ASSOCIATION BETWEEN BODY MASS INDEX, CARDIO RESPIRATORY FITNESS, AND MUSCULOSKELETAL FITNESS AMONG ADOLESCENTS: A CROSS SECTIONAL STUDY

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ABSTRACT: *One hundred adolscents (aged 20–21 years) were included in this study. Participation was entirely voluntary, and participants were free to withdraw at any time. Participants with any physical disability (e.g., fractures) that hindered their participation in testing procedures were not included. In addition, adolscents whose parents reported cardiovascular and neuromuscular complications will be excluded. Each and every participant was evaluated for BMI, cardiorespiratory (Harvard step test) and musculoskeletal fitness (sit and reach test). Informed consent was taken priorly, data was collected & analysis was done. Results shows that BMI is significantly correlated with measure of cardiorespiratory fitness (p=0.000) and measure of musculoskeletal fitness (p= 0.14).*

Key Words: *BMI, Cardiorespiratory Fitness, Musculoskeletal Fitness, Adolescents*

I. Introduction

Childhood obesity is a global health problem[1]. These statistics are worrying as they pose serious threats to the country's health care system[1]. Obesity is associated with health complications including hypertension, type 2 diabetes and orthopaedic problems[1]. Further, obesity is known to impair physical fitness and academic performance[2]. Several factors have been postulated to explain how obesity promotes decreased physical fitness. First, obese children have low levels of physical activity compared to non-obese peers[2]. Consequently, they have less opportunity to develop motor skills which causes further participation restrictions and muscle deconditioning[2]. Compared to non-obese peers, obese children tend to avoid weight-bearing tasks (e.g., walking, running) due to the high energy cost associated with such activities[2]. This leads to poor musculoskeletal and cardio-respiratory fitness[3]. Secondly, it has been suggested that obesity-related fitness impairments are caused by neuromuscular dysfunction resulting from metabolic imbalance[4]. The association between obesity and academic performance is purported to be influenced by factors such as poor peer-relationships, low-self-esteem, and reduced cognitive abilities[2]. Though obesity is known to negatively impact physical performance, the nature of the relationship between body mass index (BMI) and aspects of physical fitness is less clear, particularly among adolescents. Several studies have documented an inverse relationship between BMI and cardiorespiratory fitness[3,5]. Higher BMI has a negative influence on musculoskeletal fitness[6]. Improved cardiorespiratory and musculoskeletal fitness (MSF) are each associated with better health outcomes[6]. MSF encompasses those components of physical fitness responsible for successful execution of motor tasks such as walking and running, and includes measures such as muscular strength and endurance, flexibility and joint mobility[6]. Lower levels of MSF are associated with higher BMI in school-aged children[6].

II. RESEARCH METHODOLOGY

2.1Population and Sample

One fourty seven adolscents (aged 20–21 years) were participated in this study.

2.2 Data and Sources of Data

Data was collected from School of Physiotherapy, P.P. Savani University, India

2.3 Theoretical framework

This cross-sectional study analysed baseline data of a larger school-based intervention study designed to improve motor competence and physical fitness among adolescents.

One fourty seven adolscents (aged 20-21 years) were participated in this study. Participants were recruited using convenience sampling techniques. Participation was entirely voluntary, and participants were free to withdraw at any time. Participants with any physical disability (e.g., fractures) that hindered their

participation in testing procedures were not included. In addition, adolscents whose parents reported cardiovascular and neuromuscular complications was excluded.

Outcome measures

1. Antropometric measurements[7]

Height and weight were measured, and BMI was calculated using the formula [BMI = weight (kg)/height $(m)^2$]. BMI scores was categorised into normal-weight, overweight and obese groups using BMI definitions proposed by the International Obesity Task Forc.

2. Harvad step test[8]

This test was used to measure cardiorespiratoryfitness. Participants were asked to step up and step down at the rate of 30 steps per mintute for 5 minute or untill the exhution. Participant can sit immidiately after completetion of test and radial pulse were measured for frist, second and third minute. Fitness index was calculated.

3. Sit and reach test[9]

The sit-and-reach (SR) test was use to assess flexibility. Participants were tested individually under supervision. Each participant was required to sit with their feet approximately hip-wide apart against a wooden testing box, with their knees in extension. Next, they were asked to place their right hand over the left, and slowly reach forward as far as possible by sliding their hands along the measuring rule. The farthest distance reached was recorded to represent the participant's flexibility. Three trials were conducted, and the best score will be reported.

2.4Statistical tools and econometric models

Statistical analysis was performed using SPSS 23.0 version. Descriptive analysis was presented as mean; standard deviation (SD), which describes the demographic data of the participants. Kendall's Tau_b Test has been applied to find correlation between BMI, sit and reach test(measure of musculoskeletal fitness), harvard step test (measure of cardiorespiratory fitness) at $p \leq 0.05$.

III. RESULTS AND DISCUSSION

3.1 Results of Descriptive Statics of Study Variables

Table 4.1: Descriptive Statics

Variables	Minimum	Maximum	Mean	Standard Deviation (SD)	Normality test significance
BMI (kg/m2)	16.00	36.00	21.3469	3.80456	0.000
Fitness Index (harvard step test)	50.00	118.00	74.4558	16.24775	0.000
Sit and reach test (cm)	27.00	48.00	36.4626	5.43236	0.000

Table 3.1 displayed mean, standard deviation, maximum minimum and Kolmogorov-Smirnov. The descriptive statistics indicated that the mean values of variables (BMI, fitness index, sit and reach test) were 21.34, 74.45, and 36.46 respectively.

The standard deviations for each variable indicated that data were widely spread around their respective means.

Column 6 in table 3.1 shows Kolmogorov-Smirnov test which is used to checkthe normality of data. The hypotheses of the normal distribution are given;

H_0 : The data is normally distributed.

H_1 :The data is not normally distributed.

Table 3.1 shows that at 5 % level of confidence, the null hypothesis of normality is rejected. Values of BMI, sit and reach test and fitness index are not normally distributed.

Table 3.2 correlation between variables

Variables	Correlation coeffcieant (τ_b)	P value
BMI (kg/m2) and Fitness Index (harvard step test)	0.304	0.000*
BMI (kg/m2) and Sit and reach test	0.146	0.000*

*Significant correlation between measures

Kendall's Tau_b Test has been applied to find correlation between BMI, sit and reach test (measure of musculoskeletal fitness), Harvard step test (measure of cardiorespiratory fitness) at $p \leq 0.05$.

As shown in table 3.2, We have found significant correlation between BMI and measure of musculoskeletal fitness (sit and reach test) (p=0.000) ($\tau_{b=}$ 0.146). We have also found significant correlation between BMI and measure of cardiorepiratory measure (harvad step test) (p=0.000) ($\tau_{b=}$ 0.304).

The main aim and objective of this study is to find association between BMI and measure of musculoskeletal fitness and between BMI and measure of cardiorespiratory fitness. We have found significant correlation between them. BMI, Cardiorespiratory and musculoskeletal fitness are important health indicators that support optimal physical functioning. Understanding the relationship between body mass index and these health markers may contribute to the development of evidence-based interventions to address obesity-related complications.

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