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Relationship between physical fitness and lifestyle of early school-aged boys and girls

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Abstract: *Monitoring physical fitness is a strong indicator of health status in childhood, adolescence, and adulthood. School provides an ideal environment to assess and monitor the level of physical fitness in children. The research aims to determine the correlation between the physical fitness of early school-aged children (6 to 10 years old) and their lifestyle, particularly the time spent in physical activity. The study was conducted on a sample of 940 participants aged 6 to 10, randomly selected from several primary schools in the Skopje region. The sample was divided into two subgroups by gender, consisting of 466 male participants and 474 female participants. Differences between groups were determined through one-factor multivariate and univariate analysis of covariance (MANCOVA and ANCOVA) with age partialization. The results of this research show a correlation among male participants who engaged in more than 60 minutes of daily physical activity and tests assessing physical fitness (motor skills). For girls, self-reported physical activity was only associated with results on the 20-meter progressive shuttle run test.*

Keywords: *children; physical fitness; lifestyle; physical activity.*

INTRODUCTION

Monitoring physical fitness is a powerful predictor of health status in childhood, adolescence, and adulthood (Guedes et al., 2012; Blair et al., 2001; Williams, 2001; Myers et al., 2004; Warburton et al., 2005; Ortega et al., 2008). Physical fitness relates to academic performance, including cognitive skills and attitudes (attention, memory, understanding), academic behavior (organization, attendance, impulse control), and achievements (better test scores, higher average grades) (Kohl et al., 2013; Grissom, 2005; Welk et al., 2010; Rasberry et al., 2011). School serves as an ideal environment to assess and track children's physical fitness levels (Welk et al., 2010; Condello et al., 2016), enabling the identification of potential low levels and the creation of appropriate interventions to improve it. Additionally, it is important to identify factors that may influence physical fitness levels in childhood or adolescence and study them concurrently (Ortega et al., 2008). Although analyzing risk factors poses a new challenge in various research fields, including health promotion, sociodemographics, kinesiology, and behavioral sciences (Guedes et al., 2012; Condello et al., 2016), few studies have investigated the correlation between physical fitness and risk factors (Grao-Cruces et al., 2014; Castro-Piñero et al., 2012). Information on children's physical fitness from different geographic regions and cultures is crucial for promoting and creating public health strategies aimed at preventing adult disorders.

MATERIAL AND METHODS

Study Participants

This research involved a sample of 940 participants from various primary schools. The sample was further divided by gender, consisting of 466 male and 474 female participants. All students regularly attending physical and health education classes and who were physically and mentally healthy were included in the measurement.

Anthropometric Measures

Measurements were taken in standard school conditions during regular physical and health education classes. Experts in kinesiology, previously trained in specific motor tests, conducted the measurements. The intended tests were conducted following the methodology recommended by the Council of Europe (the EUROFIT test battery). Some tests were modified and adapted within international scientific projects such as "Nutrition and Assessment of the Nutritional Status of Spanish Adolescents" (AVENA Study), "Healthy Lifestyle in Europe by Nutrition in Adolescence" (HELENA Study) (Ruiz et al., 2006), "Assessment of Fitness in Children and Adolescents" (ALPHA project), and "Identification and Prevention of Health Effects Caused by Nutrition and Lifestyle in Children and Infants" (IDEFICS study).

Variable Sample

The study used 7 criterion variables (fitness tests) and 3 predictor variables. Criterion variables for flexibility, musculoskeletal fitness, motor fitness, and cardiorespiratory fitness included: sit-and-reach (FLE), handgrip dynamometry (HG), standing long jump (SKOK), sit-up for 30 seconds (SIT30), 4 x 10 meters shuttle run test (4X10M), 20-meter shuttle run test with progressive speed increase (Stg), and 20-meter progressive shuttle run test (VO2 max). **Predictor variables**: Time spent in daily physical activity up to 60 minutes, time spent in daily physical activity between 60 and 120 minutes, and time spent in daily physical activity exceeding 120 minutes.

Methodology

For all variables, basic statistical parameters were calculated: mean (X) and standard deviation (SD). Differences between groups were determined through one-factor multivariate and univariate analysis of covariance (MANCOVA and ANCOVA) with age partialization (age was treated as a fixed covariate).

RESULTS

From the obtained results represented in Table 1, with Wilks' Lambda at 0.94 and Rao's F approximation at 2.16 and a statistical significance level of Sig. .008 among younger school-aged boys (Table 1), significant statistical differences in motor status were found between formed groups regarding time spent in physical activity.

In the univariate analysis of covariance, statistically significant differences were found in five variables: handgrip dynamometry (HG) at p = .031, standing long jump (SKOK) at p = .002, 20m shuttle run with progressive speed increase (covered segments) (StG) at p = .001, 20-meter progressive shuttle run test (VO2 max) at p = .000, and sit-up for 30 seconds (SIT30) at p =.012. The partial effect of determinants ranked between 0.01 and 0.03, indicating a small influencing effect.

From the obtained results shown in Table 2, it can be observed that from the analysis of multivariate analysis of covariance and Rao's F-approximation, which is 1.15, and the level of statistical significance Sig, 312, it is evident that there are no statistically significant differences between the groups.

Out of a total of seven analyzed univariate motor tests, significant statistical differences were found in only one test among the analyzed groups of female participants formed based on the time spent in physical activity. Statistically significant differences were found only in the 20-meter progressive shuttle run test (Stg) with a significance level of p= .013.

Table 1. *Differences in motor status between groups of male participants formed based on the time spent in physical activity*

	Value	F	Hypothesis df	Error df	Sig.	n^2
Wilks' lambda	0,94	2,16	14	908	,008	,032

Table 2. *Differences in motor status between groups of female participants formed based on the time spent in physical activity*

	<60 мин		60-120 мин		>120		F	P	n^2	Post hoc pairwise comparisons		
	Mean	SD	Mean	SD	Mean	SD				1-2	1-3	2-3
FLE	13,74	6,78	15,01	6,06	15,04	6,49	2,58	,077	0,01	ns	ns	ns
HG	13,30	3,43	14,38	4,93	14,17	4,00	3,52	,031	0,02	>	>	ns
SKOK	111,08	23,21	118,25	24,20	121,02	24,73	6,45	,002	0,03	>	>	ns
SIT30	12,75	5,19	13,99	5,49	14,71	5,04	4,45	,012	0,02	>	>	ns
4X10M	14,88	2,02	14,42	2,09	14,74	2,41	2,37	,095	0,01	ns	ns	ns
Stg	3,47	1,45	4,03	1,60	4,04	1,71	7,31	,001	0,03	>	>	ns
VO2max	48,20	3,76	49,38	3,40	49,68	3,50	8,09	,000	0,03	>	>	ns

	Value	F	Hypothesis df	Error df	Sig.	n²
Wilks' lambda	0,97	1,15	14	916	,312	,017

	<60 мин		60-120мин		>120		F	P	n²	Post hoc pairwise comparisons		
	Mean	SD	Mean	SD	Mean	SD				1-2	1-3	2-3
FLE	17,79	6,42	16,95	6,48	17,26	7,45	0,96	,384	0,00	ns	ns	ns
HG	12,71	4,75	12,57	4,26	13,28	3,80	0,51	,601	0,00	ns	ns	ns
SKOK	104,11	22,10	104,00	22,09	109,90	19,98	1,66	,192	0,01	ns	ns	ns
SIT30	12,29	4,85	11,60	5,18	12,22	5,29	0,79	,456	0,00	ns	ns	ns
4X10M	15,41	2,19	15,68	1,91	15,20	1,83	1,32	,268	0,01	ns	ns	ns
Stg	3,19	1,14	2,97	1,06	3,46	1,28	4,40	**,013**	0,02	ns	ns	>
VO2max	47,38	3,44	47,27	2,68	48,13	2,89	2,22	,110	0,01	ns	ns	ns

DISCUSSION

Physical activity is crucial for improving children's health (Rizzo et al., 2007). It reduces the risk of cardiovascular and metabolic diseases, body fat, anxiety, and depression symptoms while enhancing bone health and cardiorespiratory and muscular fitness in children (Huang & Malina, 2002).

Previous cross-sectional studies have shown a positive association between physical activity and physical fitness in children, with greater self-reported physical activity linked to better motor fitness (Dencker et al., 2006). This research indicates that boys engaged in over 60 minutes of daily physical activity show better results in handgrip dynamometry, standing long jump, 30-second sit-ups, and the 20-meter shuttle run test (number of sections and VO2) compared to their peers engaging in less than 60 minutes. However, there was no significant difference between boys participating in 60-120 minutes and over 120 minutes of daily physical activity, suggesting that 60-120 minutes of daily physical activity is sufficient to maintain physical fitness in boys of early school age.

For girls, self-reported physical activity was only associated with the 20-meter step-up test (number of segments). Differences were found among girls engaging in over two hours of daily physical activity. This aligns with the 2008 American and European physical activity guidelines, stating that all children and adolescents should engage in at least 60 minutes of moderate to vigorous physical activity daily (Herrmann et al., 2015). Hence, schools should enhance children's (especially girls') physical activity through suitable sports and games programs, while educational institutions should reinforce supervision to ensure daily physical activity during early school years.

The difference between 60-120 and over 120 minutes of daily physical activity in boys suggests that the threshold for adequate daily physical activity for early school-aged boys for full benefit should be at least 60 minutes but not more than 120 minutes. Extended periods (>120 minutes) won't provide additional benefits for improving muscular and cardiorespiratory fitness. Conversely, for girls, increasing activity intensity might lead to positive changes in physical fitness components and engagement in organized physical activities. This aligns with some studies showing weak or insignificant correlations between physical activity and physical fitness since daily physical activity explains a small portion of aerobic activity, which could independently determine fitness (Morrow et al., 2009; Dencker et al., 2006; Martinez Vizcaino et al., 2008). Conversely, other studies indicate a strong association between physical activity frequency and physical fitness (Hogstrom et al., 2014; Kaminsky et al., 2013). Furthermore, some studies advocate considering physical activity alongside proper nutrition since interventions considering both determinants significantly increase students' fitness levels (Eather et al., 2013; Kriemler et al., 2010; Langford et al., 2015).

CONCLUSION

Boys engaged in over 60 minutes of daily physical activity show better results in handgrip dynamometry, standing long jump, 30-second sit-ups, and the 20-meter shuttle run test (number of segments and VO2 max) compared to peers engaging in less than 60 minutes. For girls, self-reported physical activity was only associated with results in the 20-meter shuttle run test (number of segments).

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