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HEALTH STATUS, PHYSICAL FITNESS AND CORRELATES TO PHYSICAL ACTIVITY OF CHILDREN IN SOUTH ITALY

ZDRAVSTVENI STATUS, TELESNA ZMOGLJIVOST IN POVEZANOST S TELESNO DEJAVNOSTJO OTROK V JUŽNI ITALIJI

ABSTRACT

The inverse relationship between sedentary habits, physical fitness, self-perception, and enjoyment during physical activity (PA) has been widely demonstrated by international literature. Furthermore, according to recent epidemiological report, Italy is one of the European countries with the highest prevalence of overweight and obese children and adolescents. The present study aims to assess physical fitness levels, self-perception and enjoyment in a sample of 3676 primary school children (M = 1861, F = 1815, mean age = 9-10 years) attending the SBAM! project in Apulia, Southern Italy. The objective is to provide epidemiological data of the health status of children through the assessment of BMI Z-scores, physical fitness and factors related to the practice of PA. The following physical fitness test were proposed: standing long jump, (SLJ), shuttle run 10x4, (10x4), and 6 minutes walk test (6MWT), to assess lower limb explosive strength, agility and coordination, and aerobic endurance, respectively. Two validated questionnaires were used to assess self-perception and enjoyment. Results showed a large percentage of children that were overweight/obese or underweight, and a negative relation with physical fitness test and questionnaires. Moreover, normal weight sample had better motor performance, self-perception, and enjoyment during PA than underweight or overweight/obese groups. These results confirm the needs to promote and develop projects and institutional interventions aimed at enhancing physical activity and healthy lifestyles in Southern Italy.

Keywords: health-related physical fitness, self-perception, enjoyment

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IZVLEČEK

V mednarodni literaturi je bila že velikokrat dokazana obratna povezanost med sedečim vedenjem, telesno zmogljivostjo, samoocenjevanjem in užitkom med telesno dejavnostjo. Poleg tega je glede na nedavno epidemiološko poročilo Italija ena izmed evropskih držav z največjo prevalenco prekomerno težkih otrok in mladostnikov. Namen te študije je oceniti telesno zmogljivost, samoocenjevanje in užitek med telesno dejavnostjo na vzorcu 3676 osnovnošolskih otrok (M = 1861, F = 1815, povprečna starost = 9-10 let), ki so bili vključeni v projekt SBAM! v mestu Apulia v južni Italiji. Cilj je priskrbeti epidemiološke podatke o zdravstvenemu stanju otrok s pomočjo ocene ITM, telesne zmogljivosti in dejavnikov povezanih s telesno dejavnostjo. Za oceno eksplozivne moči spodnjih okončin, agilnost, koordinacijo in srčno-dihalno vzdržljivost so bili izvedeni testi telesne zmogljivosti: skok v daljino z mesta (SDM), stopnjevalni tek 10x4 (10x4) in 6-minutni test hoje (6MTH). Za ovrednotenje samoocene telesne zmogljivosti in užitka med telesno dejavnostjo sta bila uporabljena dva validirana vprašalnika. Rezultati so pokazali velik odstotek prekomerno težkih, debelih in podhranjenih otrok ter negativno povezanost med rezultati testov telesne zmogljivosti in vprašalnikoma. Poleg tega se je izkazalo, da otroci, ki so v območju normalnih vrednosti ITM, dosegajo boljše rezultate pri testih telesne zmogljivosti, bolje ocenijo svojo telesno zmogljivost in bolj uživajo med telesno dejavnostjo. Ti rezultati potrjujejo potrebo po spodbujanju in razvoju projektov in intervencij usmerjenih v dvig telesne dejavnosti in zdravega življenjskega sloga v južni Italiji.

Ključne besede: z zdravjem povezana telesna zmogljivost, samoocena telesne zmogljivosti, užitek med telesno dejavnostjo

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https://doi.org/10.52165/kinsi.30.1.20-35

INTRODUCTION

Evidence from international literature have shown the importance of physical activity (PA) for the improvement of physical, mental, and cognitive domains (CDC, 2023). According to the World Health Organization (WHO) (Bull et al., 2020), children and adolescents (from 5-17yrs) should practice at least 60min of moderate to vigorous physical activity (MVPA) daily. Increased physical activity levels (PAL; >60min x day) brings additional health benefits, such as the improvement of muscular strength (García-Hermoso et al., 2019), cardiorespiratory fitness (CRF) (Hartwig et al., 2021), academic achievement (Cadenas-Sanchez et al., 2020), reducing the symptoms of anxiety and depression (Dale et al., 2019).

However, according to the WHO European Regional Obesity Report 2022 about one in three school-aged children, one in four adolescents and almost 60% of adult population are characterized by excessive body adiposity and live in a condition of overweight or obesity (WHO, 2022a). In this regard, the percentage of overweight and obesity have progressively reached an epidemic dimension in Europe, and this unhealthy condition is even more worrying when considering the Mediterranean and Eastern European countries (WHO, 2022a). The WHO Global Health Observatory report (WHO, 2022a) has shown that Italy has the higher prevalence of 5-9yrs children overweight (about 15%) and obese (more than 40%), and is fourth country in Europe with higher percentage of overweight and obese children and adolescents aged 10-19 years. These data are confirmed by the latest report of Italian National Institute of Statistic (ISTAT), according to which in 2021 about 42,6% of the population aged >18 years were overweight (34,2%) and obese (12%), while more than 30% of sample aged >3yrs didn’t practice sport or physical activity during free time (ISTAT, 2022).

Moreover, data from OKkio alla Salute – an Italian national surveillance system promoted by the Ministry of Health for the monitoring of the evolution of childhood obesity, with both regional and local details – showed that (a) in 2019 the prevalence of children spending more than two hours a day on a normal school day in front of TV, on a computer/tablet/mobile phone or playing video games was 44.5%, (b) this value progressively increased compared to that of 2016 (41.2%) and 2014 (35.1%), and (c) the prevalence of children who spend more than 2 hours a day in sedentary activities increased moving from Norther to Southern Italy (Nardone et al., 2022). Despite the last WHO European Obesity Surveillance Initiative (COSI) has shown positive trend for the reduction of the prevalence of overweight and obesity in Italy, policies trying to reverse childhood obesity trends are urgently needed (WHO, 2022b). As required by the Global Action Plan on Physical Activity 2018-2030 (WHO, 2019a), globally there’s a need to set up interventions and policies aimed at assessing sedentary behavior and unhealthy lifestyles and enhancing physical activity levels in children and adolescents.

Recent studies showed an inverse relationship between body weight (or adiposity) and the development of physical fitness (Godoy-Cumillaf et al., 2023), defined as the bodily ability to be healthy and perform efficiently the activities of day living, composed of different but complementary components: health-related physical fitness (i.e. body composition, cardiorespiratory endurance, flexibility, muscular endurance, power, and strength) to ensure better health status and wellness, and skill-related physical fitness (i.e., agility, coordination, and reaction time) to enhance sport performance and other activities based on motor skills (Corbin et al., 2021). Moreover, high children’s perception of their physical fitness and enjoyable bodily-motor experiences can improve and guarantee better adherence to PA during lifetimes (Lonsdale et al., 2019).

Considering this evidence, this study aims to assess differences in physical fitness, enjoyment, and self-perception in a sample of Italian children. The results of the present study will be used to plan local and regional interventions for health promotion in Southern Italy.

METHODS

Sample

The sample is composed of 3676 primary school children (mean age= 9-10 years, male= 1861, female= 1815), recruited from schools that joined the 2018-2019 edition of the SBAM Project - Health, Wellness, Food Education and Movement at School – in Southern Italy.

The project provides different and complementary PE teaching-educational areas of intervention (e.g., physical education, active transport, correct eating habits) oriented to health promotion and the prevention of sedentary behavior through the improvement of motor development and motor skills learning process. Primary school children of 4th and 5th were involved from all Apulia province: Bari, Foggia, BAT (Barletta, Andria, Trani), Taranto, Brindisi, and Lecce.

The Project was carried out from January to June 2019, for a total of 22 hours of PE per class. In this study, only data from the province of Bari have been considered and analyzed. Since this study involved all Bari province data assessment, no randomization has been applied to recruit sample. After collecting data, the total sample was divided according to gender (male and female) and Z-scores groups.

Procedure and Assessment

Assessment was carried out by a team of bachelor and master's degree in Motor and Sports Sciences and involved in the SBAM! Project. Before the project started, experts/teachers participated in three training meetings of 4 hours (3 meetings x 4 hours = 12 hours of teacher training course) to share and standardize assessment methods and procedure. During the meetings, both practical and theoretical activities were carried out, with practical laboratories dedicated to teaching-learning episodes in PE and motor assessment. Both physical fitness test and questionnaires have been proposed to ensure the validity, reliability, and objectivity of the monitoring. The assessment was carried out during the second weeks of intervention. Informed consent was obtained from all participants before the Project started.

Anthropometric Characteristics

Anthropometric profile assessment provided height, weight and body mass index (BMI) measurement. Height and weight were measured with a digital portable stadiometer with a precision of about 0.1mm and 0.1 kg, while BMI was carried out dividing weight (kg) by the square height (m2). After recording and calculating the BMI, the data were analyzed to define and derive the BMI-for-age z-scores value (WHO, 2006). In fact, in the pediatric population the diagnosis of pre-obesity and obesity is based on the use of percentiles of the weight/length ratio, up to 24 months of age, z-score model (number of standard deviations) from 3 to 19 years of age (WHO, 2006).

The use of the weight and state growth curves defined by the WHO for the definition of obesity in infants, children and adolescents is recommended, to develop a system that can compare the worldwide growth of individual children or groups from a specific population (Wang and Chen, 2012). Anthropometric data analysis has been conducted with AnthroPlus Software for personal computers (WHO, 2019b) that included weight-for-age, height-for-age, and BMI-for-age indicators of children from birth to 19 years old. In this study only BMI-for-age indicator has been used. After processing data, the software showed BMI-for-age-z-score value based on the WHO standards or the WHO reference value according to child's age (de Onis et al., 2007). Results were presented with the following cut-off classification: -3SD, -2SD, -1SD, +1SD, +2SD, +3SD (where SD is referred to standard deviation), that corresponded to the percentile classification system charts, 3rd, 15th, 50th, 85th and 97th percentiles, respectively (WHO, 2019b; WHO, 2006).

Physical Fitness

Muscular strength has been identified as an important determinant of future health status in children and adolescents, showing a strong negative relation with adiposity and cardiometabolic risk factors, and positively associated with bone health, self-esteem, and perceived competence (García-Hermoso et al., 2019). In fact, standing long jump represents a functional expression of explosive lower limbs body strength that is strictly related to health status in children and adolescents (Tomkinson et al., 2021).

Moreover, speed and agility are significantly associated with musculoskeletal fitness parameters – specifically with jump performance – and bone mineral density (Mello et al., 2023). International literature has highlighted the negative association between increased body weight with speed and agility performance (Stanković et al., 2021).

Finally, aerobic endurance represents one of the most important health indicators in children and adolescents (Kasović, Štefan, and Petrić, 2021), and it has been widely demonstrated the role of aerobic exercise in developmental age in improving cognitive control and executive function, academic achievement, and overall general health status (Van Waelvelde et al., 2020).

In the light of these evidence, physical fitness has been assessed with the standing long jump (SLJ), 10x4 shuttle run (10x4), and 6 minutes walk test (6MWT) to evaluate lower limbs strength, agility, speed and over-all coordination, and endurance, respectively (Council of Europe, 1993; Ruiz et al., 2011; Lammers et al., 2008). The children performed 2 times each physical fitness test (only 6MWT was performed once to avoid fatigue) of which only the best has been reported in assessment and used for data analysis. The assessment procedure for physical fitness test is described as follows.

Standing Long Jump

In the SLJ the student was placed behind the starting line, previously traced on the mat in the gym. From this starting position, the teacher asks the children to perform long jump as far as possible with the help of arm swing, falling back to the mat. Distance was measured from the starting line to the nearest sign left on the mat by feet or any other part of the body, paying attention to the arrival of heels on the floor or on the mat (Council of Europe, 1993).

Shuttle Run 4x10

Shuttle run 4x10 has been proposed to assess children's agility and speed. In this physical fitness test, students were asked to run quickly over 10 m, going back and forth twice (4x10 m). The starting and ending lines were marked with a white line (1m long and 5cm wide) on the floor (Ruiz et al., 2011). The test started at the teacher/expert's verbal signal (3-2-1, go!). During the sense changes, both feet must passed the line. Upon arrival on the starting line, after the last 10m, the time was recorded with an accuracy to the hundredth of a second (e.g., 10,60s) using a manual chronometer. The test was performed individually (Ruiz et al., 2011).

6 Minutes Walk Test

Physical endurance was assessed with 6 minutes walk test. Students were asked to walk (not run) for 6 minutes trying to travel as far as possible in outdoor space preferably , and if it was no possible, inside the school gym along a path with two cones aligned arranged at 15 meters (Lammers et al., 2008), with cones positioned at a distance of 3m. The test has been performed by 1-2 pupils a time. to avoid competition. Pupils were informed of the time spent at each pass and are notified with a signal during the last 30 seconds. The teacher – student ratio was 1:2 and the number of laps for each student was reported. At the end of the test the students stopped at the point where they were until the end of the measurement of the distance covered. The space covered in meters by each pupil was measured (Lammers et al., 2008).

Self-Perception and Enjoyment

The daily practice of physical activity has positive effects not only in improving muscular strength and body composition (Chen et al., 2022), the efficiency of the cardiorespiratory systems (D'Agostino et al., 2022), and in enhancing motor skills learning and motor competence acquisition (Wälti et al., 2022).

However, according to Heening et al. (2022a) perceived physical fitness (PPF) can best promote motivation and adherence to physical activity in children. In fact, perceived physical fitness is not only positively associated with autonomous motivation, self-efficacy and daily practice of physical activity, but self-efficacy mediates the relation between PPF and PA (Heening et al., 2022a; Sallen et al., 2020), as well as PPF has positive effects on PA autonomous motivation, as a strong predictor of adherence to PA from childhood to adulthood (Heening et al., 2022b). Moreover, PE activities that are intrinsically motivating can enhance factors related to the practice of physical activity, such as PA intentions, enjoyment, and PAL (Lonsdale et al., 2019; Ruiz-Montero et al., 2020).

Therefore, considering the importance of self-perception and enjoyment for health promotion and the mutual interaction with physical fitness, and more generally the entire process of motor development (Barnett et al., 2016), the present study assessed physical self-perception (PSP) and enjoyment with two validated questionnaires. The Physical Activity Scale for Children (Colella et al., 2008) is 6 items questionnaires for evaluating children's perceived physical fitness components (i.e., strength, speed, and agility) based on a 4-point Likert scale (min 6 points – max 24 points). Higher values define better self-perception and self-confidence in children's own motor abilities.

Enjoyment was assessed with the Physical Activity Enjoyment Scale (PACES), 16-items questionnaires based on a 5-points Likert Scale (Carraro et al., 2008). Children were asked to indicate if they were in agreement with some statements (e.g., when I practice physical activity…I feel happy, I feel annoying, etc.). Despite the questionnaire is composed of two subscales (positive enjoyment and negative enjoyment), this study considered only the positive scale.

Statistical Analysis

Since the sample involved in this study was large, Kolmogorov-Smirnov test was obtained for all variables for testing normality. Furthermore, descriptive profile was computed to better understand nature of data, and Pearson's correlation coefficient (r) was carried to analyze significant relations between BMI, physical fitness, self-perception, and enjoyment according to Z-Scores groups and gender. After verifying the equality of variance assumption with Levene's test, a 2x4 Factorial ANOVA was performed to assess the main effect and possible interaction effect of gender (two levels) and Z-scores (four levels) on physical fitness, self-perception, and enjoyment. According to Cohen (2013) partial eta squared was used to measure the effect size (small, $\eta p2 = 0{,}01$; medium, $\eta p2 = 0{,}06$, and large $\eta p2 = 0{,}14$). Moreover, Tuckey HSD Post Hoc test was performed to describe differences groups. All significant levels were set at $p < .05$. SPSS Software (vers.26) was used to perform statistical analysis.

RESULTS

The sample's distribution according to the z-scores standards is shown in Table 1. Considering the total sample, about 50% of the children with study are under 50%, 40% between 15°-85°, and 15% have Z-scores BMI levels above and below the 3°-97° percentile, while about 4% is classified as N.A. As for data obtained from total sample, about 50% of both boys and girls fell below the 50° percentile.

Table 1. Sample's distribution according to BMI Z-Scores

Z-Scores Distribution						
	Total Sample		Gender			
			M		F	
Percentile	N	%	N	%	N	%
50°	1827	49,7%	904	48,6%	923	50,9%
15°-85°	1133	30,8%	551	29,6%	582	32,1%
3°-97°	567	15,4%	295	15,8%	272	15,0%
N.A.	149	4,1%	111	6,0%	38	2,0%

Sample's descriptive profile (mean±standard deviation) has been reported in Table 2 according to gender and BMI groups for age, weight, height, and BMI, while data obtained from physical fitness test, self-perception, and enjoyment have been included in Table 3.

Table 2. Sample's Descriptive Anthropometric Profile

Sample's Descriptive Anthropometric Profile						
Gender	N	Percentile	Age	Weight	Height	BMI
Female	921	*50°*	9,85±0,38	27,58±3,44	1,29±0,06	16,58±1,08
	582	*15°-85°*	9,84±0,42	30,73±6,31	1,31±0,07	17,96±3,04
	272	*3°-97°*	9,87±0,50	37,67±9,95	1,33±0,07	21,16±5,13
	55	*N.A.*	9,68±0,47	39,05±16,13	1,37±0,06	21,25±9,20
Male	904	*50°*	9,86±0,40	27,93±3,15	1,30±0,06	16,49±0,96
	549	*15°-85°*	9,86±0,38	30,90±5,76	1,31±0,07	17,85±2,52
	296	*3°-97°*	9,88±0,39	38,40±7,72	1,34±0,07	21,45±3,67
	133	*N.A.*	9,82±0,39	44,93±12,52	1,36±0,08	24,28±6,46

Table 3. Physical Fitness test, Self-Perception and Enjoyment Descriptive Statistics

Gender	N	Percentile	SLJ M	SLJ SD	10x4 M	10x4 SD	6MWT M	6MWT SD	PSP M	PSP SD	PACES M	PACES SD
Female	923	*50°*	1,07	0,21	14,87	1,96	520,48	129,51	12,95	1,97	18,54	2,08
	582	*15°-85°*	1,04	0,20	15,15	2,15	512,41	115,98	12,71	1,83	18,57	1,67
	272	*3°-97°*	0,98	0,20	15,58	2,31	503,55	115,53	12,72	2,01	18,48	2,35
	38	*N.A.*	1,02	0,23	15,42	2,06	484,70	125,01	12,58	2,11	18,66	1,81
Male	904	*50°*	1,19	0,20	14,24	2,16	540,34	129,05	13,64	1,96	18,53	2,57
	551	*15°-85°*	1,15	0,57	14,47	2,34	533,40	136,76	13,41	2,18	18,41	2,43
	295	*3°-97°*	1,09	0,20	14,88	2,87	513,59	114,11	13,31	2,23	18,47	2,51
	111	*N.A.*	1,04	0,25	15,55	3,16	496,94	105,40	12,68	2,29	17,97	2,45

Pearson's correlation coefficient has been carried out to assess possible relation between BMI and dependent variables according to gender and BMI groups (Table 4). Data analysis showed that BMI is significantly negatively related with SLJ ($p < .05$), 6MWT ($p < .05$) and self-perception ($p < .05$), and positively related to 10x4 ($p < .05$) in N.A BMI groups for boys. Moreover, there's a significant inverse relation between SLJ and BMI between boys above and under the 3°-97° percentile ($r = -.270$, $p < .01$), and in all female groups independently of BMI. As the BMI increase the time to perform 10x4 for girls increases for both below and above the 15°-85° ($r = .154$, $p < .01$) and 3°-97° ($r = .185$, $p < .01$) percentile, respectively. Self-perception is negatively related to girls under and above 15°-85° percentile ($r = -.128$, $p < .01$) and N.A ($r = -.336$, $p < .05$). Small significant association between enjoyment and BMI Z-scores for boys at 50° percentile has been found ($r = .091$, $p < .01$).

Table 4. Pearson's Correlates Between Physical Fitness Test and Questionnaire with BMI. *= *p*< .05, ** = *p*< .01.

Physical Fitness Test	Male *50°*	Male *15°-85°*	Male *3°-97°*	Male *N.A*	Female *50°*	Female *15°-85°*	Female *3°-97°*	Female *N.A*
SLJ	-.024	.027	-.270**	-.441**	-.114**	-.248**	-.272**	-.461**
10x4	-.002	.074	.037	.346**	.079**	.154**	.185**	.312
6MWT	.016	.01	.081	.325**	-.018	-.076	.083	.268
PSP	.042	.022	-.064	-.193*	.005	-.128**	-.047	-.336*
PACES	.091**	-.022	-.078	-.008	.013	-.028	-.117	-.008

Levene's F-test has been used to test null hypothesis of equality of variance (Table 5). Since p value associated with F-test is non-significant for all variables except for 6MWT ($p < .05$), the assumption of homogeneity of variance is satisfied and ANOVA 2x4 can be performed.

Table 5. Levene's Test of Equality of Error Variance

Physical Fitness, SE and Enjoyment				
	F	df1	df2	Sig.
SLJ	.093	1	3690	.760
10x4	.322	1	3697	.570
6MWT	8.476	1	3660	.004
PSP	.836	1	3706	.360
PACES	.561	1	3672	.454

Table 6 showed the F values for gender, Z-scores groups, and Interaction. Despite F value for gender and Z-scores group was all significant because its associated p value is less than 0,05 (excepted for enjoyment), the interaction effect was significant only for SLJ (F= 2.679, p= .045) with small effect size (ηp2 = ,02). Moreover, the analysis of the effect size, as an indicator of the strength of the magnitude of difference between groups, showed large dimension of effect in SLJ for according to gender (ηp2 = ,23) and BMI Z-Scores (ηp2 = ,28), and medium effect for 10x4 and SE (,04 <ηp2 < ,12). Furthermore, post hoc analyses were performed to analyze significant main effects of gender and BMI in Table 7.

Table 6**.** Main and Interaction Effects Between Variables

Testing effect between Subjects									
	Gender			Z-Scores			Gender*Z-scores		
	F	p	ηp^2	F	p	ηp^2	F	p	ηp^2
SLJ	85,743	,000	,23	35,074	,000	,28	2,679	,045	,02
10x4	16,030	,000	,04	14,426	,000	,12	1,960	,118	,02
SE	26,736	,000	,07	6,684	,000	,05	1,214	,303	,01
Enjoyment	3,498	,062	,01	,291	,832	,01	1,136	,333	,01

According to SLJ, 50° percentile boys performed significantly better than other Z-score groups (p<. 01), while for female significant differences have been highlighted between 3-97° and 15°-85° (p= .001), 3°-97° and 50° (p= .000), and15°-85° and 50° (p= .007). 10x4 post hoc analysis showed that boys under 50° performed better than N.A (p= .000) and 3°-97° groups (p= .000); even 50° percentile girls showed better physical fitness in 10x4 than those at 3°-97° percentile (p= .000). Moreover, no significant difference has been carried out for self-perception in girls, while male N.A self-perception was significantly lower than 50° (p= .000) and 5°-85° percentile (p= .011).

Table 7. Post-Hoc Analysis between Groups.

		Male			Female		
		Mean	SD	*p*	Mean	SD	*p*
SLJ	*N.A*	1,04	0,25	,787	1,02	0,23	,147
	3°-97°	1,09	0,20		0,98	0,20	
	N.A.	1,04	0,25	,000	1,02	0,23	,995
	15°-85°	1,15	0,57		1,04	0,20	
	N.A.	1,04	0,25	,000	1,02	0,23	,759
	50°	1,19	0,20		1,07	0,21	
	3°-97°	1,09	0,20	,000	0,98	0,20	,001
	15°-85°	1,15	0,57		1,04	0,20	
	3°-97°	1,09	0,20	,000	0,98	0,20	,000
	50°	1,19	0,20		1,07	0,21	
	15°-85	1,15	0,57	,000	1,04	0,20	,007
	50°	1,19	0,20		1,07	0,21	
10x4	*N.A*	15,55	3,16	,542	15,42	2,06	,227
	3°-97°	14,88	2,87		15,58	2,31	
	N.A.	15,55	3,16	,008	15,42	2,06	,945
	15°-85°	14,47	2,34		15,15	2,15	
	N.A.	15,55	3,16	,000	15,42	2,06	,979
	50°	14,24	2,16		14,87	1,96	
	3°-97°	14,88	2,87	,087	15,58	2,31	,030
	15°-85°	14,47	2,34		15,15	2,15	
	3°-97°	14,88	2,87	,000	15,58	2,31	,000
	50°	14,24	2,16		14,87	1,96	
	15°-85	14,47	2,34	,287	15,15	2,15	,057
	50°	14,24	2,16		14,87	1,96	
SE	*N.A*	12,68	2,29	,074	12,58	2,11	1,000
	3°-97°	13,31	2,23		12,72	2,01	
	N.A.	12,68	2,29	,011	12,58	2,11	1,000
	15°-85°	13,41	2,18		12,71	1,83	
	N.A.	12,68	2,29	,000	12,58	2,11	,819
	50°	13,64	1,96		12,95	1,97	
	3°-97°	13,31	2,23	,925	12,72	2,01	,999
	15°-85°	13,41	2,18		12,71	1,83	
	3°-97°	13,31	2,23	,098	12,72	2,01	,336
	50°	13,64	1,96		12,95	1,97	
	15°-85	13,41	2,18	,182	12,71	1,83	,087
	50°	13,64	1,96		12,95	1,97	

DISCUSSION

The results of the present study revealed differences in physical fitness, physical self-perception, and enjoyment according to BMI cutoff Z-scores. Although the results showed that about 50% of the sample was normal weight (50°), there still was a large prevalence of overweight, obese, or underweight children.

These data are important for the development of interventions aimed at promoting both physical activity and correct eating habits in primary school children. In fact, Nardone et al. (2022) have highlighted some of unhealthy dietary habits adopted by most of the Apulian children, such as the daily consume of energy-dense foods during recreation at school, the daily intake of energy drinks, and low intake of fruits and vegetables. Moreover, data analysis highlighted that both the excess of higher and lower BMI negatively influenced physical fitness components and self-perception, while normal weight sample (50° percentile) showed better performance in SLJ,10x4 and scores in physical self-perception.

The results of the present study are in line with those of other similar ones. In fact, Boddy et al. (2014) assessed whether CRF, BMI Z-scores and the daily practice of physical activity contribute to determine cardiometabolic risk in a sample on one hundred and one 10-12yrs old children. Results showed that children who didn't reach the international recommendations and guidelines (almost 60min of MVPA per day) were not only more sedentary, but had also significant higher cardiometabolic risk scores, lower CRF, and unhealthy BMI Z-scores than active children. The development of cardiorespiratory fitness and muscle strength due to the improvement of overweight and obesity has been object of interest by recent systematic review and longitudinal studies. Fühner et al. (2021), analyzing the progressive decline and negative secular trends in cardiorespiratory fitness between 1986 and 2010-12, recommended the improvement of physical fitness (especially CRF) in children and adolescents to prevent overweight and obesity, and promote muscle strength to learn motor skills. Another study confirmed that both the practice of physical activity, non-excessive weight status and body composition are significant predictors of healthy physical fitness levels (Riso et al., 2019). Moreover, children's obesity was related to lower physical self-perception as a limiting factor for the participation and adherence in physical activity (Vandoni et al., 2021). Therefore, analysis of international literature requires the research and concrete application of best practice to promote healthy lifestyles during childhood.

In this regard, Villa-González et al. (2023) highlighted the importance of school-based intervention for at least 3 days per week to develop strength and muscular fitness in boys and girls. Instead, Seljebotn et al. (2019) have conducted a study based on an Active School program to assess the effects on physical activity and aerobic fitness in a sample of 446 children aged 9-10yrs. The experimental activities consisted of active lessons, physically active homework, and active recess, determining an increase in PAL and aerobic fitness. At the same time, Caldwell et al. (2020) demonstrated that the positive relation between physical literacy – that is a learning process that allows children to acquire motor skills transferable in relationship life and sports to promote healthy lifestyles (Whitehead, 2013) – and health indicators are mediated by MVPA, suggesting the importance of promote new and different opportunities for children and adolescents to be physically active.

CONCLUSION

This study highlights some important information about children's health status in Apulia. The high prevalence of underweight and overweight/obese children represents an alarming and worrying phenomenon that cannot be unnoticed by the entire school, cultural, social, and governmental institutions. However, multicomponent interventions are urgently needed to promote different component of physical activity and active lifestyles (i.e., active transport, correct eating habits and food education, sports practice, etc.) since kindergarten, involving not only school, PE teachers and sports coaches, but also family.

Further studies should be oriented to promote and disseminate physical activity best practices through parents-training course to prevent the development of unhealthy lifestyles. On the other hand, research in physical education and physical activity should attribute to teachers training to enhance and update methodological-didactical frameworks of PE according to the latest scientific evidence.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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