

# To Study the Correlation of Body Mass Index with Six Minute Walk Test and Six Minute Walk Work in Young Individuals

Saloni M Rana<sup>1</sup>, Vishva N Vyas<sup>2</sup>, Bosky M Mehta<sup>3</sup>

<sup>1,2,3</sup>Apollo Institute of Physiotherapy, Gujarat University, Ahmedabad, India.

Corresponding Author: Saloni M Rana

DOI: <https://doi.org/10.52403/ijshr.20250312>

## ABSTRACT

**INTRODUCTION:** The Six-Minute Walk Test (6MWT) is a widely utilized measure of functional exercise capacity, assessing the distance an individual can walk in six minutes. While Body Mass Index (BMI) is a standard metric for evaluating weight relative to height, its relationship with 6MWT performance in young, healthy adults remains underexplored. This study aims to investigate the correlation of BMI with 6MWT and 6MWW in individuals aged 18 to 35 years.

**METHOD:** A cross-sectional study was conducted involving 45 young, healthy participants (23 males, 22 females) aged 18–35 years. Each participant underwent the 6MWT following the American Thoracic Society guidelines. The distance covered was recorded, and 6MWW was calculated by multiplying the distance by the participant's body weight. Anthropometric data, including height, weight, and BMI, were collected prior to the test. Statistical analysis was performed using Pearson's correlation coefficient to assess the relationship between BMI and 6MWT distance, as well as BMI and 6MWW.

**RESULT:** The mean age of participants was  $22.7 \pm 2.31$  years, with a mean BMI of  $23.30 \pm 6.11$  kg/m<sup>2</sup>. The Spearman's correlation analysis revealed a weak, non-significant correlation between BMI and

6MWT distance ( $r = 0.28$ ,  $p = 0.30$ ) and between BMI and 6MWW ( $r = 0.14$ ,  $p = 0.34$ ).

**CONCLUSION:** This study found no significant correlation between BMI and 6MWT performance or 6MWW in young, healthy adults aged 18 to 35 years. These findings suggest that BMI may not be a reliable predictor of functional exercise capacity in this demographic. Further research is warranted to explore other factors influencing 6MWT outcomes and to develop more accurate predictive models for assessing functional capacity in young adults.

**Keywords:** Body mass index, Six-minute Walk test, Six-minute Walk work

## INTRODUCTION

High body mass index (BMI) is the sixth most important risk factor contributing to the global disease burden according to the 2010 global burden of disease study BMI or the Quetelet index is used to assess weight relative to height and is calculated by dividing body weight in kilograms by height in meters squared (kg/m<sup>2</sup>)<sup>[1]</sup>

## CLASSIFICATION OF BMI <sup>[1]</sup>

CLASS:	BMI (kg/m <sup>2</sup> ):
UNDERWEIGHT	<18.5kg
NORMAL	18.5-24.9
OVERWEIGHT	25.0-29.9
OBESE, CLASS	
I	30.0-34.9
II	35.0-39.9
III	≥40.0

The Expert Panel on the Identification, Evaluation, and Treatment of Overweight and Obesity in Adults defines a BMI of 30 kg/m<sup>2</sup> has excess body fat. An increased risk of obesity-related diseases, health conditions, and mortality are associated with a BMI ≥30.0 kg/m<sup>2</sup>. <sup>[1]</sup> Obesity is defined by a body mass greater than 30 kg/m<sup>2</sup> <sup>[1]</sup>

Underweight, defined as a body mass index (BMI) of less than 18.5 kg/m<sup>2</sup>.<sup>[1]</sup> It often indicates insufficient nutritional intake, chronic illness, or underlying metabolic disorders.<sup>[1]</sup> Individuals who are underweight are at increased risk of various health complications, including impaired immune function, osteoporosis, infertility, and delayed wound healing.<sup>[2]</sup> In children and adolescents, being underweight can hinder proper growth and development, while in adults it is associated with increased morbidity and mortality.<sup>[2]</sup> Various factors contribute to underweight status, including socioeconomic conditions, eating disorders, and medical treatments such as chemotherapy.<sup>[2]</sup> Identifying and addressing the underlying causes of underweight is essential for designing effective nutritional and clinical interventions, particularly for vulnerable populations.<sup>[2]</sup> Being underweight means having a body weight that is too low to be considered healthy for children or adults.<sup>[2]</sup> It is sometimes referred to as wasting, emaciation, thinness, or stunting, and is often the result of insufficient nutrition.<sup>[3]</sup> In wealthier, developed nations, underweight is not a major public concern because it is relatively rare.<sup>[3]</sup> However, it can still occur in certain groups, such as elderly individuals with illnesses, people with disabilities or

chronic conditions, the homeless, refugees, and those affected by war or natural disasters.<sup>[3]</sup>

The six-minute walk test (6MWT) is a straightforward and practical field exercise assessment that requires no specialized equipment or advanced training, making it commonly used in both clinical settings and research to evaluate physical capacity in individuals with chronic illnesses.<sup>[4]</sup> The primary outcome, the distance covered in six minutes 6MWD(m) has been linked to prognosis in several chronic conditions (e.g., COPD, ILD, HF, PAH) and is responsive to various pharmacological and non-pharmacological treatments.<sup>[4]</sup> The six-minute walk test (6MWT), as a submaximal and field exercise evaluation, acts as an easy, safe, and extensively recognized gauge of functional capacity, offering significant insights into a person's cardiorespiratory health.<sup>[4]</sup> Additionally, the 6MWT has been validated in diverse populations, including those without symptoms.<sup>[4]</sup> Various factors such as age, body measurements, medical conditions, and physiological traits can impact how individuals perform on the test, whether they are healthy older adults or patients with heart and lung diseases.<sup>[5]</sup> Because the 6-minute walk test (6MWT) is self-paced, outcomes can be affected by outside influences like how much energy the person uses, the encouragement provided by the examiner, and the person's own motivation.<sup>[5]</sup> As a result, the distance walked in six minutes (6MWD) can vary greatly, even among healthy individuals. Therefore, it is essential to carefully standardize both the test instructions and the level of verbal encouragement given.<sup>[5]</sup>

The six-minute walk work (6MWW, kg.m; calculated as the product of 6MWD in meters and body mass in kilograms) can be derived from the 6MWT.<sup>[4]</sup> This outcome, derived from 6MWT, could have significant clinical relevance for patient groups where overweight and obesity might impact exercise limitations and display prognostic value in individuals with COPD.<sup>[4]</sup> By

incorporating body weight into the calculation of the 6MWW, a more thorough evaluation of functional capacity is achieved, as it acknowledges both the mechanical load of excess weight and its metabolic consequences, thereby offering richer physiological insights compared to the 6MWD alone.<sup>[4]</sup> The distance-weight (DxW) product better reflects the physical effort of walking, as well as peak oxygen consumption and anaerobic threshold, compared to walking distance alone.<sup>[5]</sup> However, its role in managing chronic respiratory disease in adults remains unclear. In individuals with lung disease, the 6-minute walk work rate (6MWW) has shown greater sensitivity and specificity in detecting exercise intolerance compared to the 6-minute walk distance (6MWD).<sup>[5]</sup> Recently, Hill et al. identified the 6-minute walk work (6MWW) as a suitable measure for estimating maximum exercise capacity in individuals with chronic obstructive pulmonary disease during an incremental cycling test. Therefore, 6MWW should be considered a valuable tool for broadly assessing walking ability.<sup>[5]</sup>

Obesity rates are highest in certain ethnic and gender groups for example non-Hispanic black women have age-adjust obesity. For all ages and ethnicities obesity are linked to an increased risk of developments of numerous chronic diseases including CVD, DM, some form of cancer and musculoskeletal problem.<sup>[1]</sup> Obesity poses a significant threat to public health due to its strong association with many of the leading causes of morbidity and mortality.<sup>[6]</sup> Beyond its health implications, obesity also imposes substantial societal costs, including increased healthcare expenditures, higher rates of sick leave, and reduced productivity.<sup>[6]</sup> Additionally, individuals living with obesity often face widespread stigmatization and discrimination. Obesity is a growing global public health concern that poses serious consequences for individual well-being and healthcare systems.<sup>[4]</sup> Its prevalence is rising rapidly in both developed and developing

nations.<sup>[7]</sup> Key contributing factors to obesity include geographical conditions, lifestyle habits, and dietary patterns.<sup>[7]</sup> In many low- and middle-income regions—particularly in the Asia-Pacific, South and Southeast Asia, and Central and East Africa—body mass index (BMI) levels are increasing at an accelerated rate, leading to a significant rise in the burden of overweight and obesity in these areas.<sup>[7]</sup>

## NEED OF THE STUDY

There has been a noticeable increase in sedentary behavior and unhealthy weight gain among young adults aged 18 to 35 in recent years. The Body Mass Index (BMI) is a commonly used tool to evaluate body weight relative to height, while the Six-Minute Walk Test (6MWT) and Six-Minute Walk Work (6MWW) are effective methods for assessing physical endurance and functional exercise capacity across age groups. Exploring how BMI relates to 6MWT and 6MWW in this age range is important, as potential limitations due to excess weight may not be apparent in individuals who otherwise appear healthy. Moreover, there is currently no research specifically addressing this correlation in young adults. Gaining insight into this relationship could help identify individuals at risk early on, promote healthier lifestyle decisions, and support the creation of preventative measures to enhance long-term cardiovascular and physical well-being. This highlights the importance and necessity of the present study.

## AIMS AND OBJECTIVES

### AIMS:

The aim of the study is to find the correlation of BMI with 6MWT and 6MWW in young healthy individuals.

### OBJECTIVES:

- To find the correlation between Body Mass Index and 6Minute Walk Test (6MWT) in young healthy individuals.

- To find the correlation between Body Mass Index and 6Minute Walk Work (6MWW) in young healthy individuals.

## REVIEW OF LITERATURE

### 1. Zou, Xiaoshu Chen et.al. (2025) did a study on “Breaking barriers: novel reference equations for the six-minute walk distance and work in obese Chinese adults”. *Journal of Health, Population and Nutrition*

The introduction effectively highlights obesity as a rising global and national health issue, particularly in China. It explains the limitations of current six-minute walk test (6MWT) reference equations, which are often based on non-obese or non-Chinese populations. The text makes a strong case for the need to develop population-specific equations that account for body mass and better reflect the functional capacity of obese individuals. The inclusion of the six-minute walk work (6MWW) as a more comprehensive metric is well-justified. Overall, the introduction is clear, well-supported, and sets up the rationale for the study effectively. Minor improvements in clarity and flow could enhance its impact further. The newly proposed reference equations for the 6MWD and 6MWW enhance the assessment of functional capacity in obese Chinese adults by offering more accurate and physiologically relevant predictions. These equations can help clinicians better understand and manage the functional limitations of obese patients, ultimately contributing to improved clinical outcomes and quality of life. Future research should focus on refining these equations further and evaluating their applicability across broader and more diverse populations.

### 2. J.M. Delbressine, D. Jensenc et.al. (2023) did a study on “Reference values for six-minute walk distance and six-minute walk work in Caucasian adults”.

The study is on the six-minute walk test (6MWT) is a simple, widely used tool to assess physical capacity in patients with chronic diseases. However, current reference values for the six-minute walk distance (6MWD), especially on a 20 m course, are limited by small sample sizes and inconsistent methodologies. Additionally, no reference values exist for six-minute walk work (6MWORK). This study used data from the *CanCOLD* study, a large population-based cohort from Canada, to develop reference equations for the six-minute walk test (6MWT). A subset of 1019 participants who had completed detailed respiratory testing and exercise assessments was selected. Only Caucasian participants with normal lung and exercise capacity were included to ensure data quality. Key exclusion criteria included significant smoking history (>30 pack-years), abnormal pulmonary function, or significant respiratory symptoms.

Participants performed two standardized 6MWTs on a 20 m course, with the best distance (6MWD) used for analysis. 6MWORK was calculated as the product of 6MWD and body weight. Cardiopulmonary exercise test (CPET) data from an earlier visit were used to confirm normal oxygen uptake. This study developed a conclusion of new sex-specific reference values and prediction equations for the 6-minute walk distance (6MWD) and 6-minute walk work (6MWORK) on a 20-meter course in Caucasian adults aged 40 years and older with normal pulmonary function and  $VO_{2peak}$ . These equations offer a useful tool for evaluating functional capacity in clinical settings. However, external validation in other populations is necessary to confirm their generalizability and clinical utility.

### 3. Erik HEMMINGSSON, Örjan Ekblömet.al. (2020) did a study on “Prevalence and time trends of overweight, obesity and severe obesity

**in 447,925 Swedish adults, 1995–2017”. Scandinavian Journal of Public Health.**

The study aimed to assess the current prevalence of obesity (BMI  $\geq 30$  kg/m<sup>2</sup>) and severe obesity (BMI  $\geq 35$  kg/m<sup>2</sup>) in Sweden using objective data from 2016-2017. It also analysed trends in obesity from 1995 to 2017, considering factors like gender, age, education, and geographic region. The research highlights that obesity is more prevalent in lower socioeconomic groups, a trend that has been increasing over time. Previous studies had limitations due to biased self-reported data and insufficient representation across key variables. The study used data from the Health Profile Assessment (HPA) database, which includes data on over 520,000 participants from 1995 to 2017. The participants were primarily employees connected to occupational or health services, and participation was voluntary. The HPA method included a questionnaire, an interview, and anthropometric testing. Data were analysed for trends in obesity prevalence over time, segmented into two-year periods. For each period, a cross-sectional analysis was conducted, with unique individuals measured in each period. The data were standardized to the 2015 Swedish population (aged 18-74) to compare trends across variables like age, gender, education, and geographic region. Between 1995 and 2017, obesity (BMI  $\geq 30$  kg/m<sup>2</sup>) in Sweden steadily increased from 9.1% to 17.0%, and severe obesity (BMI  $\geq 35$  kg/m<sup>2</sup>) rose from 1.6% to 4.2%. This trend was observed across all age groups, genders, and geographic locations. However, the increase was more pronounced in individuals with lower education levels and those living in rural areas. The findings highlight the urgent need for effective obesity prevention efforts.

**4. Matthew Little, Sally Humphries et.al (2016) did a study on “Factors associated with BMI, Underweight, overweight, and obesity among adults in a population of rural south India: A cross-sectional study”**

This study focuses on the rising obesity prevalence in rural India, a region often overlooked in obesity research. Obesity and its related health risks, such as metabolic syndrome and cardiovascular diseases, are increasingly becoming major public health concerns. Despite urbanization's role in increasing obesity, rural areas in India, where 70% of the population lives, are also experiencing rising obesity rates. Additionally, India's population, especially Asian Indians, is more prone to obesity-related health issues at lower BMI levels compared to Western populations. The study aimed to assess the prevalence of underweight, overweight, and obesity in rural northern Tamil Nadu and identify the factors influencing BMI in this region. It used statistical models to examine lifestyle and dietary risk factors. It concluded as the increasing prevalence of overweight and obesity in rural India poses significant public health challenges, stressing the healthcare system's capacity to handle related health outcomes. This study highlights the urgent need for population-level strategies to prevent obesity. Effective prevention requires accurate data to target high-impact risk factors. The identified risk factors can be categorized into individual-level factors (such as physical activity, television usage, and dietary habits) and societal-level factors (including caste and socioeconomic status). Addressing individual-level factors through behaviour change programs and societal-level factors through policy, infrastructure, and development programs is essential. As India continues to modernize, it is crucial to implement strong education programs to raise awareness about

obesity and associated no communicable diseases

5. **Mohammad Enamul Hoque, Munim Mannan et.al. (2016) has done study on “Economic burden of underweight and overweight among adults in the Asia-Pacific region: a systematic review” Tropical Medicine and International Health.**

This study assesses Global trends of decline in underweight prevalence and a rise in overweight, with high BMI now a major contributor to the global disease burden. While developed countries have seen a plateau in overweight rates, low- and middle-income countries (LMICs), especially in the Asia-Pacific region, are facing a dual burden of underweight and overweight due to rapid urbanization and economic transitions. This double burden strains healthcare systems and contributes to significant health risks such as cardiovascular disease, diabetes, and cancer. Despite well-documented economic impacts of overweight in developed nations, little is known about the costs associated with both underweight and overweight in LMICs. This gap underscores the need for a systematic review assessing the economic burden of these conditions in the Asia-Pacific region. A systematic review was conducted per PRISMA guidelines, searching PubMed, CINAHL, EMBASE. Studies were included based on PICOS criteria, focusing on cost analyses with defined BMI or arm circumference measures. Only English-language, human studies with sample sizes over 1000 were considered. After screening 7288 records, 17 studies were included. They results were the dual burden of underweight and rising overweight in Asia-Pacific countries pose serious health and economic challenges. Standardized research and targeted policy interventions are urgently needed to address and mitigate their growing impact.

6. **Stella G. Uzogara (2016) did a study on “Underweight, the Less Discussed Type of Unhealthy Weight and Its Implications: A Review”. American Journal of Food Science and Nutrition Research**

This study describes about Underweight is a form of malnutrition characterized by body weight below healthy standards and can affect all age groups. It is commonly assessed using BMI and is often described with various informal terms. Alongside stunting, wasting, and overweight, underweight significantly impacts child growth and serves as a key indicator of a population’s nutritional health. It concludes as Underweight remains an overlooked health issue with serious consequences, especially in vulnerable populations. Addressing it requires a multifaceted approach involving nutrition, healthcare, and public health education, supported by coordinated efforts from professionals and policymakers to promote healthy weight and overall well-being.

7. **A.M. Iwama, G.N. Andrade et.al. (2009) did a study on “The six-minute walk test and body weight-walk distance product in healthy Brazilian Individuals”. Brazilian Journal of Medical and Biological Research**

This study depicts about the 6-minute walk test (6MWT) is a practical and widely used tool to assess functional exercise capacity, particularly in relation to daily activities. Test performance can vary significantly due to demographic, physiological, and motivational factors. As a self-paced test, results are influenced by external variables like encouragement and standardization of procedures. While international reference values exist, they may not apply universally. Existing equations may not accurately reflect Brazilian populations. Additionally, six-minute walk work (6MWw)—the product of 6MWD and body weight—has shown greater sensitivity in detecting exercise

intolerance, especially in patients with lung disease. Given the lack of reference equations for healthy Brazilian individuals, this study aimed to establish predictive equations for 6MWD and 6MWW in a broad sample of healthy Brazilians aged 13–84 years and to assess the reliability of these predictions. The study included 134 healthy participants (ages 13+) from the Federal University of São Paulo, Santa Casa Hospital, and the local community in Santos, Brazil. Participants were categorized by physical activity and BMI. Those with lung disease, cardiovascular issues, or other health conditions were excluded. An additional 85 participants from Botucatu Medical School were included for validation. Pulmonary function and cardiovascular risk were assessed. This study developed a reference equation for predicting 6MWD in healthy Brazilian Individuals, highlighting the significant impact of age, height, and gender. The equation outperforms those from other populations, which tend to overestimate 6MWD for Brazilians. Our findings emphasize the need for population-specific reference values, which can

improve the assessment of exercise capacity in Brazilian patients with chronic diseases.

## **MATERIALS & METHODS**

### **METHODOLOGY:**

**STUDY SETTING:** College

**STUDY POPULATION:** College going students

**STUDY DURATION:** 6 months

**STUDY DESIGN:** Cross-sectional Correlation study

**SAMPLING TECHNIQUE:** Convenient sampling

**SAMPLE SIZE:** 45 individuals

### **MATERIAL USED:**

1. 6-minute walk test data collection sheet
2. Pulse oximeter (Figure no- 1)
3. Sphygmomanometer (Figure no-2)
4. Borg's scale
5. Colour tape (Figure no-3)
6. Chair and Table
7. Cone (Figure no-4)
8. Stopwatch
9. Lap counter
10. Performa
11. Consent Form
12. Pen, Pencil



**Figure 1: PULSE OXIMETER**



**Figure 2: SPHYGMOMANOMETER**



Figure 3: COLOUR TAPE



Figure 4: CONES

### Selection criteria:

#### • Inclusion Criteria:

1. Age 18 to 35 years was included in the study.
2. Both male and female were included in the study
3. Individuals with different groups were included
  - Underweight individuals whose BMI is below  $18.5 \text{ kg/m}^2$
  - Normal individuals whose BMI is between  $18.5 - 25 \text{ kg/m}^2$
  - Obese individuals whose BMI is  $> 30 \text{ kg/m}^2$

#### • Exclusion Criteria:

1. Individuals with any cardio-respiratory conditions were excluded from the study.
2. Individuals with musculoskeletal disorder were excluded from the study
3. Individuals with diabetes and hypertension were excluded from the study
4. Individuals who are not willing to participate in study were excluded from the study

### OUTCOME MEASURES:

1. 6-Minute Walk Test (6MWT) -ATS Guidelines<sup>[8]</sup>
2. 6-Minute Walk Work (6MWW)-Breaking barriers: novel reference equations for the six- minute walk distance and work in obese Chinese adult<sup>[9]</sup>

### 1. 6-Minute Walk Test (6MWT)

The 6-minute walk test (6MWT) is a reliable and valid tool for assessing functional capacity in healthy populations, particularly when performed according to ATS guidelines. Studies demonstrate strong test-retest reliability, with intra-class correlation coefficients (ICCs) ranging from 0.82 to 0.99, indicating minimal variability in repeated testing. Furthermore, the 6MWT correlates strongly with peak work capacity and physical activity, supporting its validity as a measure of functional capacity.

#### Reliability:

##### • Excellent test-retest reliability:

Studies show high ICCs, indicating consistent results across repeated testing.

##### • Minimal learning effect:

While some studies suggest learning affect in the first few tests, this effect is often small and diminishes with subsequent tests.

##### • Standardized protocols:

Following ATS guidelines ensures consistency and reduces variability in test administration.

#### Validity:

- Strong correlation with peak work capacity:

The 6MWD is strongly correlated with VO<sub>2</sub> max, a measure of maximal oxygen uptake, indicating its validity as a measure of cardiorespiratory endurance.

- **Relationship with physical activity:**  
The 6MWD also correlates with self-reported physical activity levels, suggesting it reflects real-world functional capacity.
  - **Predictive of exercise-induced hypoxemia:**
  - In some populations, the 6MWD can be predictive of exercise-induced hypoxemia, highlighting its clinical utility.
- 2. 6-Minute Walk Work:**
- The product of 6MWD in meters and body mass in kilograms.

**6 MINUTE WALK DISTANCE (m) x WEIGHT (kg)<sup>[9]</sup>**

### **PROCEDURE**

This is a cross-sectional study carried out to find out correlation of BMI with six-minute walk test and six-minute walk work in young individuals with age group between 18 to 35 years. The aims and objectives of the study have been thoroughly explained. Consent has been taken for carrying out 6-minute walk test and those who are not willing to participate in the study were excluded. This study was carried out in college, demographic of all individuals has been taken, and anthropometric data have been documented, and further 6-minute walk test was carried out after completion of test again post records were carried out and results were notes. Further according to individuals' weight six-minute walk work was calculated.

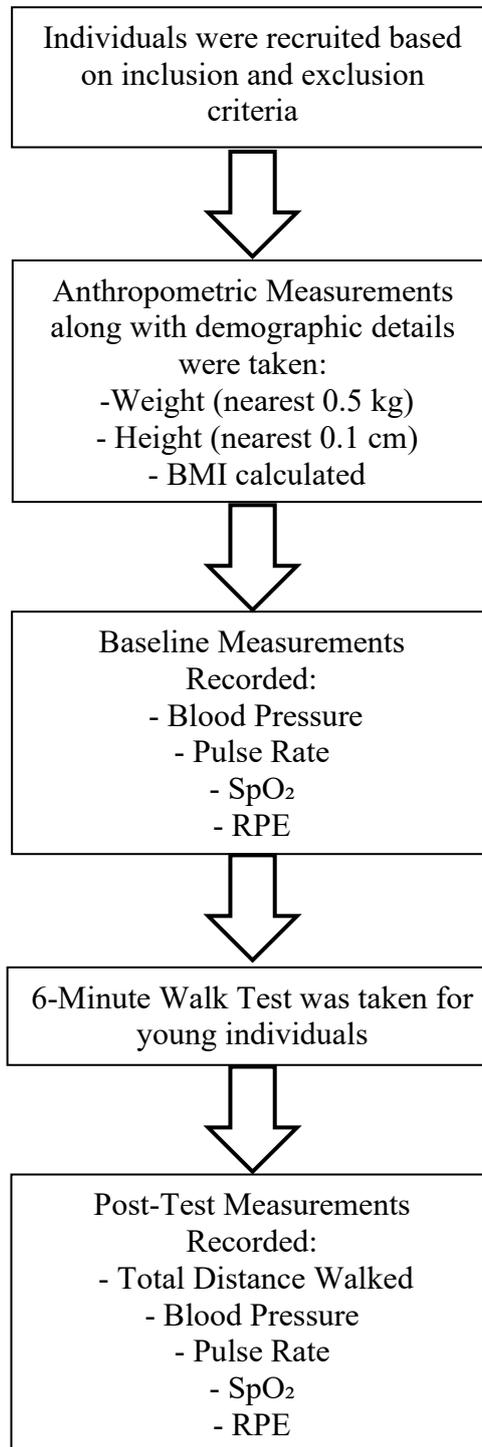
### **Procedure for 6-Minute Walk Test (6MWT)**

A standardized corridor was used for the walking test. Individuals were instructed to walk from one end to the other at their own pace, attempting to cover as much distance as possible in a six-minute period. The total distance walked was measured in meters. The walk was timed and the total distance covered in 6 minutes was recorded.

### **Location:**

A long, flat, straight, enclosed 30-meter corridor marked by cones was used. The length of the corridor was measured precisely using measuring tape. The total distance walked was calculated as the outcome measure. Resting periods were allowed during the test if necessary, and the walk resumed when the subject was ready. The 6-minute walk test was conducted in a long, flat, straight, enclosed 30-meter corridor, marked with cones at each end. The corridor was marked at every 3-meter interval using adhesive tape. The total distance walked was used as the final measurement. Participants were asked to rest for 10 minutes in a chair near the starting point before the test. During this time, baseline measurements including blood pressure, pulse rate, SpO<sub>2</sub>, and Rate of Perceived Exertion (RPE) were recorded. As soon as the subject began walking, the timer was set for 6 minutes. The number of laps was counted each time the participant returned to the starting point. Any additional distance covered was also noted. Post-test measurements—including total walking distance, blood pressure, pulse rate, SpO<sub>2</sub>, and RPE—were recorded immediately after the test.

**Procedure for 6-Minute Walk Test (6MWT):**



**6-Minute Walk Work:**

The product of 6MWD in meters and body mass in kilograms.  
 $6 \text{ MINUTE WALK DISTANCE (m)} \times \text{WEIGHT (kg)}^{[9]}$



## STATASTICAL ANALYSIS AND RESULT

The aim of the present study is to find the correlation of BMI with 6MWT and 6MWW in young healthy individuals. A total of 45 participants were included from college in Ahmadabad.

Statistical software SPSS 26.0 was used for the analysis of the data. The data was tested

for normality by Kolmogorov Smirnov test. As the data was not normally distributed, Spearman's Rank Correlation test was used to assess the correlation between the variables(r). Spearman's correlation coefficients range from -1 to +1, a positive value indicates a positive correlation, and a negative value indicates a negative correlation. P value is kept as < 0.05.

**TABLE 1: SPEARMANS CORRELATION COEFFICIENT INTERPRETATION<sup>[10]</sup> Interpretation for correlation coefficient:**

0.00-0.19	Very weak
0.20-0.39	Weak
0.40-0.59	Moderate
0.60-0.79	Strong
0.80-1.00	Very strong

**TABLE 2: DEMOPGRAPHIC DETAILS OF YOUNG INDIVIDUALS. (MEAN±SD)**

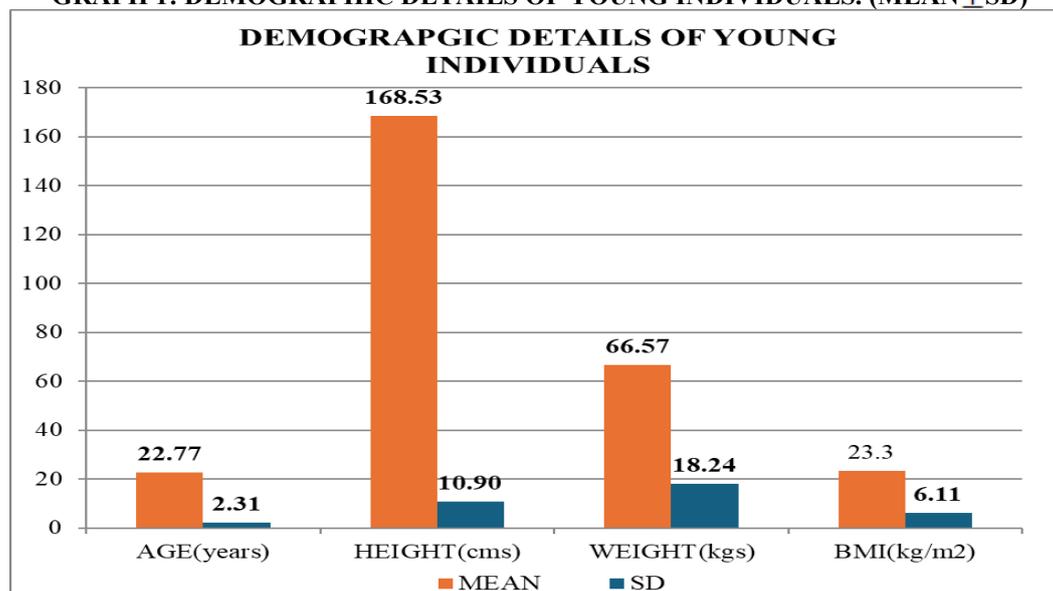
Demographic details	Mean±SD
Age(years)	22.7±2.31
Height(cm)	168.53±10.90
Weight(kg)	66.57±18.24
BMI (kg/m <sup>2</sup> )	23.30±6.11

(SD= Standard deviation, BMI= body mass index, cm= centimeters, kg= kilograms, m= meter)

Table 2 shows descriptive characteristics of participants with the value of mans and standard deviation of age, height, weight and BMI of young individuals. The mean age and standard deviation of participants was 22.7 years and 2.31 respectively. The mean height and standard deviation of participants was 168.53 centimeters with a

standard deviation of 10.90 respectively. The mean weight and standard deviation of participants was 66.57 kilograms with a standard deviation of 18.24 respectively. The mean BMI was 23.30 kg/m<sup>2</sup> with standard deviation of 6.11 respectively.

**GRAPH 1: DEMOGRAPHIC DETAILS OF YOUNG INDIVIDUALS. (MEAN±SD)**



(SD=Standard deviation, BMI= body mass index, cm= centimeters, kg= kilograms, m= meter)

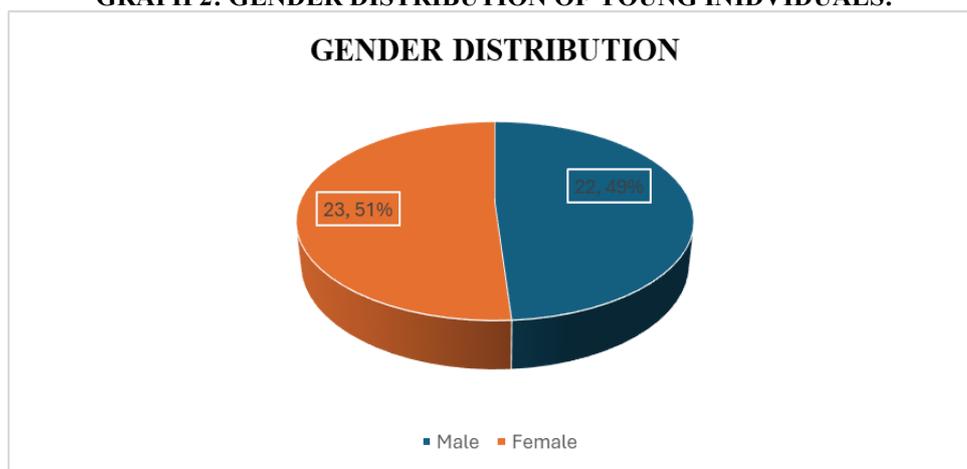
The mean age (years) and standard deviation of young individuals were 22.77 and 2.31 years respectively. The mean height (cms) and standard deviation of young individuals were 168.53 and 10.90 cms. The mean weight (kgs) and standard

deviation of young individuals were 66.57 and 18.24 kgs. The mean BMI ( $\text{kg}/\text{m}^2$ ) and standard deviation of young individuals were 23.3 and 6.11  $\text{kg}/\text{m}^2$  respectively.

**TABLE 3: GENDER DISTRIBUTION OF YOUNG INDIVIDUALS.**

GENDER DISTRIBUTION	NUMBER OF INDIVIDUALS	PERCENTAGE (%)
Male	22	48.88
Female	23	51.11

**GRAPH 2: GENDER DISTRIBUTION OF YOUNG INDIVIDUALS:**



GRAPH 2 and Table 2 shows gender distribution of young individuals. Out of total individuals 23 are male and 22 are female.

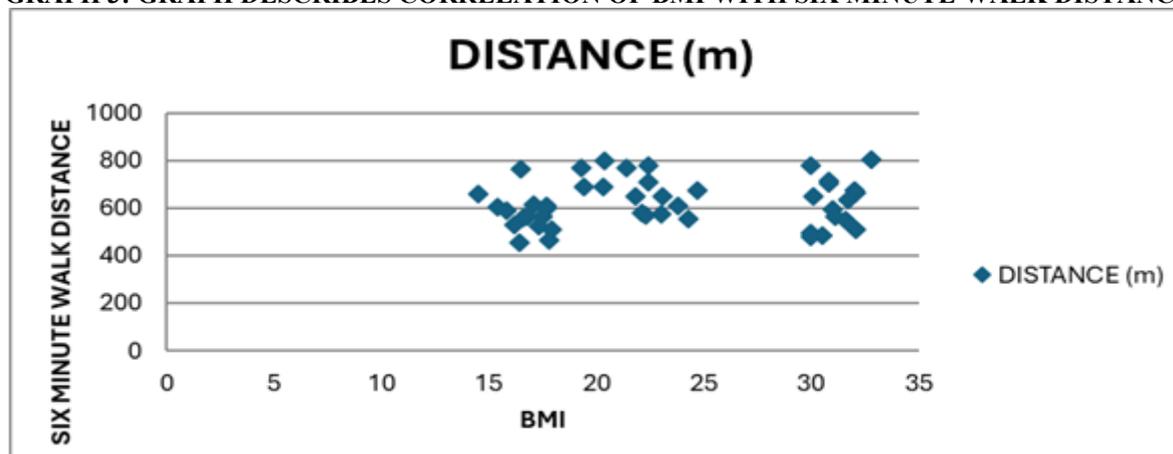
**TABLE 4: CORRELATION OF BMI WITH 6-MINUTE WALK TEST AND 6 MINUTE WALK WORK:**

OUTCOME MEASURES	r- value	p-value
6MWT	0.28	>0.05
6MWW	0.14	>0.05

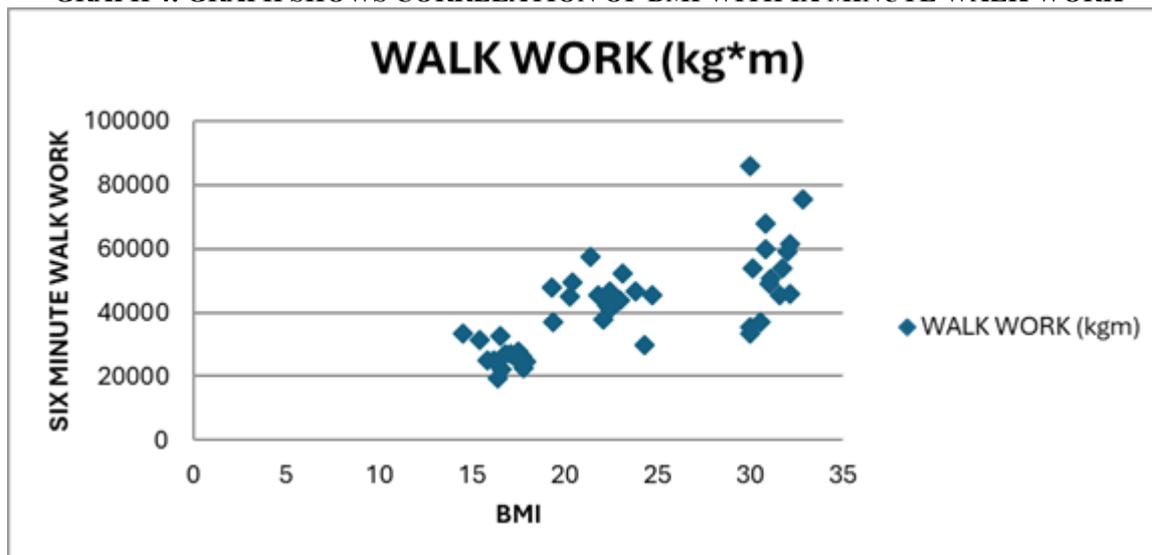
(6MWT= 6-minute walk test, 6MWW= 6-minute walk work, r= spearman correlation of coefficient, p= level of significance)

A statistically not significant correlation was found between BMI and 6-minute walk test ( $r=0.28$ ,  $p=0.30$ ) and 6-minute walk work ( $r=0.14$ ,  $p=0.34$ ) in young individuals.

**GRAPH 3: GRAPH DESCRIBES CORRELATION OF BMI WITH SIX MINUTE WALK DISTANCE**



GRAPH 4: GRAPH SHOWS CORRELATION OF BMI WITH IX MINUTE WALK WORK



## DISCUSSION

The aim of this study was to find correlation of Body Mass Index with six-minute walk test and six-minute walk work. Based on the result of this study there was no correlation found between BMI with the six-minute walk test and six-minute walk work. The primary reason for such a result is that the individuals recruited are young and healthy. Based on the result of this study it is found that the variations in 6MWD and 6MWW were well explained by demographic and anthropometric factors. Specifically, age, height, BMI and gender were identified as significant predictors of 6MWD. These findings emphasize the importance of considering individual physical characteristics when interpreting 6MWT results, as they directly influence walking performance and aerobic capacity in healthy individuals.<sup>[5]</sup>

In healthy young adults, the cardiovascular and respiratory systems are generally efficient, ensuring adequate oxygen delivery and utilization during physical activities like the 6MWT. This efficiency can compensate for any additional load imposed by excess body weight. While higher BMI may increase energy expenditure during walking, the body's adaptive mechanisms in young individuals can maintain walking performance without significant decline. In young individuals, oxygen uptake ( $VO_2$ )

increases steadily throughout the 6MWT. However, the test is submaximal in nature, meaning it does not typically push participants to their maximum effort. As a result, the peak  $VO_2$  achieved during the 6MWT is usually around 60–80% of the individual's actual  $VO_2$  max. Heart rate and respiratory rate also increase proportionally with the walking distance and physical effort exerted during the test. Despite this physiological response, young and physically fit individuals often do not reach their true  $VO_2$  max; young individuals are capable of efficient oxygen extraction at the muscular level. This ability improves with endurance training, contributing to higher aerobic capacity.<sup>[11]</sup> Lung volumes and ventilatory efficiency improve with age and maturation. Children have a higher respiratory rate and lower tidal volume compared to adults. Alveolar surface area increases during growth, enhancing gas exchange efficiency.<sup>[11]</sup>

Taller individuals generally have longer stride lengths, which can contribute to covering more distance per step. This biomechanical advantage often translates to a higher walking cadence, allowing them to cover more ground in the same time frame. Longer strides can lead to more efficient energy use during walking, potentially reducing fatigue and enabling individuals to maintain a higher pace throughout the test.

Height was found to have a significant positive influence on 6MWD in both normal-weight and obese groups. Previous studies have explained this positive relationship by suggesting that greater height is typically associated with longer leg length, which allows for longer strides and thus more efficient walking.<sup>[12]</sup> In contrast, this advantage appears to be diminished in obese individuals, likely due to the greater body weight placing additional load on the joints and increased skin friction caused by rubbing of larger limbs. These biomechanical factors may limit stride length and walking efficiency, reducing the impact of height and leg length on walking performance in obese individuals.<sup>[12]</sup> The impact of excess body weight on walking at a preferred speed and revealed notable gait adaptations in obese individuals. Additionally, stance time did not significantly vary across groups. However, the study found substantial modifications in temporal stride characteristics among obese participants. The result of the study concludes that an increase in leg swing velocity appears to be the primary and unique adaptation mechanism employed by obese women to maintain a functional walking pattern at their preferred speed. These findings highlight how the human gait system adapts to excess body weight to preserve balance and efficiency during locomotion.<sup>[12]</sup>

## CONCLUSION

The conclusion of this study is that there is no significant correlation of BMI with six-minute walk test and six-minute walk work in young individuals with 18 to 35 years.

### Declaration by Authors

**Ethical Approval:** Approved

**Acknowledgement:** We are thankful to Apollo Institute Of Physiotherapy and all the students who contributed immensely. We are grateful to our principal ma'am Dr. Vipra shah and our guide Dr. Bosky Mehta also other faculties and our seniors who

helped and provided valuable guidance throughout the research.

**Source of Funding:** None

**Conflict of Interest:** The authors declare no conflict of interest.

## REFERENCES

1. Wolters K American College of Sports Medicine. ACSM's guidelines for exercise testing and prescription. 10th ed. Philadelphia: Katie Feltman 2018.
2. Hoque ME, Mannan M, Long KZ, Mamun AA. Economic burden of underweight and overweight among adults in the Asia-Pacific region: a systematic review. *Tropical Medicine & International Health*. 2016 Apr; 21(4):458-69.
3. Uzogara SG. Underweight, the less discussed type of unhealthy weight and its implications: a review. *American Journal of Food Science and Nutrition Research*. 2016; 3(5):126-42.
4. Delbressine JM, Jensen D, Vaes AW, Li PZ, Bourbeau J, Tan WC, et al . Reference values for six-minute walk distance and six-minute walk work in Caucasian adults. *Pulmonology*. 2023 Sep 30; 29(5):399-409.
5. Iwama AM, Andrade GN, Shima P, Tanni SE, Godoy ID, Dourado VZ. The six-minute walk test and body weight-walk distance product in healthy Brazilian Individuals. *Brazilian Journal of Medical and Biological Research*. 2009; 42:1080-5.
6. Hemmingsson E, Ekblom Ö, Kallings LV, Andersson G, Wallin P, Söderling J et al . Prevalence and time trends of overweight, obesity and severe obesity in 447,925 Swedish adults, 1995–2017. *Scandinavian journal of public health*. 2021 Jun;49(4):377-83.
7. Little M, Humphries S, Patel K, Dewey C. Factors associated with BMI, underweight, overweight, and obesity among adults in a population of rural south India: a cross-sectional study. *BMC obesity*. 2016 Dec; 3:1-3
8. American Thoracic Society. ATS Statement: Guidelines for the Six-Minute Walk Test. *American Journal of Respiratory and Critical Care Medicine* [Internet]. 2002 Jul;166(1):111–7.
9. Zou H, Chen X, Zhang J, Wu X, Wu S, Lin C et al. Breaking barriers: novel reference equations for the six-minute walk distance

- and work in obese Chinese adults. *Journal of Health, Population and Nutrition*. 2025 Mar 28;44(1):91.
10. Statstutor. Spearman's correlation [Internet]. 2018. Available from: <https://www.statstutor.ac.uk/resources/uploaded/spearmans.pdf>
  11. Jalili M, Nazem F, Sazvar A, Ranjbar K. Prediction of maximal oxygen uptake by six-minute walk test and body mass index in healthy boys. *The Journal of pediatrics*. 2018 Sep 1; 200:155-9.
  12. Vinchhi RP, Shah DS, Vyas DN. Association of Six Minute Walk Distance with Different Body Mass Index in Healthy Young Adults. *World Journal of Pharmaceutical Research*. 2015 Aug 15;4(10):2447-60.
- How to cite this article: Saloni M Rana, Vishva N Vyas, Bosky M Mehta. To study the correlation of body mass index with six minute walk test and six minute walk work in young individuals. *International Journal of Science & Healthcare Research*. 2025; 10(3): 97-112. DOI: <https://doi.org/10.52403/ijshr.20250312>

\*\*\*\*\*