



HEALTH AND SKILLS RELATED FITNESS INDICATORS IN ALBANIAN CHILDREN – REFERENCE VALUES FROM A COUNTRY IN TRANSITION

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Abstract:

The aims of this study were to analyze age and gender differences for health-related fitness, physical activity and gross motor coordination level in Albanian children. Data consisted of a cross-sectional study of 1176 children between first and fourth grade elementary school (618 boys and 558 girls) aged 7-10 years old). Anthropometrics (body mass and height, body mass index (BMI), waist circumference, % body fat), level of gross motor coordination (Körperkoordinationstest für Kinder, KTK) and physical activity by questionnaire (PAQ-C) were assessed. Gross motor coordination and physical activity level increased until 9 years of age and then declined. Significant gender differences ($P \leq 0.05$) were found for body mass, BMI and waist circumference where boys were heavier, had higher BMI scores and had greater values in waist circumference measurement than girls. Data obtained from this study showed that boys and girls in all age group fell into the normal level of physical activity. The results from this investigation study reveal strong evidence that children in Albania show motor difficulties in everyday skills (moderate motor disorder-31.2% and severe motor disorder-8%).

Keywords: children, BMI, waist, motor coordination

1. Introduction

Data from several sources have identified the increased incidence of obesity in children, due to excessive consumption of calories (Roberts et al., 2000), low level of physical activity (Boreham et al., 2004; Venn et al., 2007) and cardiorespiratory fitness (Lobstein et al., 2004; Janssen et al., 2005; Katzmarzyk and Tremblay, 2007). These can be some of the factors that makes these children grow up as adult obese compared to those peers with

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normal weight (Whitaker et al., 1997). Problem of obesity in children is spreading rapidly around the world (Flodmark et al., 2004). There is an increasing prevalence of overweight and obesity among children in Europe (Ogden et al., 2006) especially Eastern Europe and Middle east region that had the highest prevalence of overweight children (Kelishadi, 2007).

It appears that gross motor coordination plays a crucial role in children participation on physical activity. Results from a study of Bouffard et al. (1996) indicated that children lacking gross motor coordination are at risk of being less physical active which later will hamper opportunities for developing good motor competence and is directly related to sedentary activity (Wrotniak et al., 2006). The relationship between gross motor coordination and BMI has been widely investigated. Results of several studies reported that children who had a high level of gross motor coordination showed the lowest BMI values (Lopes et al., 2012; Martins et al., 2010; Graf et al., 2004). Recent evidence suggests that a very important role as a predictor in increasing physical activity participation plays the child motor skill and coordination level (Lopes et al., 2011). In general, therefore, it seems that children with better motor abilities may find it easier to be physically active and may be more likely to engage in physical activity compared to peers with poorer motor competence (Wrotniak et al., 2006; Williams et al., 2008). A prediction of body fat from a population perspective is BMI, widely used in scientific research as an indirect estimate to define obesity in children and adolescents. Other anthropometric measurement such as skin-fold and waist circumference are also used in the population based studies. Children are considered overweight or obese based on age-specific BMI indicator guidelines (Flodmark et al., 2004). Albania, is a country in Southeast Europe, emerged in 1990 from the most isolated communist regime (Nuri and Tragakes, 2002; Rechel and McKee, 2003). In the following decade the country opened up rapidly to Western influences, experiencing a major social and political transition process. It is difficult to find reliable data and in most of the studies, national data are often in contradiction with those of international organization (Bank, 2006). The present study was designed to analyze age and gender differences (aged 7-10 yrs) for health-related fitness, physical activity and gross motor coordination level in Albanian children.

2. Materials and Methods

Study participation This study is a cross sectional in Tirana where children were monitored for health related variables, fitness components, gross motor coordination and the level of physical activity. A total of 1176 children between first and fourth grade elementary school (618 boys and 558 girls) aged 7-10 years old) were enrolled in this study (see Table 1 for gender and age distribution). The elementary schools (N=6) were randomly selected from 52 schools placed in the city of Tirana.

Table 1: Main descriptive statistics for mean age and gender distribution of children participated in the study

	1st Grade		2nd Grade		3rd Grade		4th Grade	
	N	Mean	N	Mean	N	Mean	N	Mean
Total	366	6.8	228	8.0	226	9.1	356	9.8
Boys	192	6.9	118	8.1	118	9.1	190	9.9
Girls	174	6.8	110	8.0	108	9.1	166	9.7

2.1 Study design

Three measurements were used as health-related variables: body mass index (BMI), body fat percent and waist circumference. Body height and body mass were measured. BMI was calculated using usual formula (kg/m^2). To predict body fat percent, skin fold thickness measurement was used (Slaughter et al., 1988). Gross motor coordination was evaluated using Kiphard and Schilling (1974, 2007) body coordination test (KTK). PA was assessed by questionnaire PAQ-C.

Body height and body mass were measured using a Health O Meter 402 KL professional physician beam scale. Values were recorded to the nearest 0.1 cm and 100 g, respectively. Body Mass Index was calculated using the usual formula; $\text{BMI} = \text{body mass (kg)} / \text{body height (m)}^2$. The waist circumference was measured at the part of the trunk located midway between the lower costal margin (bottom of lower rib) and the iliac crest (top of pelvic bone) and was measured to the nearest 0.5 cm, at the end of a normal expiration.

Skin fold thickness measurement were used for the estimation of children body fat percent. Triceps and sub scapular thickness were measured to the nearest 0.1mm using a calliper on the right side of the body (Harpenden Skinfold Caliper; Baty International RH15 9LR. England). All skin folds were taken three times by the same examiner to ensure consistency in the results with the average of the three values used as a final value. To predict percent body fat, the equation described by Slaughter et al. (1988) were used. Gross motor coordination evaluation to assess gross motor coordination we used Body Coordination Test for Children (KTK) (Kiphard and Schilling, 1974, 2007) using a final score (MQ- motor quotient). It consists of four subtests where each value of a subtest in converted in a motor quotient score. All four values are summed and converted into a final score.

Physical activity assessment Physical activity was assessed by questionnaire PAQ-C. Reference scores in PA questionnaire were (1, inactive- 5, very active).

2.2 Statistical analysis

Descriptive statistics (mean and standard deviation) were calculated for the variables assessed in this study. ANOVA tests with score variables as depended on variable were used. For those significant variables a Post Hoc analysis 'after the fact' was carried out. Multiple comparisons test by the LSD method 'least significant difference method' was used to show significant differences in comparisons (LSD 's post hoc comparisons. P-

values of ≤ 0.05 were considered statistically significant. All analysis was performed using the statistics system SPSS 26.0.

3. Results

Age and sex differences for the health-related variables Table 2 presents main descriptive statistics (mean scores and standard deviation) for the health-related variables (body mass, body height, BMI, waist circumference and percent body fat) and a 2×4 ANOVA comparisons between group ages and sex differences for Albanian children. Mean body mass and body weight results show an average annual difference (7-10 years of age) respectively by 3.7 kg and 5.7 cm per year, while for boys this increase was 3.8 kg and 5.4 cm and for girls was 3.7 kg and 5.8 cm. Overall, there was a general pattern of increasing values for the health-related variables in all age group. Significant gender differences ($P \leq 0.05$) were found for body mass, BMI and waist circumference where boys were heavier, had higher BMI scores and had greater values in waist circumference measurement than girls except one age group (eight years) where post hoc analysis show no significant sex differences in the three variables mention above for this age group (body mass- (7 years : $P = 0.001$; 8 years : $P = 0.681$, NS ; 9 years : $P = 0.007$; 10 years : $P = 0.022$: BMI- 7 years: $P = 0.003$; 8 years : $P = 0.389$, NS ; 9 years : $P = 0.001$; 10 years : $P = 0.028$: waist circumference- (7 years: $P = 0.002$; 8 years : $P = 0.639$, NS ; 9 years : $P = 0.038$; 10 years : $P = 0.000$). Both genders did not have significantly different scores on body height and body fat percent values in all age groups.

Table 2: Descriptive statistics indicating mean values and standard deviation for health-related variables by age and sex

	7 yrs		8 yrs		9 yrs		10 yrs		Sex x Age		Age	Sex
	mean	SD	mean	SD	mean	SD	mean	SD				
B-Mass (kg)												
Mean	25.1	4.6	29.5	6.2	32.1	5.9	36.3	8.5	F= 0.776	F= 168.998	F= 9.169	
Boys	25.9**	4.8	29.3	5.5	33.1**	6.1	37.2**	8.7	P= 0.508	P= 0.000	P= 0.003	
Girls	24.2	4.3	29.7	6.9	31	5.6	35.2	8.2				
B-Height (cm)												
Mean	122.8	5.2	128.2	5.7	134.2	5.8	139.6	6.1	F= 1.992	F= 517.421	F= 2.838	
Boys	123.7	5	128.6	5.3	134	4.9	140.1	6.2	P= 0.113	P= 0.000	P= 0.092	
Girls	121.8	5.2	127.8	6.2	134.4	6.7	139.2	6				
BMI (kg/m^2)												
Mean	16.6	2.3	17.8	2.7	17.7	2.7	18.5	3.4	F= 1.809	F= 27.121	F= 10.578	
Boys	17.0**	2.5	17.6	2.5	18.4**	2.9	18.8*	3.4	P= 0.144	P= 0.000	P= 0.001	
Girls	16.2	2	18	3	17.1	2.3	18.1	3.4				
Waist (cm)												
Mean	57.8	7.1	61	8.1	61	8	67.1	9.5	F= 1.849	F= 87.395	F= 12.68	
Boys	58.9**	7.9	61.3	7.5	62.3*	8.3	68.8**	9.9	P= 0.137	P= 0.000	P= 0.000	
Girls	56.6	6	60.7	8.7	59.8	7.5	65.3	8.8				
B-Fat												
Mean	16.4	6.4	17.5	7	17.4	6.7	20.9	8	F= 1.086	F= 25.956	F= 0.861	
Boys	16.3	7.1	17.2	7.8	17.4	7.7	21.4	9.2	P=0.354	P= 0.000	P= 0.354	
Girls	16.5	5.8	17.8	6	17.3	5.5	20.4	6.4				

Abbreviations: BMI- body mass index; Waist- waist circumference; Post Hoc analysis for gender differences: ** $p < 0.001$ * $p < 0.005$

Classification for gross motor coordination level and BMI Table 3 represents main descriptive data results by gender, for children’s categorization of gross motor coordination level obtained from KTK test and BMI percentile classification. The children that were categorized at normal level represented only 59.3% of the entire sample, while almost 39% of the sample participated in the study were categorized below the normal level, having probably moderate motor disorder (31.2%) and severe motor disorder (8%). Boys (65.6%) showed significantly better results than girls (52.4%) in the normal category ($P \leq 0.05$). The motor quotient for the category of severe motor disorder for boys was 5.8% and for girls was 10.4% ($P \leq 0.05$)).

Table 3: Classification of gross motor coordination level

GMC (%)	high/good	normal	moderate motor disorder	severe motor disorder
Mean	1.5	59.3	31.2	8
Boys	1.5	65.6	27.1	5.8
Girls	1.4	52.4	35.8	10.4

Notes: Mean values refer to percentage of children by gender. Abbreviations: GMC- gross motor coordination

3.1 Age and sex differences for gross motor coordination and level of physical activity

The results for subtests, gross motor coordination and the level of physical activity by gender and age are shown in Table 4. Gross motor coordination increased until 9 years of age and then declined. For girls and boys, the mean values for gross motor coordination showed a wave like pattern ($p \leq 0.01$). Gross motor coordination results show clear gender differences with boys outperforming girls at every age. Post hoc results show that boys had significantly better scores than girls at all ages except one age group (7 years : $P = 0.000$; 8years : $P = 0.000$; 9years : $P = 0.186NS$; 10years : $P = 0.000$).

Performance on the four subtests improved significantly (in all subtests $P \leq 0.01$) with increasing age. Post hoc analysis showed that each age group scored significantly ($P \leq 0.05$) better than their one year younger counterparts on all four subtests. Balancing backwards results revealed girls having better results than girls but post hoc results showed that this difference was significantly only for one age group (7years: $P = 0.000$), but not in ages 8, 9, 10 years ($P \geq 0.05$).

Significant gender differences ($p \leq 0.01$) were found for jumping one leg where post hoc results show boys having better results than girls at all age groups (7 years: $P = 0.015$; 8 years: $P = 0.000$; 9years: $P = 0.032$; 10 years: $P = 0.000$). ANOVAs analysis showed that, boys and girls did not have any significantly differences in moving with plates ($p = 0.466$) and lateral jumping ($p = 0.131$) subtests. There was a general pattern of increases of the level of physical activity until 9 years of age and then this level declines. Results showed that physical activity at all age group was at a normal level ($PA = 2.46$) knowing that final reference scores for PA questionnaire were (1, inactive- 5, very active). Results for physical activity revealed boys being more active than girls but post hoc analysis showed that this difference was not significantly in all age groups (7 years: $P = 0.006$; 8 years: $P = 0.134$, NS; 9 years: $P = 0.217$, NS ; 10 years : $P = 0.011$).

Table 4: Descriptive statistics (mean and standard deviation) for the sub tests of gross motor coordination (raw scores) and the level of physical activity, by age and gender

	7 yrs		8 yrs		9 yrs		10 yrs		Sex x Age	Age	Sex
	mean	SD	mean	SD	mean	SD	mean	SD			
BB											
Mean	27.8	11.1	33.5	11.8	38.4	13.2	41	12.3	F= 1.185	F= 86.943	F= 6.133
Boys	26.1	10.5	33.4	11.7	37.2	12.8	40.6	12.3	P= 0.314	P= 0.000	P= 0.013
Girls	29.7*	11.5	33.7	11.9	39.6	13.5	41.4	12.3			
Plate											
Mean	26.3	5.6	29.7	6.1	33.8	6.3	35.5	5.7	F= 0.784	F= 169.824	F= 0.533
Boys	26.5	5.7	29.7	6.1	33.7	7.1	35.9	5.6	P= 0.503	P= 0.000	P= 0.466
Girls	26.1	5.5	29.8	6.1	33.9	5.4	34.9	5.9			
JOL											
Mean	32.5	8.9	40.1	8.6	47.6	9.3	50.8	12.5	F= 896	F= 243.348	F= 24.776
Boys	33.3*	8.9	42.3**	8.2	49.1**	8.9	52.4**	11.7	P= 0.443	P= 0.000	P= 0.000
Girls	31.6	8.9	37.7	8.4	46	9.5	49	13.2			
LJ											
Mean	33	8.7	45	11.8	54.6	13.1	54.9	11.4	F= 2.168	F= 301.256	F= 2.292
Boys	32.7	8.3	45.9	11.4	53.2	11	54	12.3	P= 0.09	P= 0.000	P= 0.13
Girls	33.3	9.1	44.1	12.3	56.1	14.9	55.9	10.3			
sum MQ											
Mean	89.4	11.7	90.2	12	90.3	12.7	86.3	12.4	F= 0.758	F= 7.797	F= 26.222
Boys	91.5**	11.3	92.2**	11.7	91.1	11.5	88.4**	12	P= 0.518	P= 0.000	P= 0.000
Girls	87.1	11.8	88	12	89.4	13.9	84	12.3			
PA											
Mean	2.25	0.7	2.43	0.6	2.62	0.6	2.54	0.5	F= 0.377	F= 21.378	F= 15.216
Boys	2.34*	0.6	2.49	0.6	2.67	0.6	2.61**	0.5	P= 0.769	P= 0.000	P= 0.000
Girls	2.14	0.7	2.37	0.5	2.57	0.6	2.46	0.6			

Abbreviations: BB- Balance during backwards gait; Plate- Side movements on plates; JOL- Jumps on one leg; LJ- Lateral side jump; sum MQ- Sum of motor quotient. Post Hoc analysis for gender differences: * * p<0.001 * p<0.005

4. Discussion

Body mass and body weight results show an average annual increase (7-10 years of age) respectively by 3.7 kg and 5.7 cm per year, while for boys this increase was 3.8 kg and 5.4 cm and for girls was 3.7 kg and 5.8 cm. Overall, there was a general pattern of increasing values for the health-related variables in all age group. This study produced results which corroborate the findings of the previous work in this field by Martins et al. (2010) which found in their study that boys and girls show increases in BMI means with advancing age. Significant gender differences ($P \leq 0.05$) were found for body mass, BMI and waist circumference where boys were heavier, had higher BMI scores and had greater values in waist circumference measurement than girls except one age group. Both genders did not have significantly different scores on body height and body fat percent values in all age groups. However, the findings of the current study do not support the previous research by Ostojic et al. (2011) where boys had significantly lower body mass, BMI, waist-circumference, compared to their girl's counterparts ($P \leq 0.05$). The children that were categorized at normal level represented only 59.3% of the entire sample, while almost 39% of the sample participated in the study were categorized below the normal level, having probably moderate motor disorder (31.2%) and severe motor disorder (8%). These results are consistent with the those from the study of Qose (2012) who investigated

the prevalence of DCD (development coordination disorder) in 100 elementary school children in Tirana. Results of the study showed that the prevalence of development coordination disorder among children was 45%.

Boys (65.6%) showed significant better results than girls (52.4%) in the normal category ($P \leq 0.05$) for the level of gross motor coordination. The motor quotient for the category of severe motor disorder was 5.8% for boys and 10.4% for girls respectively. In contrast to the results of our study, boys-girls ratio in the study of (Qose, 2012) ranges from 1: 0,7 regarding children classified with developmental coordination disorder to 1: 0,8 concerning children classified at borderline. Boys with DCD according to test results outnumbered girls. The results from both studies reveal strong evidence that children in Albania show motor difficulties in everyday skills.

Gross motor coordination increased until 9 years of age and then declined. This study confirms previous research showing a gradual improvement in gross motor coordination across children in elementary school grades (Ahnert et al., 2009). On the contrary, results from a recent study of Vandorpe et al. (2011) found that the level of gross motor coordination declined across children, seven to ten years of age. For girls and boys, the mean values for gross motor coordination showed a wave like pattern ($p \leq 0.01$). The results from a study of Martins et al. (2010) showed that girls gross motor coordination increases until 9 years of age and then declined. Contrary to girls, boys tend to present a rather stable mean behavior ($p \leq 0.05$) in motor coordination performance. The results of this study on gross motor coordination indicated that boys score significant ($p \leq 0.05$) better than girls in all age groups. This result is in consistent with that of Lopes et al. (2012) and Graf et al. (2004) which found that boys outperformed girls at every age group regarding gross motor coordination level ($p \leq 0.05$). During puberty in children a few differences in growth characteristics exist but in terms of physical activity level, motor skills and motor coordination differences between boys and girls are observed (Thomas, 2001). Post hoc analysis for the gross motor coordination test battery showed that each age group scored significantly ($p \leq 0.001$) worse results then their younger counterparts on two sub tests (side movements on plates and jumping on one leg), while the results for two other sub tests (balancing backward and lateral jumping) show a wave like pattern. Performance on the four sub tests improved significantly with increasing age. This finding is in agreement with Vandorpe et al. (2011) findings which show that each age group scored significantly better than their 1-year younger counterparts on all four sub tests, with all P-values =0.001. Mean values data from this study for side movements on plates sub test showed no gender differences in all age groups. The same results were obtained in the study of Vandorpe et al. (2011) showing no gender differences in this sub-test.

Data obtained from this study showed that there was a general pattern of increases of the level of physical activity until 9 years of age and then this level declined. A significant ($p \leq 0.01$) continuous decline of PA was evident in girls, but not in boys in who the mean PA-values show a wave like pattern (Martins et al., 2010). Results from this study did not find any data concerning the problem of inactivity among children in all

age group and gender. Data show that boys and girls in all age group fell into the normal level of physical activity.

5. Conclusion

Data obtained from this study showed that there was a general pattern of increases of the level of physical activity until 9 years of age and then this level declined and boys and girls in all age group fell into the normal level of physical activity. The results from this investigation study reveal strong evidence that children in Albania show motor difficulties in everyday skills (moderate motor disorder-31.2% and severe motor disorder-8%. To be concerned were the number of children that fell into the level of severe motor disorder (8%) that will be the focus of future studies to be evaluated for having probably motor coordination disorder (possible DCD).

Conflict of Interest Statement

The authors declare no conflicts of interests.

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