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CORRELATION BETWEEN ANTHROPOMETRICAL AND HEALTH-RELATED PHYSICAL FITNESS COMPONENTS FOR 7- TO 10-YEAR-OLD RURAL AND URBAN BOYS IN THE EASTERN CAPE PROVINCE

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ABSTRACT

Overweight and obesity that is increasing among South African pre-adolescent boys can be attributed to lack of physical fitness, thus suggesting that correlation exists between anthropometrical and health-related physical fitness components. This correlation is still under researched in the Eastern Cape Province. The aim of this study was to determine the correlation between anthropometrical and health-related physical fitness components among 7- to 10-year-old rural and urban boys (N=325). Descriptive statistics and the Spearman correlation ($p<0.05$) were used to analyse the data. Anthropometrical and health-related physical fitness components showed no strong correlation among all 7- to 9-year-old rural and urban boys. Stature correlated positively with right and left handgrip muscle strength among 10-year-old rural ($r=0.71$ and $r=0.61$; $p<0.001$) and urban boys ($r=0.67$ and $r=0.60$; $p<0.001$). BMI correlated positively with 10m- and 35m-dash among 10-year-old rural ($r=0.84$ and $r=0.77$; $p<0.001$) and urban boys ($r=0.81$ and $r=0.78$; $p<0.001$). The correlations were similar for 10-year-old rural and urban boys, suggesting that the environment may have a minimal effect on correlations between certain anthropometrical and health-related physical fitness components as boys grow older.

Key words: Anthropometrical components; Health-related physical fitness; Correlation; Rural and urban boys.

INTRODUCTION

The increasing prevalence of overweight and obesity, especially among children, has reached epidemic proportions globally (Mirmohammadi *et al*., 2011). The prevalence of overweight and obesity has also increased rapidly among South African children and adolescents (Toriola *et al*., 2012). Overweight and obesity exacerbate the development of chronic diseases, including diabetes mellitus (Wellen & Hotamisligil, 2005), cardiovascular disease, hypertension (Sorof & Daniels, 2002; Daniels, 2006), stroke and certain forms of cancer (Daniels, 2006) during adulthood.

The prevalence of overweight and/or obesity among South African men was 29.2% in 1998 (Puoane *et al*., 2002). This epidemic is also being observed among children. The prevalence of overweight and obesity among 6- to 13-year-old South African boys was 10.9% and 2.4%, respectively in 2004 (Armstrong *et al*., 2006). Pestana *et al*. (1996) reported that South

Africa's direct and indirect costs of cardiovascular diseases were between R4 and R5 billion in 1991. The overweight and obesity related diseases, which is currently overburdening South African's economy/healthcare systems, is most likely to escalate due to this increasing prevalence of overweight and obesity among South African children and adolescents (Goedeckee *et al*., 2006). Since it is well documented that overweight and obesity tracks from childhood into adulthood (Venn *et al*., 2007; Rossouw *et al*., 2012), it is, therefore, essential that possible interventions focus on children.

The epidemiologists suggest that the lack of physical activity and/or low physical fitness levels are some of the reasons that contribute to the increased prevalence of overweight and obesity in the last 20 years among boys (Lobstein *et al*., 2004; Brunet & Tremblay, 2007; Mak *et al*., 2010). Physical fitness can be thought of as an integrated measure of most, if not all, of the body functions involved in the performance of daily physical activity and/or physical exercise (Martinez-Vizcaino & Sanchez-Lopez, 2008; Ortega *et al*., 2008).

There are some physical fitness components that were found to be directly related to health, which resulted in the words being coined into 'health-related' physical fitness components (Powell *et al*., 2009). Some of these health-related physical fitness components are: flexibility; muscular strength; muscular endurance; agility; speed; cardiovascular endurance; and body composition (Moliner-Urdiales *et al*., 2011). For the purpose of this article, the term health-related physical fitness components will be used to describe the mentioned components.

Certain anthropometrical components, such as weight, body mass index (BMI) and body fat percentage (%BF) have a negative correlation with certain physical fitness tests in which the body is projected through space (Malina *et al*., 2004; Wilmore *et al*.,2008), or moving forward (Monyeki *et al*., 2005), such as long jump and sprinting. Brunet and Tremblay (2007) reported a negative correlation between BMI and standing long jump among 7- to 10-year-old Canadian boys. A negative correlation was reported between BMI and PACER (Progressive Aerobic Cardiovascular Endurance test), and between body fat percentage and PACER among 9- to 12-year-old South African children (Truter *et al*., 2010). In contrast, Monyeki *et al*. (2005) observed a positive correlation between high BMI and standing long jump among 7- to 14-year-old rural boys in Ellisras, South Africa. BMI correlated positively with 35m-dash among 8.5- to 14.5-year-old rural Senegalese boys (Benefice, 1998). A negative correlation was observed between body fat percentage and 20m shuttle run test among 5- to 13-year-old urban American boys (Kim *et al*., 2005).

On the other hand, Malina (1994) and Benefice and Malina (1996) reported that weight had a positive correlation with performance where no body movement was required, such as handgrip muscle strength tests. This was supported by Gandhi *et al*. (2010) who reported a positive correlation between weight and handgrip muscle strength among 6- to 16-year-old Indian boys, and Dana *et al*. (2011) reported similar results for 7- to 11-year-old rural and urban Iranian boys. Stature correlated positively with right and left handgrip muscle strength among 7- to 11-year-old rural and urban Iranian boys (Dana *et al*., 2011). No correlation was observed between weight and the sit-up test among 7- to 11-year-old rural and urban Iranian boys (Dana *et al*., 2011).

PURPOSE OF THE RESEARCH

The various studies mentioned with sometimes conflicting findings, would suggest that not only is there a correlation between certain anthropometrical and health-related physical fitness components, but that correlations are different in different populations. This suggests that more investigation is needed especially among Eastern Cape boys, as no similar studies could be found for this specific region in South Africa. Therefore, the purpose of this study was to determine the correlation between anthropometrical and health-related physical fitness components among 7- to 10-year-old rural and urban boys in the Eastern Cape Province.

METHODOLOGY

Ethical clearance

Informed consent letters were given to all parents/legal guardians for the boys to participate in this study. The Eastern Cape Education Department also provided permission to conduct this study. The University of Fort Hare ethical committee further granted approval (03-REC-270710–028) to conduct this study.

Participants

The research design is a one-way cross sectional design based on baseline data. A total of 4 schools were selected by using a stratified random sampling method. Stratified random sampling is a probability sampling technique of dividing 2 or more homogeneous subgroups based on categories of interest (Cesar & Carvalho, 2011). Two schools were selected in a rural area (Nkonkobe municipality) and 2 schools in 2 urban areas (King William's Town, Buffalo City Municipality and East London, Amathole Municipality). A rural area is classified as a place where people are living on farms or in traditional villages, which is characterised by low population densities, low levels of economic activity alongside a low level of infrastructure (Milne & Taylor, 2006). An urban area is classified as a city or town with higher population densities, high levels of economic activities and high levels of infrastructure (Milne & Taylor, 2006). The total sample size consisted of 325 (139 rural and 186 urban), 7- to 10-year-old boys from the Eastern Cape Province.

Measurements

Four anthropometrical components were measured, namely weight, stature, and 2 skinfolds (triceps and calf). All skinfolds measurements were done with the Level 1 International Society for the Advancement of Kinanthropometry (ISAK) technicians who performed tests (3 times) on each subject according to the International Standards for the Anthropometric Assessment (Stewart *et al*., 2011). BMI was calculated from weight (kg) and height (m) using the equation (kg/m^2). The sum of 2 skinfolds (triceps and calf) was used to calculate body fat percentage (Slaughter *et al*., 1988). The reliability and validity of all health-related physical fitness tests have been verified by some physical field test batteries and researchers as follows: vertical jump; sit-and-reach (Meredith & Welk, 2004); agility test (r=0.90) (Johnson & Nelson, 1986); 10m- and 35m-dash (r=0.67) (Mackenzie, 2005); right handgrip (r=0.70) and left (r=0.67) handgrip tests (EUROFIT, 1993); 1-minute press-up (Meredith & Welk,

2004); 2-minute sit-up (Johnson & Nelson, 1986); and 1-mile walk/run (Meredith & Welk, 2004).

Statistical analyses

Descriptive statistics and Spearman correlation were used to determine mean and standard deviations of all anthropometrical and health-related physical fitness components. Spearman's correlation method is a statistical measure of the strength or weakness of 2 variables when paired together, that is, either the variables increase in value together, or 1 decreases when the other increases (Spearman, 1905). The Spearman correlation method ($p<0.05$) was used to evaluate the correlation between anthropometrical and health-related physical fitness components among 7- to 10-year-old rural and urban boys. Strong correlations range between r=0.70 to 0.90 /or -0.70 to -0.90 and moderate correlations range between r=0.45 to 0.70 /or -0.45 to -0.70 were considered, while weak correlations, less than r<0.45/-0.45, were not reported.

RESULTS

The means and the standard deviations of the anthropometrical and health-related physical fitness components for 7- to 10-year-old rural and urban boys are summarised in Table 1 and 2. According to the results, the urban boys presented higher mean values in most of the anthropometrical (weight, stature, BMI and body fat percentage) and health-related physical fitness (flexibility, muscular strength, muscular endurance, agility, speed and cardiovascular endurance) components in all age groups.

***TABLE 1*: RURAL BOYS AGE GROUPS: DESCRIPTIVE STATISTICS OF ANTHROPOMETRICAL AND HEALTH-RELATED PHYSICAL FITNESS MEASURES**

Measures	7 years (n=41) M±SD	8 years (n=47) M±SD	9 years (n=30) M±SD	10 years (n=21) M±SD
Weight (kg)	26.4±7.2	29.7±5.8	32.1±7.2	34.4±10.5
Stature (cm)	122.4±6.3	129.3±6.4	133.3±6.3	140.0±0.1
Body mass index (kg/m²)	17.5±7.2	17.6±2.7	17.9±2.8	18.1±4.5
Body fat percentage (%)	18.9±9.8	20.5±8.0	19.0±8.2	18.1±8.6
Sit-and-reach (cm)	40.3±5.1	40.9±5.7	44.6±7.8	39.5±7.3
Vertical jump (cm)	14.0±5.1	15.2±4.6	15.5±4.7	21.3±6.4
Agility (sec)	18.5±2.5	16.6±2.1	15.1±1.9	15.2±2.6
10m-dash (sec)	2.5±0.2	2.4±0.2	2.3±0.2	2.2±0.3
35m-dash (sec)	7.8±1.2	7.4±0.7	6.8±0.6	6.7±0.9
Right handgrip (kg)	13.6±3.0	15.3±3.8	15.5±3.2	17.8±3.3
Left handgrip (kg)	13.0±3.0	14.6±3.3	16.2±4.1	17.9±4.3
1-min press-ups (n)	9.1±4.7	11.1±7.5	10 ± 7.2	12.0±6.3
2-min sit-ups (n)	21.3±12.3	21.8±13.4	25.5±14.7	31.1±19.6
1-mile walk/run (min)	12.6±3.1	12.1±2.5	12.5±2.6	12.4±2.6

***TABLE 2*: URBAN BOYS AGE GROUPS: DESCRIPTIVE STATISTICS OF ANTHROPOMETRICAL AND HEALTH-RELATED PHYSICAL FITNESS MEASURES**

Measures	**7 years** (n=41) M±SD	**8 years** (n=47) M±SD	**9 years** (n=30) M±SD	**10 years** (n=21) M±SD
Weight (kg)	26.8±5.3	31.2±6.4	35.9±8.9	39.5±13.6
Stature (cm)	124.8±5.4	131.3±6.5	136.1±6.8	143.9±7.7
Body mass index (kg/m²)	17.2±2.8	18.1±3.0	19.2±3.8	20.4±7.2
Body fat percentage (%)	16.4±6.5	17.6±5.9	19.7±7.2	25.4±13.6
Sit-and-reach (cm)	41.1±6.9	40.8±5.8	38.9±6.7	39.2±5.7
Vertical jump (cm)	17.3±5.2	17.9±3.9	17.6±6.1	18.3±3.7
Agility (sec)	16.9±2.5	15.0±1.8	14.0±2.0	13.9±3.2
10m-dash (sec)	2.4±0.2	2.3±0.2	2.2±0.17	2.1±7.48
35m-dash (sec)	7.6±0.6	8.6±10.2	7.0±0.6	6.5±0.7
Right handgrip (kg)	14.3±2.9	15.6±6.0	17.6±2.9	19.2±4.2
Left handgrip (kg)	13.9±2.3	14.7±3.6	16.8±4.1	19.2±3.3
1-min press-ups (n)	9.1±5.7	8.2±6.3	10.1±5.8	10.4±6.8
2-min sit-ups (n)	25.1±12.3	23.7±12.4	30.8±19.5	32.1±19.6
1-mile walk/run (min)	11.0±3.2	9.9±1.8	10. 2±2.5	10.3±2.5

Most of the anthropometrical components increased consistently with age among 7- to 10-year-old rural and urban boys. In Table 1, the 8-year-old boys had the highest body fat percentage value (20.5±8.0) compared to the other age groups. The 9-year-old boys had the best mean for the sit-and-reach test value (44.6±7.8) among all rural boys and the 1-minute press-up value (10±7.2) was lower than the 8-year-old 1-minute press-up test (11.1±7.5). Table 2 indicates that the 7-year-old boys had the best value in the sit-and-reach test (41.1±6.9). The 8-year-old urban boys had the fastest 1-mile walk/run value (9.9±1.8), while the 9-year-old rural boys had the best sit-and-reach value of (44.6±7.8) (Table 1). The 8-year-old boys had the poorest mean values on the 35m-dash test (8.6±10.2 sec), 1-minute press-up (23±12.4) and 2-minute sit-up test (23±12.4) among other urban boys (Table 2).

No strong correlations were found between anthropometrical and health-related physical fitness components among **7-year-old** rural and urban boys, thus only moderate correlations were reported in Table 3. A correlation was found between weight and right and left handgrip muscle strength ($r=0.57$ and $r=0.47$; $p<0.001$), and between stature and right and left handgrip muscle strength ($r=0.50$; $p<0.003$ and $r=0.55$; $p<0.004$), among the *rural* boys. There was a positive correlation between weight and left handgrip muscle strength ($r=0.48$; $p<0.001$) and between stature and the left handgrip ($r=0.56$; $p<0.001$) among the *urban* boys. A correlation between BMI and right handgrip ($r=0.47$; $p<0.001$) exists for *rural* boys. There was a negative correlation between BMI and 1-mile walk/run for *rural boys* ($r=-0.46$; $p<0.001$) and a positive relationship for *urban* boys ($r=0.48$; $p<0.007$). Between weight and 1-mile walk/run for *urban* boys the relationship ($r=-0.45$; 0.001) was also negative.

***TABLE 3*: CORRELATION (r) BETWEEN ANTHROPOMETRICAL AND HEALTH-RELATED PHYSICAL FITNESS TESTS FOR 7-YEAR-OLD RURAL AND URBAN BOYS**

Measures	Area	Weight	Stature	BMI	% Body fat
Vertical jump (cm)	Rural	r=0.12; p<0.060	r=0.32; p<0.04	r=0.31; p<0.009	r=0.24; p<0.003
	Urban	r=0.14; p<0.503	r=0.06; p<0.72	r=0.11; p<0.061	r=0.02; p<0.130
Sit-and-reach (cm)	Rural	r=0.28; p<0.100	r=0.06; p<0.691	r=0.07; p<0.671	r=0.20; p<0.240
	Urban	r=0.29; p<0.052	r=0.45; p<0.001	r=0.10; p<0.002	r=0.07; p<0.630
Agility (sec)	Rural	r=0.03; p<0.610	r=0.26; p<0.372	r=0.08; p<0.813	r=0.32; p<0.180
	Urban	r=0.14; p<0.350	r=0.01; p<0.501	r=0.17; p<0.220	r=0.23; p<0.033
10m-dash (sec)	Rural	r=0.27; p<0.011	r=0.16; p<0.196	r=0.41; p<0.001	r=0.38; p<0.001
	Urban	r=0.11; p<0.006	r=0.19; p<0.843	r=-0.03; p<0.273	r=0.05; p<0.392
35m-dash (sec)	Rural	r=0.08; p<0.210	r=0.31; p<0.071	r=0.26; p<0.006	r=0.29; p<0.001
	Urban	r=-0.03; p<0.470	r=0.17; p<0.501	r=0.04; p<0.551	r=0.24; p<0.001
Right handgrip (kg)	Rural	r=0.57; p<0.001^	r=0.50; p<0.003^	r=0.47; p<0.001^	r=0.35; p<0.001
	Urban	r=0.40; p<0.001	r=0.30; p<0.006	r=0.40; p<0.023	r=0.20; p<0.005
Left handgrip (kg)	Rural	r=0.47; p<0.001^	r=0.55; p<0.004^	r=0.32; p<0.001	r=0.32; p<0.001
	Urban	r=0.48; p<0.001^	r=0.56; p<0.001^	r=0.35; p<0.001	r=0.39; p<0.003
1-min Press-up (n)	Rural	r=0.34; p<0.23	r=0.11; p<0.776	r=0.30; p<0.001	r=0.39; p<0.061
	Urban	r=0.19; p<0.20	r=0.11; p<0.230	r=0.17; p<0.242	r=0.13; p<0.889
2-min Sit-up (n)	Rural	r=0.22; p<0.02	r=0.07; p<0.473	r=0.26; p<0.524	r=0.32; p<0.212
	Urban	r=0.03; p<0.64	r=0.19; p<0.140	r=0.13; p<0.093	r=0.19; p<0.090
1-mile walk/run (min)	Rural	r=0.37; p<0.001	r=0.02; p<0.031	r=-0.46; p<0.001^	r=0.22; p<0.001
	Urban	r=-0.45; p<0.001^	r=0.14; p<0.891	r=0.48; p<0.007^	r=0.43; p<0.001

*p<0.05 **Strong correlations: 0.70 to 0.90 or -0.70 to -0.90 ^ Moderate correlation: 0.45 to 0.69 or -0.45 to -0.69

No strong correlations were found between anthropometrical and health-related physical fitness components among **8-year-old** rural and urban boys, thus only moderate correlation are reported in Table 4. There was a correlation between weight and the 1-minute press-up test (r=0.48; p<0.001) and the left handgrip muscle strength test (r=0.53; p<0.001), among the *urban* boys. A correlation was found between stature and right handgrip (r=0.52; p<0.001) and left handgrip (r=0.46; p<0.001**),** muscle strength among the *rural* boys. BMI and the 10m-dash test correlate among the *rural* (r=0.53; p<0.001) and *urban* (r=0.54; p<0.005) boys, while BMI and left handgrip muscle strength correlate (r=0.46; p<0.003) among the *urban* boys. There was a negative correlation between BMI and the 1-mile walk/run test (r= -0.47; p<0.001) among the *urban* boys. The percentage body fat and agility correlate negatively (r=-0.48; p<0.001) for the *rural* boys.

***TABLE 4*: CORRELATION (r) BETWEEN ANTHROPOMETRICAL AND HEALTH-RELATED PHYSICAL FITNESS TESTS AMONG 8-YEAR-OLD RURAL AND URBAN BOYS**

Measures	Area	Weight	Stature	BMI	% Body fat
Vertical jump (cm)	Rural	r=0.08; p<0.601	r=0.33; p<0.001	r=0.06; p<0.110	r=0.33; p<0.001
	Urban	r=0.24; p<0.002	r=0.05; p<0.260	r=0.30; p<0.061	r=0.05; p<0.261
Sit-and-reach (cm)	Rural	r=0.10; p<0.050	r=0.04; p<0.091	r=0.08; p<0.210	r=0.31; p<0.800
	Urban	r=0.05; p<0.711	r=0.07; p<0.900	r=0.04; p<0491	r=0.33; p<0.008
Agility (sec)	Rural	r=0.40; p<0.110	r=0.13; p<0.401	r=0.44; p<0.001	r=-0.48; p<0.001^
	Urban	r=0.11; p<0.0816	r=0.01; p<0.001	r=0.21; p<0.001	r=0.17; p<0.071
10m-dash (sec)	Rural	r=0.36; p<0.001	r=0.05; p<0.995	r=0.53; p<0.001^	r=0.23; p<0.022
	Urban	r=0.44; p<0.001	r=-0.19; p<0.133	r=0.54; p<0.005^	r=0.21; p<0.155
35m-dash (sec)	Rural	r=0.09; p<0.266	r=0.28; p<0.001	r=0.29; p<0.007	r=0.24; p<0.019
	Urban	r=0.21; p<0.211	r=0.17; p<0.176	r=0.16; p<0.118	r=0.39; p<0.009
Right handgrip (kg)	Rural	r=0.34; p<0.002	r=0.52; p<0.001^	r=0.12; p<0.641	r=0.01; p<0.188
	Urban	r=0.27; p<0.001	r=0.31; p<0.007	r=0.16; p<0.001	r=0.13; p<0.030
Left handgrip (kg)	Rural	r=0.33; p<0.011	r=0.46; p<0.001^	r=0.15; p<0.041	r=0.14; p<0.611
	Urban	r=0.53; p<0.001^	r=0.36; p<0.008	r=0.46; p<0.003^	r=0.17; p<0.261
1-min Press-up (n)	Rural	r=0.15; p<0.600	r=0.04; p<0.281	r=0.17; p<0.110	r=0.34; p<0.059
	Urban	r=0.48; p<0.001^	r=0.13; p<0.131	r=0.43; p<0.251	r=0.40; p<0.001
2-min Sit-up (n)	Rural	r=0.03; p<0.961	r=0.05; p<0.144	r=0.01; p<0.711	r=-0.09; p<0.903
	Urban	r=0.17; p<0.056	r=0.18; p<0.061	r=0.12; p<0.339	r=0.09; p<0.711
1-mile walk/run (min)	Rural	r=0.23; p<0.055	r=0.03; p<0.819	r=0.28; p<0.056	r=0.30; p<0.006
	Urban	r=0.42; p<0.001	r=0.14; p<0.018	r=-0.47; p<0.001^	r=0.42; p<0.001

*p<0.05 **Strong correlations: 0.70 to 0.90 or -0.70 to -0.90 ^ Moderate correlation: 0.45 to 0.69 or -0.45 to -0.69

Table 5 presents no strong correlation between anthropometrical and health-related physical fitness components among **9-year-old** rural and urban boys, thus only moderate correlation were reported. Weight correlated with right (r=0.50; p<0.001) and left (r=0.48; p<0.001) handgrip muscle strength among the *rural* boys. However, weight correlated negatively with agility (r= -0.47; p<0.001), the 10m-dash (r= -0.48; p<0.001) and the 35m-dash (r= -0.48, p<0.001), among *urban* boys. For the *urban* boys, stature and the 1-minute press-up test correlated positively (r=0.49; p<0.001). In the case of the *rural* boys, BMI correlated positively with the 10m-dash test (r=0.53; p<0.001) and the right handgrip test (r=0.45; p<0.001). The BMI of the *urban* boys also correlated positively with the right handgrip test (r=0.62; p<0.001) and the 1-mile walk/run test (r=0.57; p<0.004). Lastly, body fat percentage correlated negatively with the 10m-dash test (r= -0.47; p<0.001) and the 1-mile walk/run (r=-0.57; p<0.001), among the 9-year-old *urban* boys.

***TABLE 5*: CORRELATION (r) BETWEEN ANTHROPOMETRICAL AND HEALTH-RELATED PHYSICAL FITNESS TESTS AMONG 9-YEAR-OLD RURAL AND URBAN BOYS**

Measures	Area	Weight	Stature	BMI	% Body fat
Vertical jump (cm)	Rural	r=0.03; p<0.700	r=0.14; p<0.168	r=-0.09; p<0.619	r=-0.03; p<0.161
	Urban	r=-0.09; p<0.911	r=0.23; p<0.009	r=-0.25; p<0.001	r=-0.08; p<0.064
Sit-and-reach (cm)	Rural	r=0.07; p<0.633	r=0.25; p<0.003	r=-0.00; p<0.035	r=-0.05; p<0.151
	Urban	r=-0.06; p<0.122	r=-0.09; p<0.789	r=0.03; p<0.121	r=0.28; p<0.009
Agility (sec)	Rural	r=-0.20; p<0.110	r=0.05; p<0.110	r=0.27; p<0.001	r=-006; p<0.220
	Urban	r=-0.47; p<0.001^	r=0.24; p<0.001	r=0.46; p<0.005^	r=0.39; p<0.002
10m-dash (sec)	Rural	r=0.37; p<0.003	r=0.11; p<0.111	r=0.53; p<0.001^	r=0.25; p<0.001
	Urban	r=-0.48;p<0.001^	r=0.06; p<0.791	r=0.62; p<0.001^	r=-0.47;p<0.001^
35m-dash (sec)	Rural	r=0.26; p<0.003	r=0.05; p<0.801	r=0.27; p<0.001	r=0.36; p<0.001
	Urban	r=-0.48;p<0.001^	r=0.11; p<0.001	r=0.59; p<0.001^	r=0.36; p<0.001
Right handgrip (kg)	Rural	r=0.50; p<0.001^	r=0.41; p<0.001	r=0.45; p<0.001^	r=0.29; p<0.001
	Urban	r=0.25; p<0.052	r=-0.25; p<0.916	r=0.10; p<0.010	r=0.14; p<0.841
Left handgrip (kg)	Rural	r=0.48; p<0.001^	r=0.33; p<0.001	r=0.41; p<0.004	r=0.21; p<0.002
	Urban	r=0.01; p<0.090	r=0.07; p<0.910	r=-0.01; p<0.100	r=0.06; p<0.091
1-min Press-up (n)	Rural	r=0.40; p<0.001	r=0.44; p<0.001	r=0.28; p<0.006	r=0.30; p<0.001
	Urban	r=0.49; p<0.060	r=0.49; p<0.001^	r=0.46; p<0.061	r=0.40; p<0.001
2-min Sit-up (n)	Rural	r=-0.28; p<0.582	r=-0.08; p<0.067	r=-0.32; p<0.111	r=0.33; p<0.001
	Urban	r=0.42; p<0.001	r=-0.20; p<0.856	r=0.42; p<0.001	r=0.43; p<0.003
1-mile walk/run (min)	Rural	r=0.44; p<0.001	r=0.29; p<0.004	r=0.40; p<0.001	r=0.39; p<0.001
	Urban	r=0.42; p<0.055	r=0.21; p<0.050	r=0.57; p<0.004^	r=-0.57;p<0.001^

*p<0.05 **Strong correlations: 0.70 to 0.90 or -0.70 to -0.90 ^ Moderate correlation: 0.45 to 0.69 or -0.45 to -0.69

Several moderate correlations were found between weight and certain health-related physical fitness components among **10-year-old** rural and urban boys (Table 6). Weight correlated with right and left handgrip muscle strength (r=0.66 and r=0.61; p<0.001) and (r=0.62 and r=0.60; p<0.001) among the *rural and urban* boys respectively. However, weight correlated negatively with the 1-minute press-up test (r=-0.56 and r=-0.52; p<0.001) and 2-minute sit-up test (r=-0.64 and r= -0.62; p<0.001), among *rural and urban* boys respectively. In the case of the *urban* boys, weight also correlated negatively with the 35m-dash (r=-0.48; p<0.001). Stature correlated with right handgrip muscle strength (r=0.71 and r=0.61; p<0.001) and left handgrip muscle strength (r=0.67 and r=0.60; p<0.001), for the *rural and urban* boys respectively.

***TABLE 6*: CORRELATION (r) BETWEEN ANTHROPOMETRICAL AND HEALTH-RELATED PHYSICAL FITNESS TESTS AMONG 10-YEAR-OLD RURAL AND URBAN BOYS**

Measures	Area	Weight	Stature	BMI	% Body fat
Vertical jump (cm)	Rural	r=0.32; p<0.001	r=0.20; p<0.571	r=0.39; p<0.001	r=0.35; p<0.001
	Urban	r=0.31; p<0.001	r=0.02; p<0.920	r=0.32; p<0.001	r=0.43; p<0.007
Sit-and-reach (cm)	Rural	r=0.23; p<0.119	r=0.24; p<0.672	r=0.35; p<0.001	r=0.20; p<0.120
	Urban	r=0.07; p<0.688	r=0.12; p<0.550	r=0.35; p<0.029	r=0.01; p<0.330
Agility (sec)	Rural	r=0.32; p<0.122	r=0.01; p<0.911	r=0.39; p<0.008	r=0.31; p<0.071
	Urban	r=0.09; p<0.766	r=0.02; p<0.140	r=0.08; p<0.678	r=0.11; p<0.009
10m-dash (sec)	Rural	r=0.42; p<0.001	r=0.14; p<0.201	r=0.84; p<0.001*	r=0.45; p<0.001^
	Urban	r=0.06; p<0.877	r=-0.00; p<0.991	r=0.81; p<0.001*	r=0.15; p<0.851
35m-dash (sec)	Rural	r=0.35; p<0.002	r=0.09; p<0.481	r=0.77; p<0.001*	r=0.35 p<0.001
	Urban	r=-0.49; p<0.001^	r=0.31; p<0.122	r=0.78; p<0.001*	r=0.38; p<0.001
Right handgrip (kg)	Rural	r=0.66; p<0.001^	r=0.71; p<0.001^	r=0.20; p<0.030	r=0.29; p<0.001
	Urban	r=0.62; p<0.001^	r=0.67; p<0.001^	r=0.60; p<0.001^	r=0.45; p<0.001^
Left handgrip (kg)	Rural	r=0.61; p<0.001^	r=0.61; p<0.001^	r=0.19; p<0.327	r= 0.22; p<0.004
	Urban	r=0.60; p<0.001^	r=0.60; p<0.001^	r=0.55; p<0.001^	r=0.49; p<0.001^
1-min Press-up (n)	Rural	r=-0.56; p<0.001^	r=0.29; p<0.189	r=0.41; p<.001	r=-0.54; p<0.001^
	Urban	r=-0.52; p<0.001^	r=-0.17; p<0.221	r=0.41; p<0.007	r=-0.53; p<0.001^
2-min Sit-up (n)	Rural	r=-0.64; p<0.001^	r=0.42; p<0.011	r=0.40; p<0.001	r=0.41; p<0.001
	Urban	r=-0.62; p<0.001^	r=0.05; p<0.911	r=0.38; p<0.083	r=0.43; p<0.002
1-mile walk/run (min)	Rural	r=0.40; p<0.003	r=0.10; p<0.010	r=0.40; p<0.007	r=-0.52; p<0.001^
	Urban	r=0.42; p<0.001	r=0.22; p<0.111	r=-0.53; p<0.001^	r=-0.55; p<0.001^

*p<0.05 **Strong correlations: 0.70 to 0.90 or -0.70 to -0.90 ^ Moderate correlation: 0.45 to 0.69 or -0.45 to -0.69

BMI correlated with the 10m-dash test (r=0.84 and r=0.81; p<0.001) and the 35m-dash test (r=0.77 and r=0.78; p<0.001), for the *rural and urban* 10-year-old boys. Furthermore, BMI correlated positively with right and left handgrip muscle strength (r=0.60 and r=0.55; p<0.001), among *urban* boys respectively, while BMI correlated negatively with the 1-mile walk/run (r= -0.53; p<0.001) of the *urban* boys.

Body fat percentage correlated positively with the left (r=0.49; p<0.001) and right (r=0.45; p<0.001) handgrip test of the *urban* boys, however, body fat percentage correlated negatively with the 1-minute press-up test (r= -0.54 and r= -0.53; p<0.001) and the 1-mile walk/run (r=-0.52 and r=-0.55; p<0.001), among *rural and urban* boys respectively. Finally, body fat percentage correlated positively with the 10m-dash (r=0.45; p<0.001) in the case of the *rural* boys.

DISCUSSION

The aim of this study was to determine the correlation between anthropometrical and health-related physical fitness components among 7- to 10-year-old rural and urban boys. The study indicated that **weight** correlated negatively with the sit-up test among 10-year-old rural boys. This contradicts the findings of Dana *et al*. (2011) who found no correlation between weight and the sit-up test among 7- to 11-year-old rural and urban boys. With regard to the previous studies, Malina *et al*. (2004), Gandhi *et al*. (2010) and Dana *et al*. (2011) all reported that weight positively correlates with performance, especially ones that are associated with static strength such as handgrip muscle strength tests.

The results further indicated that **stature** correlated from moderately to strongly, and positively, with the right- and left handgrip tests among 7-, 8- and 10-year-old rural and urban boys (Gandhi *et al*., 2010; Dana *et al*., 2011).

In the present study the **BMI** correlated positively with the 10m- and 35m-dash tests among 8- to 10-year-old rural and urban boys. Therefore, these results are similar to the findings of Benefice (1998), who found that the BMI and the 35m-dash test showed positive correlations among 8.5- to 14.5-year-old rural Senegalese boys, whilst it also contradicts the findings of Kim *et al*. (2005) who reported that BMI and the 20m shuttle run test showed negative correlations among 5- to 13-year-old urban American boys. In the present study no correlations were observed between anthropometrical components and vertical jump and sit-and-reach test among any of the 7- to 10-year-old rural and urban boys. The latter contradicts the findings of Monyeki *et al*. (2005) who reported a positive correlation between BMI and the sit-and-reach test among 7- to 14-year-old rural South African boys.

In the present study there was a positive correlation between **body fat percentage** and the 35m-dash test among 10-year-old urban boys, the 1-mile walk/run tests among 9-year-old urban boys, 10-year-old rural and urban boys, which is in agreement with the results of Wilmore *et al*. (2008) and Dana *et al*. (2011) who reported that excessive body fat percentage is an extra burden when the body has to be propelled forward.

CONCLUSION

It is interesting to note that most of the correlations between the anthropometrical and strength-related physical fitness components observed in this study were moderate between 7- to 9-year-old boys and strong among the 10-year-old boys in both rural and urban populations. Therefore, the correlations observed between anthropometrical and health-related physical fitness components were the same for rural and urban boys, thus possibly indicating that the environment plays less of a role among all boys. Maturation might have attributed in some correlations between anthropometrical and health-related physical fitness components among rural and urban 10-year-old boys.

Limitations

Maturation was not measured in this study, therefore, the effects of maturation on the correlation between anthropometrical and health-related physical components could not be clearly detected.

Recommendations

For the future, similar research should be done as a longitudinal study in order to identify to what extent maturation influence the correlation between anthropometrical and health-related physical fitness components among the 7- to 10-year-old rural and urban boys. Further investigation is also needed to determine the levels of physical activity differences among rural and urban boys, as this will provide a better understanding of the possible causes of inactivity among these age groups. Also, similar research should be done to investigate the differences between the anthropometrical and health-related physical fitness among 7- to 10-year-old rural and urban boys in the Eastern Cape Province.

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