

Full Length Research Paper

Health-related physical fitness among rural primary school children in Tshannda, South Africa

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The socioeconomic transformation in South Africa over the previous decade may have created a less active lifestyle and a decline in fitness among South African children. This study seeks to present the data on the health-related physical fitness of the Tshannda rural school children in grades 1 to 7 and to evaluate age and gender differences in physical fitness among the Tshannda children, of which information is not yet available. The stature, body mass and skinfolds of the children were measured and the Eurofit test battery was used to assess the children's physical and performance fitness. Percentage body fats, fat mass and fat-free mass were calculated. There was progressive increase and improvement in the performance values from grade level one to seven. In the physical performance tests requiring moving the body, power and strength, the boys generally performed higher than the girls. Girls were superior to boys in the tests of flexibility. Body fat was higher in girls than in boys at all grades and increases with advancement in grades. The physical performance measures of our samples increase in grade levels and with the boys having higher values than girls as well as performing better in activities requiring physical exertion and expenditure of energy. In contrasts, the girls showed superiority in flexibility measures and accumulate more body fat than the boys. Physical fitness of these rural school children seems to be low, thus confirming the worldwide decline in fitness levels of children.

Key words: South Africa, eurofit test, anthropometric measurement, physical fitness, rural children.

INTRODUCTION

Physical fitness can be thought of as an integrated measure of most, if not all, the body functions involved in the performance of daily physical activity and/or physical exercise (Ortega et al., 2008). Included in this definition are characteristics such as cardiorespiratory endurance, muscular strength and endurance, body composition and flexibility (Howley, 2001). These characteristics are often referred to as 'health-related components' (Powell et al., 1998), and are usually associated with disease prevention and health promotion. Childhood and adolescence are important stages of life, since remarkable physiological and psychological changes take

place at these ages. Similarly, lifestyles and healthy/unhealthy behaviors are formed during these years, which may influence adult behavior and health status. Low physical fitness in children has been associated with impaired health indicators such as increased body fatness (Ruiz et al., 2005; Dencker et al., 2006) and abdominal adiposity (Ortega et al., 2007; Brunet et al., 2007), several cardiovascular disease risk factors (Buchheit et al., 2007; Thomas et al., 2003), hypertension (Katzmarzyk et al., 2001; Ruiz et al., 2006) and low physical activity (Dencker et al., 2006). Therefore, it is important to promote high levels of fitness in modern youth. A number of recent studies have drawn attention to increases in fatness (Olds and Harten, 2001) and declines in aerobic fitness (Tomkinson et al., 2003) in school age children. The implications of decreasing fitness levels in children are considerable. Children are

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losing the metabolic effects of fitness that might protect them from excessive weight gain as well as other metabolic ill health (Stratton et al., 2007). As the risks of unfitness and obesity are cumulative, tracking from childhood to adulthood (Eriksson et al., 2003), this situation is extremely worrying for the future public health. Given that fitness is an important component of metabolic health (Eisenmann et al., 2005) and a strong independent predictor of premature death (Blair et al., 1996), examining the fitness levels of children could be useful for interventions to improve fitness among the children. To be physically fit is not just a help to sport and physical education, it is also a major factor in leading a happier and fuller life (Rudolf et al., 2001; Grund et al., 2001). For the individual child, being fit can help to develop a positive attitude to the body, can enable the child to achieve a self-awareness of his or her physical state, and thus, become better motivated to maintain or improve individual fitness (Wright et al., 2007).

We present several health-related physical fitness components of 1 to 7 graders in Tshannda, Vhembe district, Limpopo province, South Africa. The study is part of the on-going project on South African children population (Tshannda longitudinal study) which encompasses the evaluation of physical fitness status of rural South African children. These grade levels (pre-pubertal years) of the children have been shown to be a time of critical decline in the physical activity levels of children (Van Mechelen et al., 2000). This study hypothesized that the socio-economic transformation that has taken place in South Africa since independence (1994) may have brought about a less active lifestyle among children and consequently, a decline in fitness.

MATERIALS AND METHODS

Study design

This was a longitudinal cross-sectional study involving primary school children attending public schools in Tshannda area of Mutale Municipality, Limpopo Province, South Africa.

Geographical location

The study was conducted in Tshannda area of Mutale Municipality in Vhembe District. This location is unique in that it can be described as a "traditional" rural environment. Tshannda is in the far north-east of South Africa close to Mozambique border. The population which is mainly Tshivenda and XiTsonga speaking relies mainly on subsistence farming and very meager financial support from males of the families working as migrant labourers within the mining sectors in the South and Gauteng.

Population and sample

The study population comprised all grades 1 to 7 public school learners attending the 181 schools on the SNAP 2004 Vhembe District list (compiled by Finance, Human Resource and Facilities Planning Divisions, Department of Education). The participants

were all children attending primary schools in Tshannda Circuit of Mutale Municipality. The choice of schools and grades depended mostly on the schedule of schools received from the District Department of Education and the Circuit. The schools chosen were not different from the other schools in the area. All the schools in the area were government schools. They all have to cope with similar socio-economic conditions including facilities and infrastructures. The cooperation of parents, principals, teachers and learners was excellent.

Sampling strategy

The sampling frame was defined using the enrolment number for each school. Private independent schools were excluded from the study population since learners from these schools constitute a very small percentage of the study population. This study employed a stratified, two stage cluster sampling strategy. This procedure ensures adequate representativeness of the study population in the sample. The procedure involved arrangement of study population into schools and class-level clusters. The first stage involved selecting randomly, schools with a probability proportional to the size and enrolment of each school. The second stage involved selecting classes within the participating schools systematically and with equal probability of participation. This afforded all learners in the selected classes the eligibility to participate in the study. It was assumed that a sample of 25% was desirable for the study. Table 1 shows the proportion of sampled participants from the 10 sampled schools. However, due to absenteeism and incomplete data of 150 participants, 409 participants (193 boys and 216 girls) eventually completed the tests and their data were used in the final statistical analysis. In order to enlist the interest and participation of the selected schools, details about the study including the objectives and procedures to be followed were provided to the teachers, parents and children. For a clear understanding of the project, the information to parents and children was translated to Tshivenda while that of the teachers remained in English language. Parents/guardians were then requested to sign the informed consent forms to indicate their approval for their wards to participate in the study. The consent forms were completed and sent to each of the selected schools with a letter to the principal indicating the classes that were selected for the project and the time table for the assessments.

To facilitate data collection, the principals were requested to collect the completed informed consent forms and hand them over to the research team on the day children from the school would be assessed.

Ethical considerations

The nature and scope of the study were explained to the children and their parents who gave informed consent. Approval to conduct the study was given by Limpopo Department of Education (DoE). The Department requested learners, managers and educators to cooperate with the research team when the research activities were conducted. The Research and Publications Committee (RPC), University of Venda in South Africa approved the study. The study was also registered with the RPC (04/BRS/R1).

Pilot study

A pilot study was conducted in March to April 2005 to ascertain the logistical and technical procedures for data collection. The sample consisted of 79 learners from three primary schools in Mutale Municipality. These schools and children did not participate in the final study.

Table 1. Proportion of sampled participants from the 10 sampled schools.

School	Boys	Girls	Total
Tshavhadinda primary school	28	29	57
Tshandama primary school	76	76	152
Mufulwi primary school	32	35	67
Guyuni primary school	26	20	46
Fefe primary school	10	13	23
Mavhode primary school	22	17	39
Tshitandani primary school	20	13	33
Gogogo primary school	39	34	73
Musunda primary school	18	16	34
Nwanedi primary school	18	17	35
Total	289	270	559

Selection and training of research assistants

The study involved lecturers and students from the Centre for Biokinetics, Recreation and Sport Science, the Department of Nutrition University of Venda and research assistants from the Department of Kinesiology and Physical Education, University of the North. A special training workshop was organized for these individuals to enable them become competent in the aspect of anthropometric and physical performance measurements. At the training workshop, each person was allocated to serve in specific portfolios for example, measure stature and body mass; skinfolds; test lower back/upper thigh flexibility (sit and reach, shoulder lift, trunk extension); test functional endurance (sit-ups and push-ups) and endurance test (600 m/1.5 mile run-walk, etc). Each station has a team leader who coordinated the activities of the station.

Assessment of motor and health-related fitness parameters

The children's motor ability and health-related physical fitness components were tested using the EUROFIT (EUROFIT, 1988) and AAHPERD (AAHPERD, 1980) tests. The motor performance tests were divided into six groups. To avoid technical errors related to tester variability, each tester maintained the same testing station throughout the study. Where two tests involved using the same muscle group, a 3-min rest interval was allowed in-between the tests. There were two testers per station. The participants received verbal encouragement from the investigators in order to achieve maximum performance. Briefly, the tests were administered in the following order:

- i) To assess flexibility, the standardized sit-and-reach test which measures the lower back/upper thigh flexibility was used. The sit-and-reach test was chosen because it is the most commonly used flexibility test in school setting and it is simple and relatively easy to administer. For sit-and-reach, a child was requested to sit keeping his/her knees straight and reach forward as far as possible from a seated position. The score was determined by the farthest position the child reached on platform with his/her fingertips. The best of three trials was recorded for each participant.
- ii) Testing for lower muscular extremity and abdominal endurance involves the sit-ups and push-ups tests. For sit-ups, each child assumed the starting position by lying on the back with knees bent at 90° and feet together. Another child held the testee's ankles with the hands only. The heel was the only part of the foot that remained in continuous contact with the ground. The child's fingers were interlocked behind the neck and such that the back of the hands

was touching the mat. The child began to raise the upper body until the elbows touched the knees. The child then lowered the body until the upper portion of the back touched the mat. The maximum sit-ups achieved in 60 s were recorded. As for push-ups, the hands were kept shoulder width apart while the feet were placed together. The back was straight, with head up and the child using the toes as the pivotal point. The girls adopted a modified "knee push-up" position, with legs together, lower leg in contact with mat and ankles plantar flexed. The back was kept straight, hands at shoulder width apart and head held up. Each child began by lowering the entire body as a unit until the upper arms were parallel to the ground and their chins and stomach touched the mat. The child returned to the starting position by raising the entire body until the arms were fully extended. The body remained straight and moved as a unit for the entire repetition. The maximal number of push-ups performed consecutively in 1 min without rest was counted as the criterion score.

- iii) To assess running speed, the 50-m sprint (from standing position) was used. This test measures speed and agility of lower limb movement. The minimal time needed on a 10 times 5-m run in seconds was used as the score.
- iv) Hand grip (right and left) measures maximum handgrip strength of upper limb, using the hand dynamometry which is calculated in kilograms. The arm grip (left and right) as a measure of static arm strength- maximal force pulled with preferred arm on a dynamometer while standing was read and recorded in centimeters.
- v) Lower limb explosive strength was measured by standing broad jump whereby children had two attempts to jump as far as possible from a standing position at the start. The maximum horizontal distance attained was measured.
- vi) The 600 m/1.5 mile run-walk was used as a test of cardiorespiratory endurance. Children in grade levels 1 to 3 walked/ran the 600 m while children in grade levels 4 to 7 ran/walked the 1.5 mile run. The time taken to complete the distance was recorded for each participant.

The order of the tests was strictly adhered to. However, sufficient rest period was allowed in-between two tests requiring the use of same muscles or muscle groups.

Anthropometric measurements

A Martin anthropometer was used to measure stature to the last 0.1 cm. A beam Seca Alpha weighing scale (Model 770) with a capacity of 200 kg and with a true zero balance was used to measure body mass to the last complete 0.1 kg. Body mass index (BMI) was

Table 2. Stature, body mass and body mass index of Tshannda school children stratified according to grade and gender.

Grade levels	Gender (n)	Stature (cm)	Body mass (kg)	BMI (kg/m ²)
1	Boys (11)	115.2 ± 5.2*	20.3 ± 2.0	15.1 ± 0.7*
	Girls (10)	122.7 ± 12.5*	20.3 ± 2.3	14.0 ± 2.2*
2	Boys (19)	124.0 ± 14.3	22.5 ± 3.8*	14.8 ± 2.3
	Girls (33)	124.5 ± 6.4	24.2 ± 3.6*	15.6 ± 1.4
3	Boys (34)	131.0 ± 7.5*	27.9 ± 4.4*	16.4 ± 2.5*
	Girls (29)	128.0 ± 11.5*	25.0 ± 5.3*	15.3 ± 2.4*
4	Boys (31)	131.3 ± 5.3	27.7 ± 3.5	16.0 ± 1.3
	Girls (37)	132.0 ± 7.3	27.7 ± 5.4	15.8 ± 1.7
5	Boys (19)	138.4 ± 6.7	31.8 ± 5.6	16.5 ± 2.0*
	Girls (22)	137.7 ± 10.1	32.6 ± 10.2	17.0 ± 3.1*
6	Boys (20)	142.2 ± 12.0*	33.6 ± 6.3*	16.5 ± 1.7*
	Girls (18)	147.5 ± 8.3*	39.2 ± 6.8*	18.0 ± 2.8*
7	Boys (59)	148.9 ± 1.0*	40.8 ± 1.0*	18.2 ± 3.3*
	Girls (67)	151.1 ± 6.5*	44.3 ± 8.9*	19.3 ± 3.1*
Total	Boys (193)	136.7 ± 13.5	31.8 ± 9.9*	16.7 ± 2.7
	Girls (216)	137.6 ± 11.1	33.0 ± 11.2*	17.3 ± 5.5

Values are mean ± SD; BMI = body mass index; *p = indicates p<0.05.

derived from the general equation, BMI = body mass ÷ height² (kg.m²); that is mass divided by height (m²). Harpenden (John Bull) caliper with inter-jaw pressure of 10 g/mm² was used to measure skinfolds (triceps and subscapular), in triplicate to the last 0.2 mm on the right side. The mean of three measurements was used in data analysis. All measurements were taken according to the standard procedures suggested by the International Society for the Advancement of Kinanthropometry (ISAK) (Marfell-Jones et al., 2006). The measurements were monitored by a qualified level 3 Kinanthropometrist. The calculation of the percentage body fat (%BF) was based on the sum of the triceps and subscapular skinfolds (ΣTS) using the equation of Slaughter et al. (1988). The equation is internationally accepted for use in children from various ethnic groups.

Boys (all ages) %BF = 1.2 (Σ TS) – 0.008 (Σ TS)² – 3.2.

Girls (all ages) %BF = 1.33 (Σ TS) – 0.013 (Σ TS)² – 2.5.

Where: Σ TS = sum of triceps and subscapular skinfolds.

Fat mass (FM) and fat-free mass (FFM) were calculated using percentage fat and body weight:

Fat mass (kg) = body weight (kg) × %fat/100; fat-free mass (kg) = body weight (kg) – fat mass (kg).

Statistical analysis

Data were presented as means and standard deviations. Analysis

of variance (ANOVA) was used to examine differences in fitness results among grade levels and gender. All statistical analyses were carried out using the SPSS 17.0 statistical package. A probability level of 0.05 or less was used to indicate statistical significance.

RESULTS

Table 2 shows the physical characteristics of the participants. Girls were significantly (p<0.05) taller, heavier and had higher mean BMI value than boys. Specifically, the girls were taller, heavier and had high BMI value than boys by 0.9 cm, 2.8 kg and 0.6 kg m² respectively. The profiles of the physical fitness characteristics of Tshannda children classified according to grade level and sex are presented in Table 3. The sit-and-reach test which measures the lower back/upper thigh flexibility indicated a significant sex mean difference between boys (26.4 ± 5.3 cm) and girls (29.3 ± 5.1 cm) (p <0.05). Except at grades 2 and 3, girls performed significantly higher than boys in sit-and-reach test which measures flexibility. Over all, mean performances for the children in the sit-up test were 27.7 ± 9.7 and 28.7 ± 10.0 for the boys and girls, respectively, which indicated slight significant difference. The mean push-up test scores

Table 3. Physical fitness scores of Tshannda school children stratified according to grade and gender.

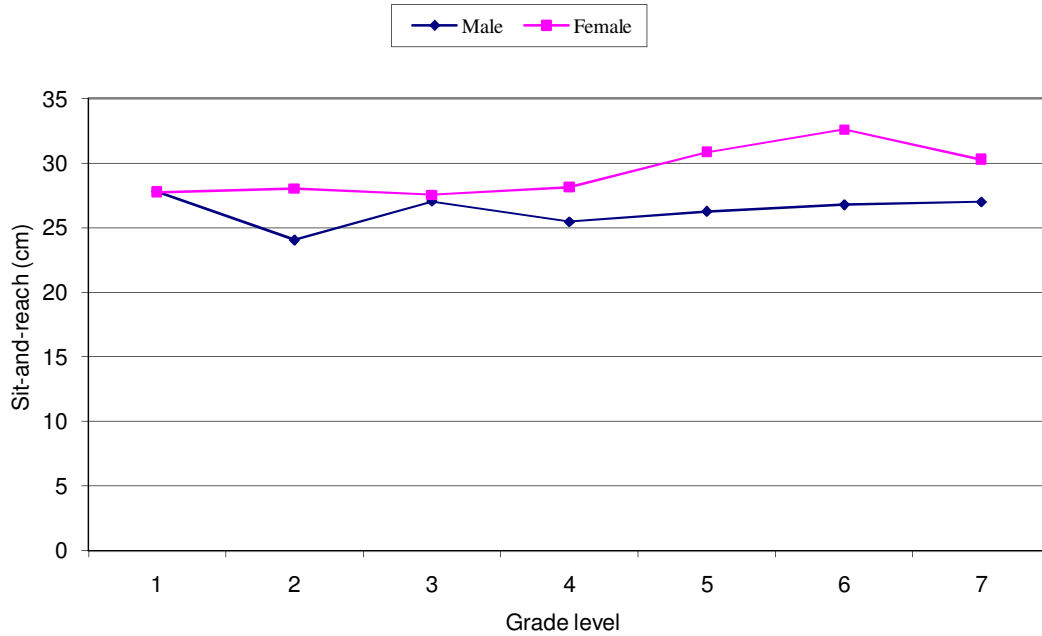
Grade levels	Gender (n)	SAR (cm)	SUP (s)	PUP (min)	Hang grip (kg) ¹	Arm grip (kg) ¹	SBJ (cm)	50 m sprint (s)	Coopers test (s)
1	Boys (11)	27.8 ± 4.5	25.1 ± 1.0	31.2 ± 7.4*	4.4 ± 2.3*	3.0 ± 0.0*	93.6 ± 22.4*	12.4 ± 1.5	11.5 ± 1.2
	Girls (10)	27.8 ± 1.6	24.4 ± 7.0	24.1 ± 8.0*	2.0 ± 2.5*	9.0 ± 0.0*	86.4 ± 14.08	12.1 ± 1.7	11.8 ± 0.8
2	Boys (19)	24.0 ± 5.7*	26.1 ± 7.2	26.9 ± 1.0*	4.8 ± 5.2	9.8 ± 4.1*	102.4 ± 19.1	12.0 ± 1.8	11.3 ± 1.7
	Girls (33)	28.0 ± 4.7*	25.8 ± 7.2	24.4 ± 9.3*	3.7 ± 4.4	3.7 ± 4.5*	102.1 ± 28.7	11.7 ± 0.7	11.0 ± 1.4
3	Boys (34)	27.0 ± 4.0	30.7 ± 10.5*	29.2 ± 8.3*	7.0 ± 6.4*	11.0 ± 4.6*	116.5 ± 39.3*	10.6 ± 1.2	9.7 ± 1.9*
	Girls (29)	27.6 ± 4.6	27.2 ± 10.4*	27.4 ± 9.3*	4.1 ± 3.4*	6.6 ± 4.4*	109.2 ± 19.1*	11.0 ± 0.8	10.7 ± 1.4*
4	Boys (31)	25.5 ± 6.7*	29.0 ± 8.6	32.7 ± 8.7*	6.2 ± 8.1	11.0 ± 4.6*	120.0 ± 16.0*	10.4 ± 1.0	10.1 ± 0.9
	Girls (37)	28.1 ± 6.5*	28.8 ± 9.5	25.6 ± 9.4*	6.2 ± 4.8	9.8 ± 2.88	115.6 ± 18.7*	10.9 ± 1.0	10.3 ± 1.2
5	Boys (19)	26.3 ± 4.4*	29.3 ± 7.0*	32.7 ± 9.6*	9.9 ± 8.0*	17.7 ± 5.4*	121.0 ± 21.1	10.1 ± 0.7	9.8 ± 1.1
	Girls (22)	30.8 ± 4.7*	32.1 ± 11.2*	27.4 ± 8.4*	8.3 ± 5.7*	14.8 ± 7.1*	121.4 ± 15.7	10.6 ± 1.8	10.2 ± 1.3
6	Boys (20)	26.8 ± 4.6*	27.3 ± 9.6*	31.4 ± 7.0*	10.9 ± 8.9*	19.6 ± 6.4*	125.4 ± 15.0*	10.4 ± 0.9*	9.8 ± 1.1
	Girls (18)	32.6 ± 5.5*	31.6 ± 10.3*	28.6 ± 8.1*	7.9 ± 7.4*	17.3 ± 10.0*	111.0 ± 19.5*	12.0 ± 4.0*	10.2 ± 0.8
7	Boys (59)	27.0 ± 5.7*	32.7 ± 10.7*	31.3 ± 10.4*	21.7 ± 11.6*	23.5 ± 10.3*	132.3 ± 19.1*	10.2 ± 0.7*	9.7 ± 1.0
	Girls (67)	30.3 ± 4.6*	29.5 ± 10.6*	26.2 ± 8.6*	17.6 ± 9.9*	24.1 ± 7.4*	124.7 ± 20.9*	11.0 ± 1.2*	10.1 ± 1.2
Total	Boys (193)	26.4 ± 5.3*	27.7 ± 9.7*	30.8 ± 9.2*	12.2 ± 11.1*	18.1 ± 9.8*	120.6 ± 25.6*	10.6 ± 1.2	11.2 ± 1.5*
	Girls (216)	29.3 ± 5.1*	28.7 ± 10.0*	26.2 ± 8.9*	9.2 ± 8.5*	17.1 ± 10.0*	114.7 ± 22.8*	11.1 ± 1.6	9.9 ± 1.3*

*p<0.05; SAR = sit-and-reach; SUP = sit-ups; PUP = push-ups; SBJ = standing broad jump; ¹Right hand measure; values are mean ± SD.

indicated that boys at all grades had significantly higher push-up (30.8 ± 9.2) values compared to girls who scored 26.2 ± 8.9 push-ups per minute (p = 0.05). Boys had significantly higher mean push-up values at all grades compared to the girls. The right hand grip test showed a significant mean difference between boys (12.2 ± 11.1 kg) and girls (9.2 ± 8.5 kg) (p<0.05). The right arm grip test indicated that boys had a slightly higher, but significant grip (18.1 ± 9.8) strength,

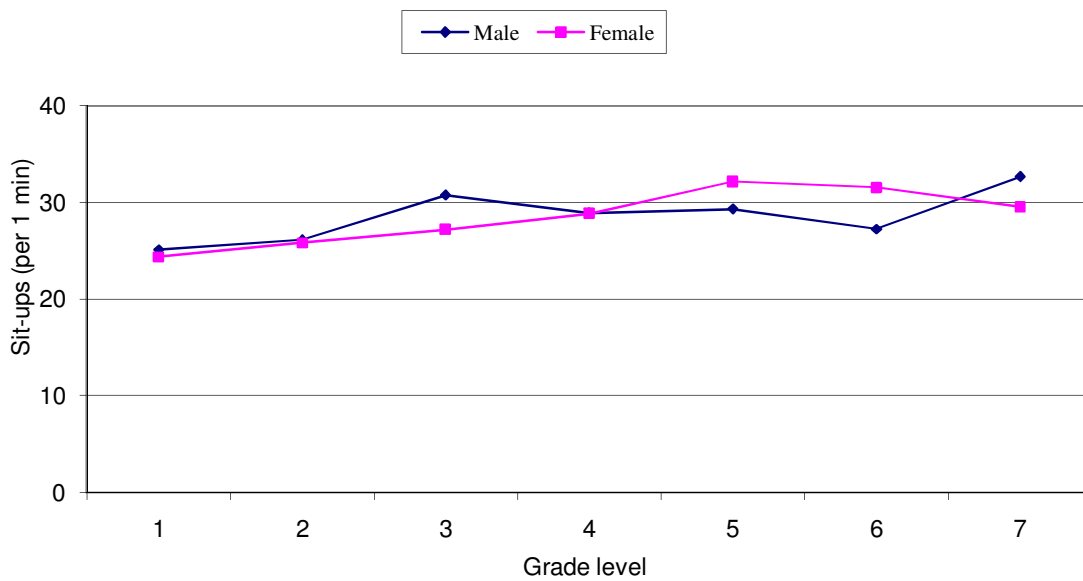
compared to girls whose grip was (17.1 ± 10.0) (p<0.05). Similarly, boys performed significantly better (120.6 ± 25.6) than the girls (114.7 ± 22.8) (p<0.05) in standing broad jump. In the 50 m sprint, girls had higher (11.1 ± 1.6) scores than boys (10.6 ± 1.2), although the difference was practically insignificant. Figure 1a shows that girls performed better in sit-and-reach (flexibility) between grades 4 and 6. Flexibility showed linear pattern in girls, but with a drop at grade 7.

Conversely, among the boys, the sit-and-reach test took a downward trend, rising up after grades 2 and 3 and thereafter, maintaining a fairly constant pattern across all the grades. Sit-ups test performance scores showed inconsistent trend in both sexes and at all the grades. Sit-up changes were higher in boys up to grade 4 where the girls overlap with higher values but leveling off at grade 6. Maximum gains in sit-ups performance occur at grades 7 and 5 for boys and girls, respectively



(a)

Figure 1a. Changes in sit-and-reach of Tshannda boys and girls.



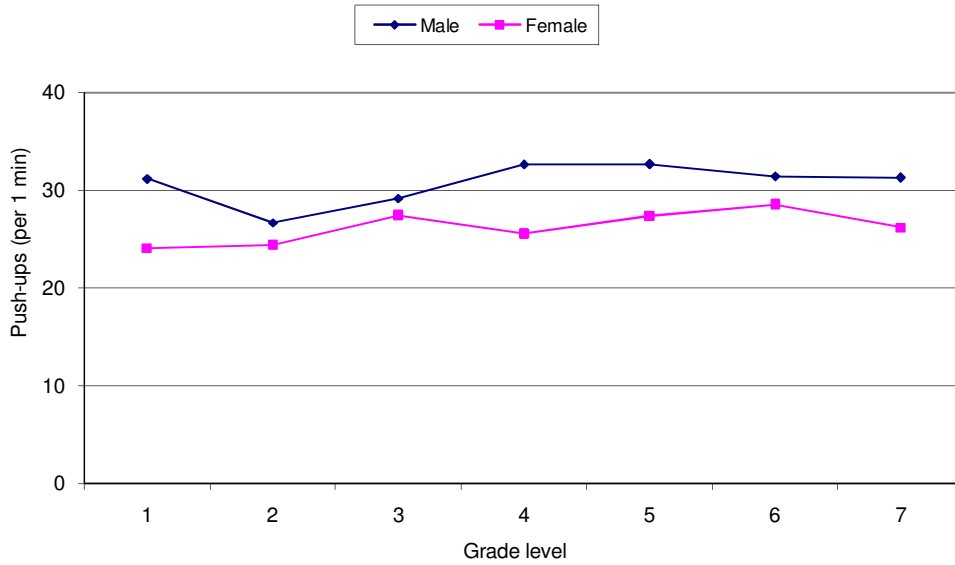
(b)

Figure 1b. Changes in sit-ups performance of Tshannda boys and girls.

(Figure 1b).

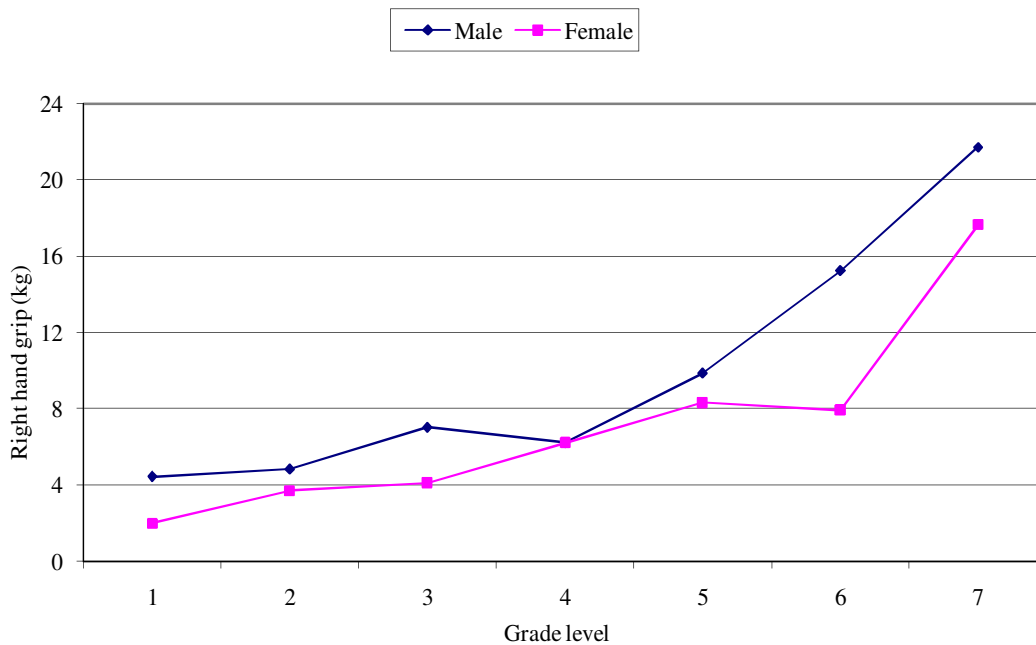
In Figure 1c, except at grade 2, boys maintained an almost linear trend in push-ups scores with maximum performances occurring at grades 4 and 5. Push-up in girls increased with increasing grade levels with a slight

decline after grade 3 and then accelerated with another decline after grade 6. Figures 1d and e shows the hand grip strength of the boys and girls for both hands. Both the right and left hand grip show identical patterns in both sexes across all grades. Except at grade level 4, both



(C)

Figure 1c. Changes in push-ups performance of Tshannda boys and girls.

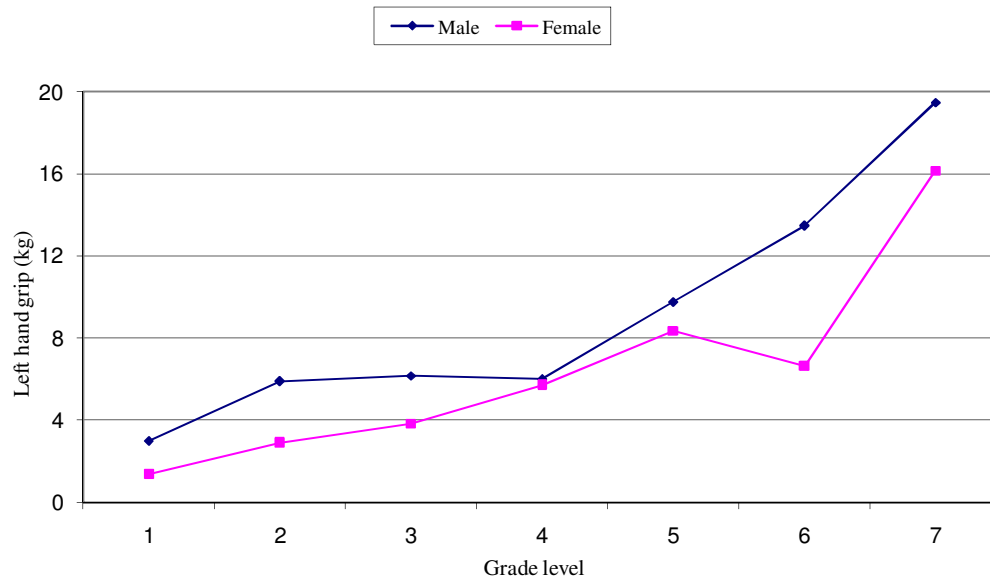


(d)

Figure 1d. Changes in right hand grip of Tshannda boys and girls.

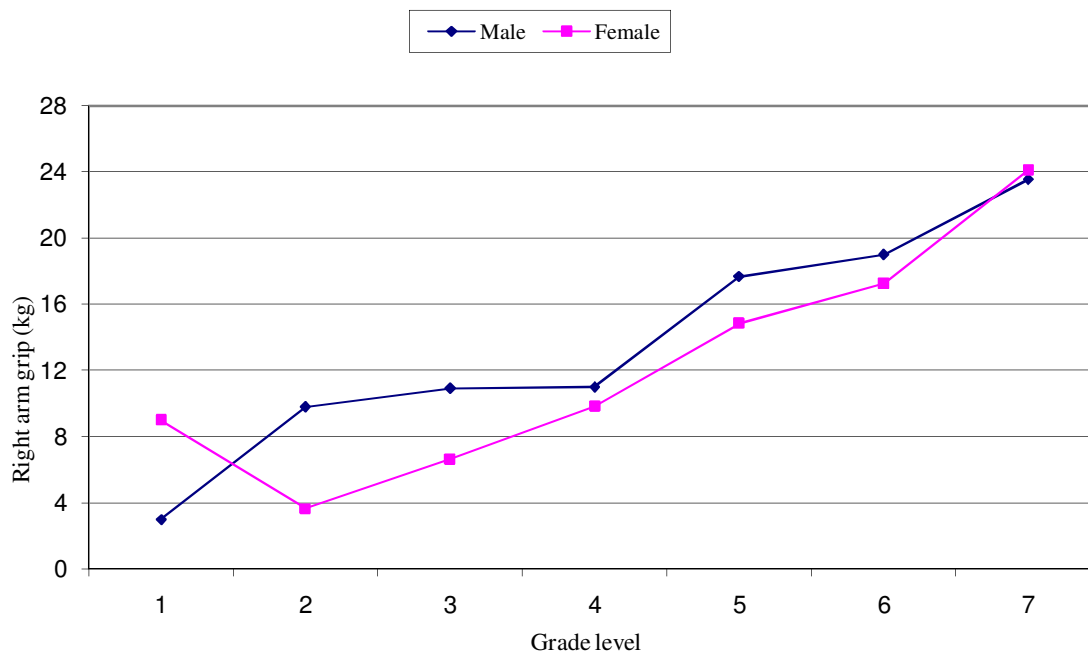
hand grips of the boys increase significantly with advancement in grade levels and boys recorded more grips than the girls. The greatest changes in both sexes occur between grades 6 and 7. Right and left hand grip among the girl's increases with grades levels off between

grades 5 and 6, and then accelerates rapidly. Right arm grip increases linearly with age in both sexes except in grades 1 and 2. Maximum grip occurred at grades 5 to 7 (Figure 1f). The left arm grip of boy's decreased between grades 2 to 4, increases up to grade 5, declined again



(e)

Figure 1e. Changes in left hand grip of Tshannda boys and girls.

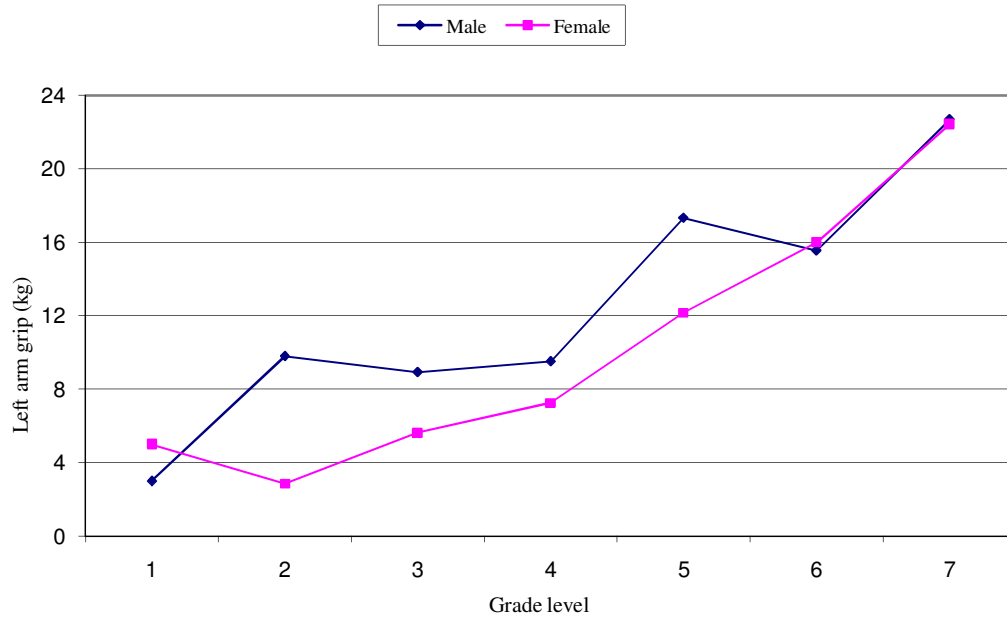


(f)

Figure 1f. Changes in right arm grip of Tshannda boys and girls.

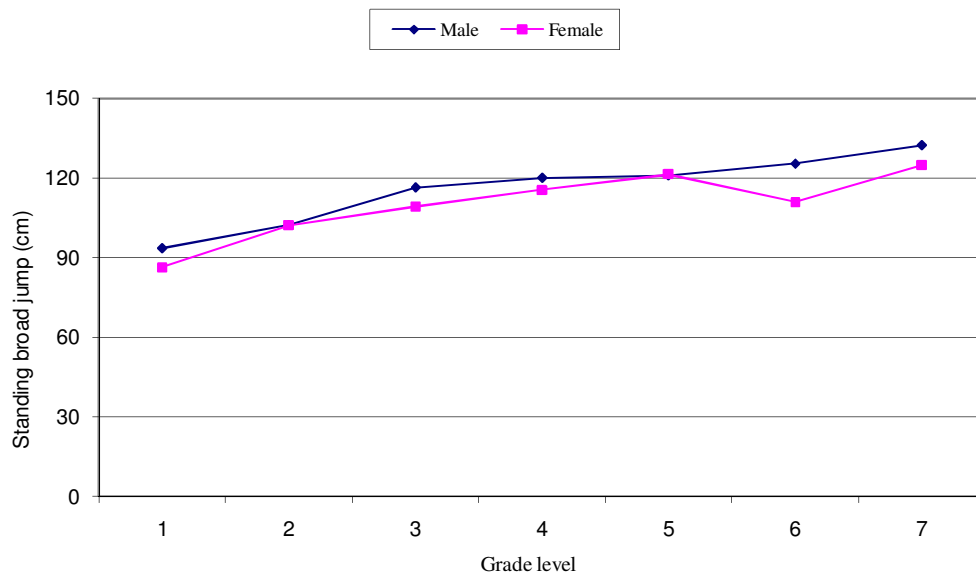
between grades 5 and 6, and ultimately increases to the highest level at grade 7 (Figure 1g). Among the girls, left arm grip shows a different pattern except between grades 1 and 2 after which linear trend was observed in other grades. Maximum difference between boys and girls was

found at early adolescence (grade 7) period (Figure 1g). Standing broad jump values increased with increasing grade levels in boys. The same pattern was observed in girls, except at grade 5 where it declined before increasing again. The maximum difference between boys



(g)

Figure 1g. Changes in left arm grip of Tshannda boys and girls.

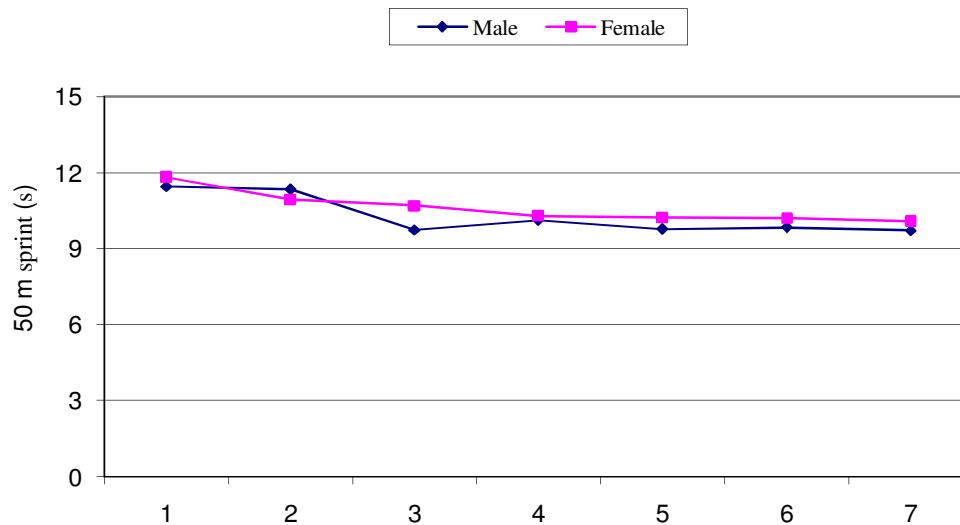


(h)

Figure 1h. Changes in standing broad jump performance of Tshannda boys and girls.

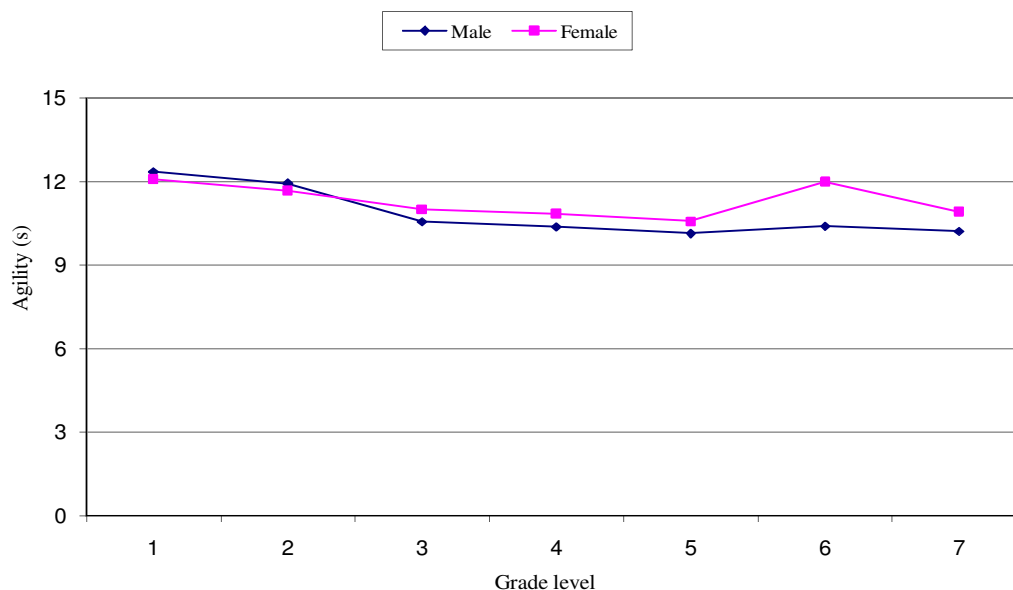
and girls was found between grades 5 and 7 (Figure 1h). The 50 m sprint scores decreased with increasing grade levels in both sexes (Figure 1i). The result of the agility test shows a downward trend in both sexes and across grade levels up to grade 5 before increasing with

advancing grade levels. The best mean time (12.12 s) was recorded at grade level 1 (Figure 1j). The Cooper's test showed inconsistent results with boys and girls and across grade levels. Cardiorespiratory endurance as measured in this test does not improve with grade levels



(i)

Figure 1i. Changes in 50 m sprint of Tshannda boys and girls.



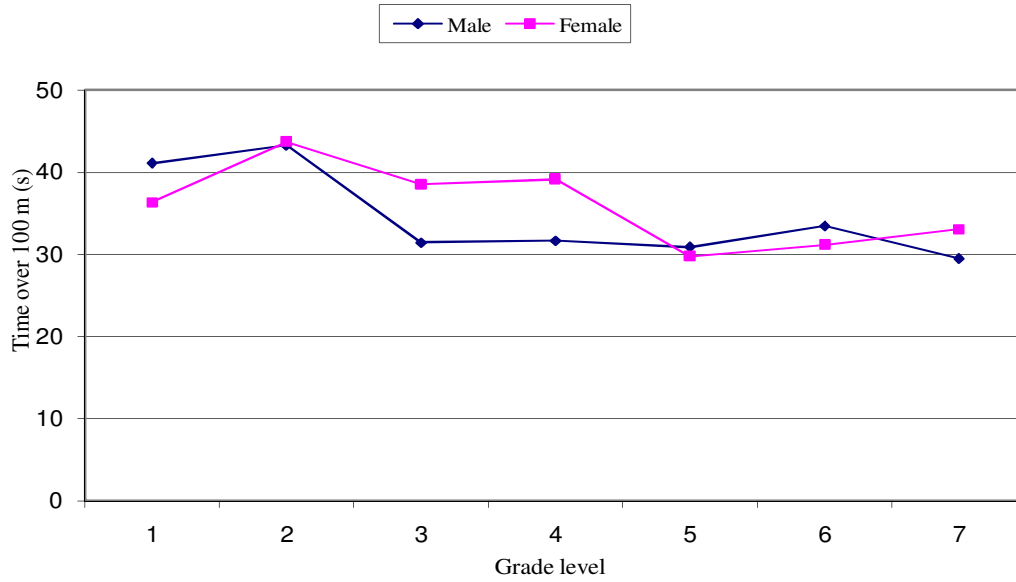
(j)

Figure 1j. Changes in agility of Tshannda boys and girls.

in both boys and girls. The best performance was observed at grade 5 for girls and grade 7 for the boys (Figure 1k).

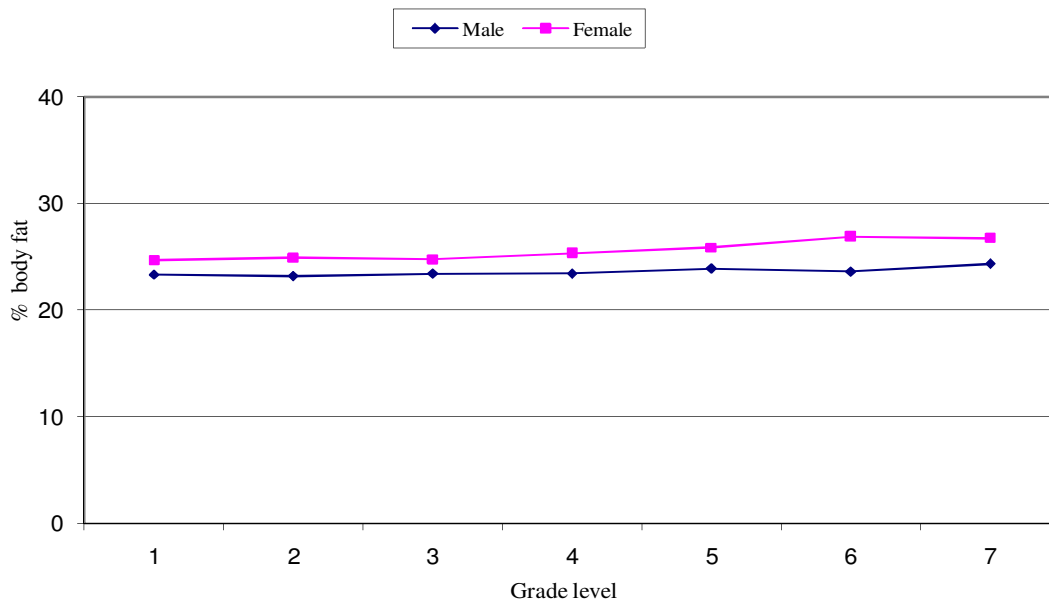
Shown in Figure 2a to c are the results of the body composition variables of Tshannda children. The patterns of development for percent body fat (%BF) are similar throughout the grade levels. Male and female values

were not significantly different from each other from grade levels 1 to 5. The values for girls are, however, higher (but not significantly different from each other) than the boys as from grade level 5. No significant difference was found in FFM between Tshannda boys and girls. FFM shows similar pattern at grade levels 1 to 5, but the girls exhibit higher values of FFM at grades 6



(k)

Figure 1k. Cooper's test of Tshannda boys and girls.



(a)

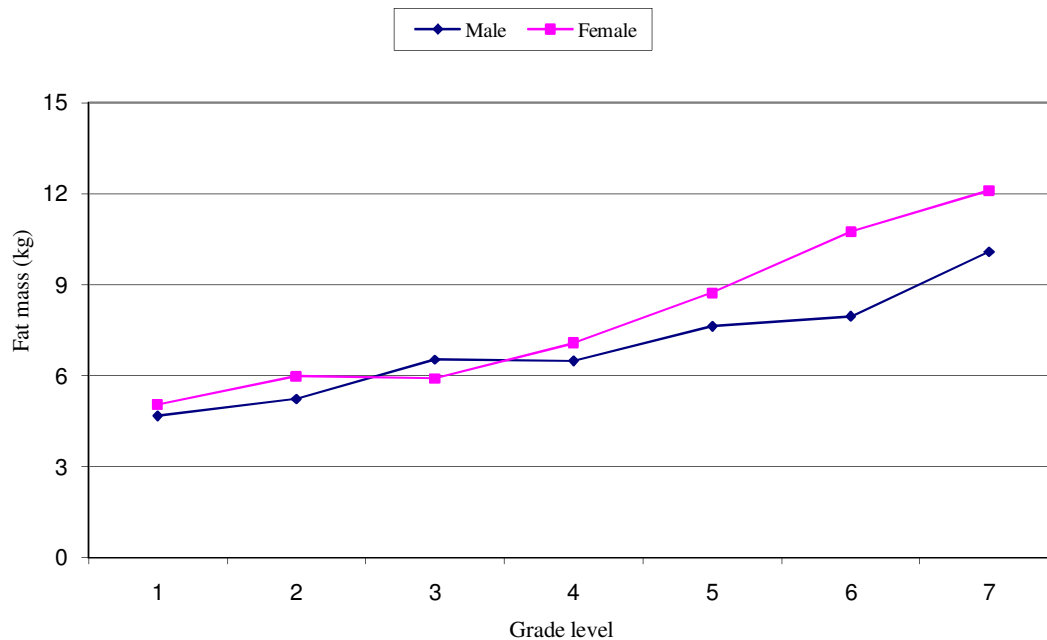
Figure 2a. Percentage body fat of Tshannda boys and girls.

and 7. Body fat, whether assessed as %BF or FM is higher in girls than in boys at all ages.

DISCUSSION

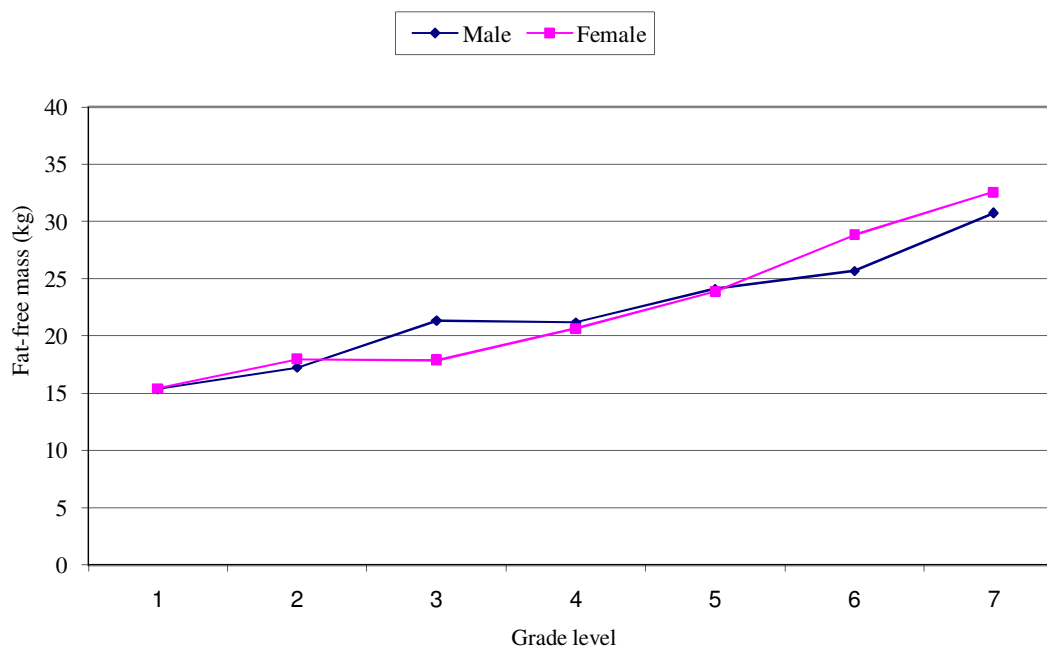
The present study evaluates the health-related physical

fitness of Tshannda rural school children in Limpopo, South Africa. Physical activity has been recognized as an important tool for prevention of diseases in developed countries (Haskell, 2003; Mckechnie and Mosca, 2003; Monyeki, 2006). Physical performance ability is commonly referred to as physical fitness, an umbrella concept covering a series of qualities related to how well



(b)

Figure 2b. Changes in FM of Tshannda boys and girls.



(c)

Figure 2c. Changes in FFM of Tshannda boys and girls.

an individual performs physical activity (Astrand et al., 2003). Physical activity is defined as any body movement produced by the skeletal muscles resulting in energy

expenditure (EE) (Lefevre et al., 2002). It is thus clear that EE during physical activity represents the most important source of variation in average daily metabolic

rate between individuals (Lefevre et al., 2002). EE is also a factor of many other variables including the health of the individual, the mode of training, environment and mood of the individuals. Generally, it is accepted that the physical activity level of individuals globally is low and has been influenced by present-day lifestyle/habits and technology. It has been suggested that physically inactive children have the potential to become extensive consumers of health care, thus increasing health care costs in the future (Riddoch and Boreham, 1995). In order to have an idea about the physical activity level of the children, they were put through physical fitness tests using the combination of the European Tests of Physical Fitness (EUROFIT, 1988) and the American Alliance for Health, Physical Education, Recreation and Dance (AAHPERD, 1980) test batteries. In doing this, we had at the back of our mind that the physical fitness test batteries of rural African children are very scarce. This makes it difficult to get norms with which the performance of the children in this study could be compared. We found that boys demonstrated significantly better performance in more activities such as explosive strength, muscular endurance and cardiorespiratory fitness than girls. However, girls performed better than boys in tests of flexibility and agility. The findings that boys have higher levels of physical performance and physical fitness than girls agrees with previous literatures (Prista et al., 1997, 2000; Benefice, 1993; Monyeki et al., 2003; Pate et al., 2006; Baquet et al., 2006; Mikkelsson et al., 2006). These results are expected in view of the cultural exposure of the boys to diverse activities and limited opportunities for the girls. No matter the results of this study, the basic question is: are these physical performance values indicative of superior physical fitness level or are they sufficiently high to provide the children with the necessary quality of life and social well-being?

Compared with results of the study on rural Ellisras children by Monyeki (2006), the children (boys and girls) in this study performed far higher in power (broad jump), flexibility (sit and reach), muscular endurance (sit-ups), speed (50 m sprint) and cardiovascular endurance (1600 m run). These findings, however, when compared with those of other studies (Monyeki, 2006; Prista et al., 1997, 2000; Monyeki et al., 2003) showed mixed values. We found it worthwhile comparing the present results of this study with these previous studies on the account that the participants were drawn from similar populations in developing nations and in particular from Africa. However, it should be stressed that the methodological differences between the various studies means that the comparisons should be interpreted as with utmost caution. Regardless of the methodologies adopted to assess the physical fitness status of the children, the values of these variables serve as bases for future comparison. The children are described in terms of their present status, hoping to see improvement in future assessments. Whether the results of the present

assessments of these fitness variables are judged to be poor, fair, good or excellent (on the basis of some standards and norms), they are manifestations of the physical activity levels of the children. Enhanced fitness performance mostly reflects the level of habitual physical activity. Indeed, studies in children have indicated that high physical fitness scores, especially high levels of cardiorespiratory fitness are associated with increased levels of physical activity (Bailey, 1973; Huang and Malina, 2002). However, a significant amount of fitness is explained by heredity (Bouchard et al., 1992). This accounts for less than 30% of the differences between people (Bouchard et al., 1988). The significant importance of these physical performance measures is related to the development of gross motor skills, improved quality of life and social well-being. Sport activities and physical education classes are essential components of a child's development. Through the development of perceptual motor skills, a child is given the practical tools that he/she can apply to his/her activities inside and outside of the classroom (Del-Busto, 2005). Excess body fat constitutes a serious health and physical performance problem. Body fat varies considerably between males and females, physical fitness levels and age groups. In normal cases, males have lower body fat percent compared with females. Girls in this study had a higher BMI (17.3 kg/m^2) than the boys (16.7 kg/m^2) and this has reflected in the level of adipose tissue. This sexual dimorphism in adipose tissue in boys and girls is expected as it is widely reported in literature (Goon et al., 2007; Mantsena et al., 2002; Cowell et al., 1997).

The more fat accumulation in girls than boys might be due to the higher physical activity among boys than girls (Reddy and Rao, 1995). Though physical activity was not assessed among the children in this present study, the gender-specific chores performed by this group of children could offer an explanation. Traditionally, the boys tend to work at farming-related tasks which enhance their physical activity levels whereas girls tend to do more household chores such as washing and cooking at home. While the aforementioned explanation is anecdotal, it should not be ignored as a possible explanation of differences in sex differentiation in adiposity among the children mediated by physical activity. Hormonal changes too, it cannot be ruled out, though this was not evaluated too. Girls gain weight and increase %BF at adolescence due to the stimulation of their sex hormones and the development of their reproductive organs (Vizmanos and Marti-Henneberg, 2000). However, we cannot conclusively attribute the increase in percentage BF found among the girls as compared to the boys to be indicative of early, sexually diverse changes in body composition that occur during puberty as maturation was not assessed. The minimum percent body fat considered safe and acceptable for good health is 5% for males and 12% for females. Adult males have between 15 to 18%

while adult females have between 22 to 25% (Quinn, 2006). The children in this study have on the average 23.7% (males) and 25.8% (females). These values are higher than the standard values of 15 to 18% (male adults) and 22 to 25% (female adults). It would not be surprising if the incidence of overweight and obesity would be manifestable in these children. The high %BF observed among school children in this locality is unexpected from a rural setting where lifestyles and other movement habits/behaviours are supposed to be different from those of urban settings. A similar trend was reported by Monyeki et al. (2005) among children from Elliras rural area in Limpopo Province. Too much body fat is detrimental to good health and physical performance. Equally too, little fat (not a case in this study) can also create devastating examples of such complications. It might be possible too that these children are exposed to high fat intake, thus making them to accumulate much fat.

Given that the present study indicates a prevalence of fat in Tshannda school children means that an intervention programme must be instituted to prevent and control possible overweight in this age group. The children need to create the right balance between calories they consume and the calories they burn. The issue of nutrition comes to focus here. The children should be encouraged to decrease their consumption of fat and step-up their activity level (Quinn, 2006). Physical fitness developed at early age could help prevent some of the health problems of adult life as it is now established that many chronic diseases start early in life (Twisk et al., 2002). The school setting therefore becomes an important avenue for the development of good quality of life and social well-being through participation in physical activity. As such, physical education and play are two areas that can develop the physical fitness level of children. Unfortunately, these are alarmingly now neglected in the public schools system. Physical activities and PE having been reduced to their barest minimum, most elementary (and even secondary) schools are being constructed without playgrounds, all this in spite of the overwhelming evidence that supports superior academic performance in the classroom as a result of physical activity (Del-Busto, 2005). This was evident in all the schools sampled in our study. During the survey, it was observed that all the schools were without playgrounds. This may potentially impact on the children's level of physical activity in schools as one of the main sources of children's physical activity is free play at school. Children have been found to be more active in school free play than at home or during structured PE lessons (McKenzie et al., 1992; Sleaf and Warburton, 1996). It therefore follows that the non-availability of playgrounds in schools for these children would make them vulnerable to their living sedentary lifestyle and this may have negative influence on their future health. As such, providing playgrounds for the

children in this remote, rural part of South Africa should be a priority. The information on health-related physical fitness in pre-adolescence in a society undergoing major societal changes (such as South Africa) can be regarded as one of the strengths of the study.

The study fills a research gap by examining an understudied region of the country and by assessing several components of fitness among Tshannda rural children. On the other hand, the samples were restricted to school-going children and to rural schools which limit the generalization of the results.

Conclusion

Taking into considerations that physical fitness components relate in varying ways to the different health outcomes, physical activity programmes should be designed to capture not only the levels of cardiorespiratory fitness but also muscular fitness and speed/agility. Thus, the role of the school comes into focus here as children spend their greater life time in school. School may play a crucial role by helping to identify children with low physical fitness and by promoting positive health behaviours such as encouraging children to be active with special interest in the intensity of the activity. The family too could help by complementing the efforts of the school in ensuring children are active at home. As stated by the American Academy of Pediatrics (AAP), "physical activity needs to be promoted at home, in the community and at school, but school is perhaps the most encompassing way for all children to benefit" (American Academy of Pediatrics, 2006). This study provides a baseline against which future progress could be measured, and further stimulates public and private leaders and decision makers to consider potentially helpful actions.

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