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Association between physical fitness and BMI among school going male children

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Abstract
Relationship between physical fitness and BMI was generally highlights the un-uniform consequences. In contrast, several studies of children and adolescents highlight the importance of variation in indicators of physical fitness across the full range of BMIs from low to high. The purpose of the study was to evaluate relationships between physical fitness items and the BMI among school going boys. The sample included 106 males (Mean±SD; height= 158.01 ±10.39cm, weight= 50.09±10.16kg BMI= 20.04±3.37 kg/m^2 and age= 14-16 years). Anthropometric measurements and five measures of physical fitness (50-m sprint, standing long jump, 600-m run, pull-up, and push-up) were measured. BMI was calculated to classify individuals into underweight, normal weight, overweight, and obesity groups (underweight=41, normal= 54,). To check the relationship between physical fitness and BMI multiple correlations was used, the level of significance was set at 0.05 levels. The results of the study showed that there is no significant relationship between selected physical fitness variables and the Body Mass Index of boys of Kendriya Vidyalaya, Bengdubi Darjeeling, West Bengal, India.

Keywords: Physical fitness, body mass index, correlation, boys

Introduction
Physical Fitness is an essential quality for learning motor skills besides the influences of growth and maturation. A child can learn a specific motor activity only when attained actual physical growth is required to accomplish that movement. In addition to having achieved the necessary physical growth, the child must be 'ready to learn a motor skill in other ways to reach a certain level of motor, emotional and social development. According to Barrow (1968) motor fitness is "a readiness or preparedness with special regard for big muscle activity without undue fatigue". Due to the fact that it is a single concept, we must reflect on its components in order to grasp it and work out - muscular strength, muscular endurance, muscular power, cardio-vascular endurance, flexibility, speed, agility, and reaction Time (Dr.K.M. Valsaraj 2013) [6]. The definition of health-related fitness is defined as a combination of the following factors cardiorespiratory endurance, abdominal muscular strength and endurance, lower-back/upper-thigh flexibility, and body composition, specifically adiposity (AAHPERD). Latest descriptions of health-related fitness now incorporate morphological and metabolic influences (Bouchard, C 1994) [3]. Body mass index (BMI), is the morphological measure that attracts the most attention which is commonly used in the surveillance of overweight and obese in children and adults. The body mass index (wt/ht2 [kg/m2], BMI) is a weight status marker used in both person and population surveys (Janssen *et al*. 2005; Ng *et al*. 2014) [7]. A low BMI, initially mark as underweight (World Health Organization 1995) [14] where is high BMI indicate overweight. Some studies suggested that low BMI negatively influence movement proficiency and fitness (Bovet *et al*. 2007; Artero *et al*. 2009) [4]. In some studies, it was found that there was a non-linear, parabolic relationship between the BMI and an index of fitness (Welon *et al*. 1988). Similar report i.e. significant non-linear relationships between the BMI and five indicators of fitness—push-ups, sit-ups, high jump, 1500m run, and the 50m freestyle swim were noted among physically active young adult males (Sekulic *et al*. 2005) [13]. Non-linear relationships were also observed among 14–16-year-old Croatian boys using a separate exercise test battery (Zenic *et al*. 2013) and for motor coordination in 6–10 years old boys and girls (Lopes *et al*. 2018). Correlations between BMI and several indicators of motor fitness tend to be linear in samples of well- and under-nourished children 6–14 yr old (Malina, R. M 1998) [10], but they are curvilinear in young adults (Damir Sekuli 2005) [13]. According to Nikolaidis, P.T *et al*., Physical fitness is inversely related with BMI (Nikolaidis, P. T *et al*. 2012; 2019) [12]. Insignificant Relationship found between BMI and physical fitness index

(Yong-Jun Lu *et al*. 2014) [15]. Correlations between physical fitness and bone parameters are particularly significant in normal BMI (Nathalie Al Rassy *et al*. 2018) [1]. Sarah Carson Sackett *et al.* reported significant relationships in physical fitness and BMI among childhood and adolescence also exist in early adulthood (Sarah Carson Sackett *et al*. 2019) [5].

From the review related literature it was observed that, the relationship between BMI and physical fitness is a debatable area. There was no uniform relationship found between BMI and physical fitness index in studies conducted previously. And In India, the adverse effects of BMI on physical fitness are ignored and no study was conducted in any age group. The purpose of this study is to evaluate relationships between the BMI and physical fitness of school going children.

Materials and methods

The study was approved by the Department of Research Committee of Lakshmibai National Institute of Physical Education, Gwalior, Madhya Pradesh, India. The study was conducted in Kendriya Vidyalaya, Bengdubi Darjeeling, West Bengal, India. Both parents and their children provided informed consent. The research data was collected in the school playground. BMI and performances on five motor fitness tests were measured by research assistants experienced with the protocols for anthropometry and for each fitness test and associated equipment. Testing was coordinated by physical education teachers at the schools.

Participants

The participants were included 106 males (Mean±SD; height= 158.01 ±10.39cm, weight= 50.09±10.16kg BMI= 20.04±3.37 kg/m^2 and age= 14-16 years). Height and weight were measured using, respectively, a prestige stadiometer and an electronic weighing scale (Omron). The BMI was calculated (weight/height [kg/m^2]). BMI values were generally divided into four groups based on the criteria of World Health Organization (WHO): < 18.5 kg/m^2, 18.5~23.9 kg/m^2, 24~27.9 kg/m^2, and≥ 28 kg/m^2, which represented low weight, normal weight, overweight and obesity, respectively. According to the BMI index the subjects are categorized four groups i.e. underweight (N=44 M±SD 16.69±0.90 Kg/m^2), normal (N=54 M±SD 21.77±1.93 Kg/m^2), overweight (N=7 M±SD 26.81±1.68 Kg/m^2) and obese (N=1). Overweight and obese are excluded from the study due to small sample size.

Procedure

A 10-minute general warm-up consisting of general exercises was administered by the researcher prior to testing. The six fitness tests were administered i.e. Cardio-vascular endurance; muscular power, agility, speed and explosive strength have been included after thorough discussion and going through the related researches done in this area. Similarly the tests namely 600 meter run, Push-up and curl up, (4x10) meter shuttle run, 50meter sprint, standing broad jump

Push-up

The test begins with the participant's hands and feet on the floor and his body in a plank stance, with feet apart and hands below the shoulder line. The participants were required to lower the body until forming a 90° angle between the arm and the forearm and then return to the starting position. This action was repeated with until they give up. The number of times each participant correctly performed this push up was counted.

500 meter run and walk

The test was measured in minutes and seconds. Adequate warm-up exercise was advised before the test. When the investigator said, ‘‘take your marks,’’ subjects in a group of six to eight stood behind the starting line; when the investigator said, ‘‘go,’’ the subjects began the 600-m run/walk. The participants were advised to maintain a consistent pace and complete the run as soon as possible. If a subject was unable to continue running, they were allowed to walk.

50-m sprint

Speed and explosive ability were checked in a 50-meter run. The subjects started the 50-meter run when the investigator said, "Go." They ran to the finish line as soon as they could. The time was measured in minutes and seconds.

Standing broad jump

To measure lower-limb explosive strength ability, a standing broad jump was performed. Each participant was asked to stand at the starting line and jump forward as long as they could. From the starting line to the heel of the nearest foot, the gap was measured in meters. The test was repeated twice, with the higher score being held.

4 × 10 m shuttle run

This test conducted to assess the agility. The participant had to sprint as quickly as they could along the parallel lines that were 10 meters long. Three sponges were previously placed behind the lines, one at the starting line and two at the other end. Participants started without a sponge and had to pick-up or exchanged the sponge every time they crossed the lines. The lines had to be crossed with both feet. The total time of the test in seconds was recorded using a stopwatch.

Statistical analysis

All statistical analyses were carried out using IBM SPSS software (version 20). To perform the analysis, the collected data were first, for the normality of the data Kolmogorov-Smirnov and Shapiro-Wilk test used. Anthropometric characteristics and all physical fitness information were expressed as the mean and standard deviation (SD). In order to establish the relation between BMI and physical fitness multiple correlation was used, 95% Confidence Intervals were computed to evaluate significance of the relationship between BMP and physical fitness.

Results

Table 1: Descriptive statistic

(Normal weight)			
	N	**Mean**	**Standard deviation**
Push up	54	22.96	10.04
500 mt run &walk	54	2.75	0.55
50mt Dash	54	9.05	1.28
Shuttle run	54	11.31	1.25
SBJ	54	2.13	0.49
BMI	54	21.77	1.93
(Under weight)			
Push up	44	22.52	8.03
500 mt run &walk	44	2.62	0.53
50mt dash	44	8.79	1.15
Shuttle run	44	11.33	1.05
SBJ	44	2.13	0.39
BMI	44	16.96	0.90
Push up	44	22.52	8.03

Descriptive statistics indicated that the mean and standard deviation of physical fines test and BMI were (push up=22.96±10.04), (500mt=2.57±0.55minutes), (50mt=9.05± 1.28), (shuttle run=11.31±1.25), (SBJ= 2.13±0.49mt) and (BMI=21.77±1.93 kg/ m^2) in normal weight category participants. And mean and standard deviation of physical fines test and BMI of underweight participants were (push up=22.52±8.03), (500mt=2.62±0.53minutes), (50mt=8.79± 1.15), (shuttle run=11.33±1.05), (SBJ= 2.13±0.39mt) and (BMI=16.96±0.90 kg/ m^2). The Kolmogorov–Smirnov and Shapiro–Wilk test statistics for testing normality of data. Normality exits if these tests are not significant. Thus, if the significance value (*p*-value) of these tests is more than 0.05, the data is considered to be normal; here all the value is more than 0.05 therefore the data are normal.

Table 2: Correlation of BMI with Physical Fitness Components

	Normal weight		Under weight	
	R^2	Correlation (sig.)	R^2	Correlation(sig.)
Push up	.004	.648	.017	.397
500 mt run &walk	.018	.334	.000	.953
50mt dash	.128	.008	.000	.407
Shuttle run	.055	.235	.016	.780
SBJ	.002	.744	.002	.948

Coefficient of determination (R2) value is very low. Which are unable to explain the variation in the dependent variable has been explained by the independent variable. And there is no significant correlation found between the BMI and physical fitness components.

Discussion

The occurrence of underweight, normal, overweight and obesity in the sample of children was respectively, 41%, 50%, 6% and 0.94%. Allowing for the relatively high prevalence of underweight and normal weight, due to low prevalence of overweight and obesity in the sample it was excluded in from the study. The results of the study showed that there is not relationship between BMI and selected physical fitness components among school going male children. Similar results have been found in several studies conducted earlier. A study conducted by Yong-Jun Lu *et al*. (2014) [15] on 4062 women in Chinese college and they reported there was no clear Relationship found between BMI and physical fitness index. According to Welon *et al*. (1988) reported non-linear, parabolic relationship between the BMI and an index of fitness. Another study conducted by Zenic *et al*. in the year of (2013) and they found Non-linear relationships were also observed among 14–16-year-old Croatian boys using a separate exercise test battery. Although BMI is indicated as a component of physical fitness, it is not a measure of fitness. Rather than BMI is a factor that significantly affects the physical fitness of children, adolescents, and adults (Yi-Ching Huang *et al*. 2006).There are some limitations in the study that should be considered. Firstly, the sample size is very small. Secondly, the physical fitness performance cannot be controlled by the researcher. This study provided the evidence on the prevalence and trends of weight status and evaluated the relation between BMI and health-related physical fitness. Future prospective, longitudinal cohort studies to identify the causal relations and potential mechanism in a good manner are required.

Implications for Practice

Several health related implications may follow from the current findings. First, the participant evaluated themselves about their weight status, among underweight, overweight and obese children, which has important implications for the development and implementation of weight management interventions. It should be the responsibility of parents and school's physical education teacher to continue actively monitor Child's Weight status early and provide anticipatory guidance and strategies to minimize risks. According to the weight status they should plan regular meal of the child. Secondly, the performance of physical fitness may encourage them to indulge themselves in various types of physical activities and sports to improve and maintain their motor abilities and that will improve their standard of living. Overall, the findings from this study demonstrate there is no significant correlation between BMI and physical fitness, but BIM is an important indicator of weight status and the child and their family should be aware about BMI that could be helpful to minimize the hypo kinetic disorders.

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