austin, TX: Pro-ed; 2000.
41. Statsoft. Statistica for Windows. Release 5.5: General conventions & statistics. Tulsa, OK: StatSoft; 2010.
42. Cohen J. Statistical power analysis for the behavioural sciences. 2nd ed. Hillsdale, NJ: Erlbaum; 1988.
43. D'hondt E, Deforche B, De Bourdeaudhuij I, Lenoir M. Relationship between motor skill and body mass index in 5- to 10-year-old children. Adapt Phys Act Q 2009;26:21-37.
44. D'hondt E, Deforche B, De Bourdeaudhuij I, Lenoir M. Childhood obesity affects fine motor skill performance under different postural constraints. Neurosci Lett 2008;440:72-5.
45. Goulding A, Jones IE, Taylor RW, Piggot JM, Taylor D. Dynamic and static tests of balance and postural sway in boys: effects of previous wrist bone fractures and high adiposity. Gait Posture 2003;17:136-41.
46. Rosell AA, Fregonesi CETP, Camargo MR, Mantovani AM, Purga MO, Freitas Junior IF *et al*. Prepubescents and pubescent overweight postural characterization. Brazilian Journal of Biomotricity 2010;4:104-14.
47. Monyeki MA, Koppes LLJ, Kemper HCG, Monyeki KD, Toriola AL, Pienaar AE *et al*. Body composition and physical fitness of undernourished South African rural primary school children. Eur J Clin Nutr 2005;59:877-83.
48. Wearing SC, Hennig EM, Byrne NM, Steele JR, Hilla AP. The impact of childhood obesity on musculoskeletal form. Obes Rev 2006;7:209-18.
49. Raudsepp L, Jürimäe T. Relationship of physical activity and somatic characteristics with physical fitness and motor skill in prepubertal girls. Am J Hum Biol 1998;9:513-21.
50. Bar-Or O. Physical activity and physical training in childhood obesity. J Sports Med Phys Fitness 1993;33:323-9.

Funding.—This project was funded by the National Research Foundation of South Africa, the National Lottery Board of South Africa and PhASRec.

Acknowledgments.—The authors want to thank the National Research Foundation of South Africa, the National Lottery Board of South Africa and PhASRec for the grants that they made available for the research.

Conflicts of interest.—The authors certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

Received on March 29, 2012.
Accepted for publication on July 2, 2013.