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Research Article

CORRELATION OF FUNCTIONAL CAPACITY WITH BODY MASS INDEX USING SIX MINUTE WALK TEST IN URBAN SCHOOL CHILDREN

Sriram Suresh, Leena Zore and Ajay Kumar

DPO's NETT College of Physiotherapy, Thane, India

A R T I C L E I N F O

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A B S T R A C T

Aim: To correlate between functional capacity and Body Mass Index using Six-Minute Walk Test in urban school going children.

Background: Obesity, overweight and underweight is undesirable health status and consists of extreme malnutrition, which has proven to be a root cause of majority of non-communicable diseases and also affects the functional capacity which is measured using six minute walk test.

Methodology: This was Cross sectional-correlational study.120 male school children in age group of 7-12 years were divided into four groups based on WHO's pediatric BMI percentile guidelines – Group A (underweight), Group B (Normal Weight) , Group C (overweight) and Group D (Obese) . Height and weight was recorded for BMI. Pre-test vitals were taken and subjects underwent 6 minute walk test (6MWT). Post-test vitals were taken.

Results: The data was analyzed using Pearson's correlation test which showed Group A, r =0.220 (weak positive correlation); Group B, r =0.678 (Strong positive correlation); Group C, r=0.131 (Very weak positive correlation); and Group D, r=0.275(Weak positive correlation).

Conclusions: Normal weight BMI has a strong positive correlation whereas Underweight, Obese has a weak positive correlation and Overweight has very weak positive correlation.

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INTRODUCTION

In this 21st Century, Most of the developing nations are under a threat of Underweight & Overweight population. This risk has attained a high epidemic level, which has proven to be a root cause of majority of non-communicable diseases such as Cardio-Vascular Ailments, as well as lifestyle disorders such as Diabetes, at a very tender age. Malnutrition as well as Obesity is also associated with metabolic disorders. [1]

In a study conducted by Imtiaz Ahmed et.al prevalence of overweight was 7.02% and obesity was 6.12%. Prevalence of underweight was 11.96% and normal nutritional status was 74.9% in school children. [2]

Obesity, overweight and underweight is undesirable health status and consists of extreme malnutrition. Underweight is caused due to Food insecurity, Decreased parental involvement, less fruit and vegetable consumption, and Imbalance in caloric intake and expenditure. Overweight is caused due to Fast food, Soft drink consumption, High socio-economic status, and Parent education. [3, 4]

Underweight due to under-nourishment is the most common problem in developing countries and it is a burning issue in our country. Though underweight is commonly seen in rural areas, it is not uncommon in urban areas. [5] Functional capacity in underweight individuals is affected due to smaller muscle mass which contributes to lower muscle strength and reduced physical activity. [6]

Overweight is a problem of increasing prevalence in different age groups that may lead to many health problems in later life. In overweight individuals, it can increase body burden limiting movement and increasing stress on joint and muscles accentuating the risk of physical activity hence affecting the functional capacity. It is becoming a serious problem which might be due to poor eating habits and sedentary lifestyle. These factors result in a decrease in functional capacity.[7]

Functional capacity refers to the capacity to perform physical activity typically performed during a normal day such as running, walking, sitting and standing. The measurement of maximal oxygen uptake (VO_2 max) can be measured directly. But its indirect measurement during the maximal exercise test continues to be a gold standard for determining the cardiovascular fitness. Since most daily activities are performed at a submaximal level of exertion. [1] Using submaximal functional tests would be a more realistic simulation of one's physical capability. In 1986, Lipkin first introduced the six-minute walk test (6MWT) as a simple, practical method to evaluate functional capacity. The six-minute walk test (6MWT) is a test which reflects daily

activities and can be easily used in clinical practice. [8] It has a reliability of 0.94 and is valid. [9]

According to the American Thoracic Society Guidelines for Six Minute walk test - age, gender, height, and weight can affect 6-minute walk distance independently. Body Mass Index (BMI) is a statistical measurement which compares weight and height. So, while measuring the distance these things should be considered. [10]

MATERIALS AND METHODS

1. Weight machine
2. Measuring tape
3. Sphygmomanometer
4. Bright coloured cones
5. Stopwatch
6. Chair
7. Pulse oximeter

Study Design

- Type of study: Cross sectional-Correlational Study
- Duration of study – 1 year
- Area – Primary and Secondary school

Sample Design

- Sample size – 120
- Sample population – Urban school children
- Sampling – convenient

Selection Criteria

Inclusion Criteria

1. Male School Going Students
2. Age group 7-12 years
3. Willing to participate in the study

Exclusion Criteria

1. Female students
2. Presence of any musculoskeletal, neuromuscular and cardiovascular disorders.

Procedure

A proper consent from the school authorities, parents and child was taken and Detailed instructions were given to the parents and a demonstration of the test was done. Six-minute walk test was performed indoors along with a long flat, straight enclosed corridor with a hard surface with a 30m Walking Course.

The length of the corridor was marked at every 3 meters. The turnaround points are marked with a cone. Subjects were asked to wear comfortable clothing and appropriate footwear. A light meal was accepted at least 2 Hours before the test.

Height and Weight of each and every subject was recorded using a Measuring Tape and Weighing Machine. The BMI was calculated for each and every subject using the Recorded Height (in m) and Weight (in Kg).Pre-Vitals such as Pulse Rate, Blood Pressure, Respiratory Rate, Oxygen Saturation, and Rate of Perceived Exertion at Rest were recorded. Four groups were made – Underweight (Group A), Normal weight (Group B) Overweight (Group C) and Obese (Group D) according to WHO's Paediatric BMI Guidelines.The Walking Duration was 6 Minutes, which may/may not be exerting for the subjects. They were instructed to report any difficulty during the procedure, and they are permitted to Slow down Stop and Rest as necessary. The number of laps was recorded every time the subject reaches the starting line. After the test concluded, Post-Exercise Vitals were recorded as done before the test.

The data recorded was statistically analyzed using Pearson's correlation test.

RESULTS

6 MWD had a strong positive correlation with Normal BMI, r=0.678, P <0.05; 6MWD had a weak positive correlation with Underweight BMI, r =0.220, p>0.05 and obese BMI, r=0.275, p>0.05 and very weak positive correlation with Overweight BMI, r=0.131, p>0.05

Table 1 Calculation of Body mass index

Variables	Group A Underweight	Group B Normal weight	Group C Overweight	Group D Obese
Mean BMI (kg/m^2)	12.685±0.932	17.367±2.026	20.259±1.803	23.271±2.505

Table 2 6 Minute Walk Distance

Variables	Group A Underweight	Group B Normal weight	Group C Overweight	Group D Obese
Mean Distance (m)	303.433±20.488	353.066±36.056	309.666±54.139	292.9±21.252

Table 3 Correlation of BMI with six-minute walk distance

Groups	Correlation coefficient (r value)	Interpretation	Significance level (P value)	Interpretation
A: Underweight	0.220	Positive	0.242	Not Significant
B: Normal weight	0.678	Positive	0.0000375	Significant
C: Overweight	0.131	Positive	0.486	Not significant
D:Obese	0.275	Positive	0.141	Not significant

DISCUSSION

The aim of the study was to correlate functional capacity with BMI in urban school children of age group 7-12, using American thoracic society approved six-minute walk test as an outcome measure. This age group was selected as a study done by Vandana Singh et.al [11] established the Mean Values for 6 Minute Walk Distance for this age group. Also, Urban School Children of this group are frequent targets of deficiencies, increased fast food consumption and decreased nutrition. [3, 4] The study was conducted by dividing the selected population into four groups based on inclusion and exclusion criteria, namely Underweight (Group A) Normal (Group B), Over-Weight (Group C) and Obese (Group D). These groups of 30 subjects each (n=120) were divided according to their BMI based on the WHO's Percentile Guidelines for Pediatrics [12].

For each group, Pre-Performance resting vitals were taken, which included Resting Heart Rate, Respiratory Rate, Blood Pressure, Oxygen Saturation and Resting RPE using BORG's Scale. Children were informed about the procedure and were demonstrated the same. Consent was taken from their parents. 6 Minute Walk Test was performed according to the ATS Guidelines [10]. Post-Performance vitals were recorded similarly. The data recorded was then statistically analyzed using Pearson's Correlation.

Table 1 describes the calculation of BMI for the selected population groups. The mean BMI for subjects of Group A (Under-Weight) was 12.685±0.932 kg/m^2; of Group B

(Normal) was 17.367±2.026 kg/$m^{2;}$ of Group C (Over-Weight) was 20.259±1.803 kg/m^2 and of Group D (Obese) was 23.271±2.505 kg/m^2.

Table 2 describes the 6 Minute Walk Distance (6MWD) for the selected population groups. The mean 6MWD by subjects of Group A was 303.433±20.488 meters, of Group B was 353.066±36.056meters of Group C was 309.666±54.139meters and of Group D was 292.9±21.252meters.

According to a study conducted by Jin-Tae Han et. al. in 2011, where a comparison was made between Vital Capacity and Underweight Women, it was found that the State of being underweight can be directly related to an increased rate of morbidity and mortality, as compared to the counterparts with BMI in Normal Range. According to Jin-Tae Han, the BMI of lesser value can be directly linked to a weakened immune system. Also, physical consequences of being underweight can be Lower Muscle Mass, Increased susceptibility to infections and increased chances of reduction in bone mineral density. [13] In Our study, for Group A (Underweight) Statistical Analysis performed using the Pearson's Correlation test shows that 6MWD had a weak positive correlation with BMI, r =0.220, p>0.05. The mean 6 Minute Walk Distance was 303.433±20.488. A Lesser 6 Minute Walk Distance as compared to the Normal Population could be attributed to the fact that Underweight Population may possess a lower muscle mass compared to the peers with normal BMI [13]. Another explanation can be that Underweight Subjects might have deficient energy sources, which might have reflected as a reduced 6MWD as compared to the Mean 6MWD for that age group.

In a study done by Upasna Desai *et al* in 2017, where 6 Minute Walk Test results were compared in Urban v/s Rural Children of the age group of 6-11 Years [14], It was observed that the least 6 Minute Walk Distance was covered by Children of Urban Dwelling Slums (399.27 ± 90.1m), whereas highest distance was covered by children of Rural Areas (632.32 ± 96.17 m). Children from affluent urban areas covered a distance greater than those from urban dwelling slums, but lesser as compared to those from Rural Areas (492.92 ± 100.60 m). The Study also concluded a positive correlation between Physical Activity and the 6 Minute Walk Distance and concluded that Socio-Economic Status and Level of Physical Activity are important factors affecting the 6 Minute Walk Distance in children.

In our study, for Group B, 6 MWD had a strong positive correlation with BMI, r=0.678, P <0.05. Based on the statistical analysis, it can be justified that for the Population group B where samples lie in the 'Normal BMI' category, Functional Capacity not only positively correlates with BMI but also has significance. This can be directly linked to the level of Fitness observed in this population group. Subjects falling in the 'Normal' Category had an ideal Height: Weight Ratio, as well as higher energy sources required to perform any given activity.

In a study conducted by Zoltan Pataky et. al. in 2014, where Effects of Obesity on Functional Capacity were observed [15], it was found that the activity of walking is of a complex nature, involving various systems, which includes a number of sensory neurons firing for maintaining balance throughout the gait cycle. According to Zoltan Pataky, A Low Cadence as compared to the Normal Peers allows Obese People to have a better command over their gait, making it more or less smooth and normal. Also, the presence of bulky fat distributed throughout the body, or over common areas such as abdomen and pelvis might have an effect on reduced Joint ROM available at the Hip Joint, which contributes to a reduced speed of walking.

In our study, Group C had a very weak positive correlation with BMI, r=0.131, p>0.05 and Group D 6MWD had a weak positive correlation with BMI, r =0.275, p>0.05. As compared to the other subject groups in our study, it is evident that the Mean 6MWD covered by Subjects of the Obese Group (D) is the least. This can be directly linked to the fact that that for a more controlled gait, Obese Subjects focus more on stability rather than cadence. Reduced speeds allow obese subjects to have increased balance and stability while walking. Also, the amount of fat mass over the abdomen and hip region could play a role in reduced gait speed, contributing to the same [15] Also, as 6MWD correlates with high levels of perceived exertion[15], Reduced 6MWD in Group D might be linked to higher levels of fatigue correlating Functional Capacity with BMI. [15]

CONCLUSION

We can conclude that Normal weight BMI has a strong positive correlation whereas Underweight, Obese has a weak positive correlation and Overweight has very weak positive correlation.

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