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Original Research Article

Study of the Six Minute Walk Test in Healthy Adults of 17 to 50 Years

Sonali Naringrekar[1], Moghi Chaudhary[2]

[1]Assistant Professor, Department of Pharmacology, Banas Medical College and Research Centre, Palanpur, Gujarat

[2]Assistant Professor, Department of Physiology, Banas Medical College and Research Centre, Palanpur, Gujarat

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Corresponding author: Dr Moghi Chaudhary

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Abstract

Background: The six-minute walk test (6MWT) is a straightforward functional capacity assessment instrument that is widely used to assess the likelihood of success and efficiency of any therapeutic or medical intervention. However, there are lots of variability in equation derived from Indian population by different researcher.

Objective: To Measure 6MWD using 6MWT in adult population and 6MWD in relation to age, Sex, BMI, WHR(waist-hip ratio), Visceral fat, Subcutaneous fat, skeletal muscle mass, Total body fat. Physiological Response of 6MWT is also studied terms of HR, BP, SpO_2, Borg's Scale.

Materials and Methods: 240 voluntarily participating healthy participants. Recruitment criteria included being between the ages of 17 and 50, injury-free, and not having a history of chronic illness or hospitalisation that would limit their ability to exercise. Age, weight, height, and body mass index (BMI), as well as SpO2, HR, BP, and Borg's Scale, were anthropometric characteristics that were recorded both before and after the test.

Results: The statistical analysis of the data makes it abundantly evident that following the 6-minute walk test, all of the metrics, including SpO2, Systolic BP, Diastolic BP, and heart rate, all considerably increase. The mean values of all the measures, including SpO2, systolic blood pressure, diastolic blood pressure, and heart rate, were calculated and compared to the mean values of the same parameters just prior to the 6-minute walk test.

Conclusion: With the exception of WHR, the differences in 6MWD between various variables including visceral fat, subcutaneous fat, skeletal muscle mass, total body fat, and BMI were statistically significant. SpO2, Systolic BP, Diastolic BP, and Heart Rate are all statistically significant physiological response metrics before and after the intervention. ($P \leq 0.05$).

Keywords: Anthropometry, Exercise test, Physiology, Six minute walk distance, Walking, Indian population.

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Introduction

For the objective assessment of functional exercise capacity, a variety of methods are available. Others provide basic information but are low tech and easier to do while yet providing a comprehensive assessment of all systems involved in exercise performance. The

modality should be selected based on the clinical question to be answered and the resources that are available [1].

Stair climbing, a 6MWT, a shuttle-walk test, identifying exercise-induced asthma, a cardiac stress test (such the Bruce protocol), and a cardio-pulmonary exercise test are the most common clinical exercise tests, in order of increasing difficulty. How many flights of stairs can you climb or how many blocks can you walk? Is a common question used to assess a patient's functional capacity.?" Patients' memories can change, and they might overestimate or underestimate their actual functional capacity. Self-reports are typically inferior to objective measurements [2].

Balke created a straightforward test in the early 1960s that measures the distance walked over a predetermined amount of time to gauge functional capability [3,4]. The 6MWT is straightforward to administer, more tolerated, and more representative of everyday life activities than the other walk tests, according to a recent assessment of functional walking tests [5].

The 6MWT is a straightforward practical test that only needs a 100-foot corridor and doesn't require any specialised equipment or training for personnel. Everyone walks every day, but for the majority of patients, it is substantially hindered. This examination gauges how far a patient can travel. (The 6MWD) [1].

In addition to the pulmonary and cardiovascular systems, systemic circulation, peripheral circulation, blood, neuromuscular units, and muscle metabolism, it assesses the overall and combined responses of all the systems affected by exercise. As is feasible with maximal cardiopulmonary exercise testing, it does not offer detailed information on the operation of each of the various organs and systems engaged in exercise or the mechanism of exercise limitation [6-8].

The 6MWT is a self-paced test that evaluates functional ability at a submaximal level. The majority of patients do not reach their maximum exercise capacity during the 6MWT; instead, they select their own exercise intensity and are permitted to pause and rest at any time. However, the 6MWD may more accurately represent the functional activity level for daily physical activities because the majority of activities of daily living are conducted at sub maximum levels of effort [5].

The goal of the current study is to determine how the 6MWT, which is administered in accordance with American Thoracic Society recommendations to healthy volunteers aged 17 to 50, is affected by demographic and anthropometric variables.

Material and Methods

Prior Permission was taken from Institutional Review Board (IRB) of Government Medical College, Bhavnagar before starting the study. The subjects were enrolled into the study with prior written informed consent (in local language) according to Inclusion and exclusion criteria described below.

Study Design: The present study is a observation study.

Study Duration: One year

Sample size: 240

Inclusion Criteria

- Age 17-50 years
- Male & female
- Ready to give written informed consent**.**

Exclusion Criteria

- Who are not willing to give written informed consent.
- Have difficulty in walking.
- Having Hypertension.
- Taking any drugs
- Dehydration
- History of any acute disease in last six weeks
- Use of walking Aids.
- Sleep disorder

Details and Parameters to be recorded

Personal details:-	**Instrument(Body fat Analyzer):**
• Name • Age • Sex • Occupation • Address • Contact number • Weight(kg) • Height(cm) • Past history of any major illness or hospitalization, • History of surgery, Medication	• BMI(body mass index) • SMM(skeletal muscle mass) • Total body fat • Visceral fat • Subcutaneous fat • RMM(resting metabolic rate) **Immediately before test and Immediately after test** • Heart rate • Blood pressure • Borg's scale • SpO_2

Equipments used

1. Stopwatch
2. Weighing machine
3. A chair that can be easily moved along the walking course
4. Worksheets on a clipboard
5. Sphygmomanometer & stethoscope
6. Body Fat Analyzer
7. Pulse oximeter

The 6 MWT was performed in the lobby of the Department of Physiology at the 4th floor of the building of Government Medical College, BhavnagarThe walking path was 30 metres long. Every 3 metres, the length of the corridor was marked on the floor with vibrantly coloured tape. The test was conducted on 240 healthy participants who volunteered for the study. The participants were between 17-50 years of age and free from any cardiopulmonary disease that may have affected exercise capacity and for statistical analysis, patients were divided into three Groups:- (1) 17-28 years (2) 29-38 (c) 39-50 years. Tests were performed between 9:00 am to 12:00am in morning.

Body Fat Analyzer was used to quantify total body weight, BMI, visceral and subcutaneous fat, skeletal muscle mass, total body fat, and RMR. Before beginning the test, the participants were instructed to relax for at least 10 minutes in a chair close to the starting position. Blood pressure, SpO2, and heart rate were assessed and recorded after a 10-minute period of rest. By placing a fingertip pulse oximeter on the right finger while seated, SpO2 and heart rate were captured.

Statistical Analysis

The Graph Pad in Stat 3 statistical software was used to conduct the statistical study. The descriptive and frequency algorithms will yield the mean, standard deviation, minimum and maximum values for the variables. T-tests were performed to examine parameter changes between measurements taken before and after the adjustment. The ANOVA test will be applied to the examination of numerical data. If the p value is under 0.05, differences are considered significant.

Results

The study was carried out in total 240 healthy participants

Table 1: Age wise distribution of Participants:- (n=240)

No.	group	Number of participants	Percentage
1	17-28 years	80	33.3
2	29-39 years	80	33.3
3	40-50 years	80	33.3
	Total	240	100.0

Table 2: Gender wise distribution of Participants:- (n=240)

Sex	Number of Participants	Percentage
Male	120	50.0
female	120	50.0
Total	240	100.0

Table 3: Anthropometric parameters of different age group. (n=240)

Varibles	Group (1)	Group (2)	Group (3)	P value
	17-28 year	29-39 year	40-50	
	Mean±SD	Mean±SD	Mean±SD	
Height(cm)	160.281±9.05323	59.96875±10.49007	158.1584±8.35304	<0.0001*
Weight(kg)	56.28±11.338	159.74±10.37	65.36378±10.57449	<0.0001*
Waist(cm)	78.95±9.0164	83.0687±8.101889	87.61728±9.067205	<0.0001*
Hip(cm)	92±7.48	93.30625±8.393852	96.8929±9.64949	<0.0001*
W:H ratio	0.846±0.103	0.892464±6.059463	0.882243±0.048481	>0.9961

The anthropometric measurements are shown in the table above, and the subjects were divided into different age groups as well. The statistics for height, weight, waist, and hip were statistically significant. (P0.05), while the W:H ratio produced non-significant findings. (P>0.05)

Table 4: Effect of BMI and 6MWD on different age groups (n=240)

Parameter	Group-1	Group-2	Group-3	P Value (one way ANOVAs with post-test)
	17-28 year	29-39 year	40-50 year	
	mean±SD	mean±SD	mean±SD	
BMI(kg/m^2)	21.7446±3.19876	23.4178±3.26379	25.6370±3.46684	0.0001*
6WMD (m)	537.76±54.846	519.58±59.899	462.75±63.898	0.0001*

*** indicate statistically significance at p≤0.05**

The BMI and 6MWD of each individual are displayed in the table above along with the results of age-appropriate calculations. There was a statistically significant variation in BMI between age groups. The walking distance varied significantly depending on the age group. BMI and 6MWD had statistical significance (P 0.0001), and there was a one-way ANOVA with a post-test (post Hoc test). (P≤0.05).

Table 5: Total Effect on SpO_2, SBP, DBP and HR Before & After 6MWT (n=240)

Variable	Before 6 MWT	After 6MWT	P Value (Paired T-test)
	Mean±SD	Mean±SD	
SpO_2 (%)	97.74±1.072	98.55±0.785	0.0001*
SBP (mmHg)	114±9.812	125.61±10.451	0.0001*
DBP(mmHg)	77.04±6.789	82.97±5.340	0.0001*
HR (bpm)	84.54±11.085	99.31±12.077	0.0001*

Above table shows the physiological response of the parameters:-SpO_2, systolic BP, diastolic BP and heart rate before and after the 6 minute walk test. All the parameters like SpO_2, systolic BP, diastolic BP and heart rate Shows significant difference before & after the test. There was Statistical Significance in SpO_2, systolic BP, diastolic BP and heart rate ($P \leq 0.0001$).

Table 6: Effect on SpO_2, SBP, DBP and HR Before & After 6MWT in Males (n=120)

Male(120)	Before 6 MWT	After 6MWT	P Value
	Mean±SD	Mean±SD	(Paired T-test)
SpO_2 (%)	97.71±1.198	98.51±0.733	0.0001*
SBP(mmHg)	116.55±9.934	128.05±10.670	0.0001*
DBP(mmHg)	77.98±6.945	83.73±5.727	0.0001*
HR (bpm)	84.22±12.421	100.53±13.687	0.0001*

Above table shows the physiological response of the parameters - SpO_2, systolic BP, diastolic BP and heart rate before and after the 6 minute walk test in males. There was Statistical significance of SpO_2, systolic BP, diastolic BP and heart rate ($P<0.0001$) in Males.

Table 7: Effect on SpO_2, SBP, DBP and HR Before & After 6MWT in Females (n=120)

Female(120)	Before 6 MWT	After 6MWT	P Value
	Mean±SD	Mean±SD	(Paired T-test)
SpO_2 (%)	97.77±0.932	98.60±0.834	0.0001
SBP (mmHg)	113.42±9.471	123.17±9.669	0.0001
DBP (mmHg)	76.09±6.521	82.20±4.826	0.0001
HR (bpm)	84.86±9.608	97.78±10.089	0.0001

Above table shows the physiological response of the parameters - SpO_2, systolic BP, diastolic BP and heart rate before and after the 6 minute walk test in females. There was Statistical significance of SpO_2, systolic BP, diastolic BP and heart rate ($P \leq 0.0001$) in Females. For considering different variables in the regression equation generated by stepwise multiple regression models for the 6MWD included following parameters:

- After SpO2 = 97.5-0.003(age) 0.097 (gender) + 0.015 (BMI) + 1.035 (W:H) + 0.003 (Total body fat) + 0.004 (skeletal muscle mass).
- After SBP= 101.8 +0.482(age) +3.75 (gender) +0.232(BMI)-14(W:H)+ 0.039 (Total body fat)- 0.204(skeletal muscle mass)+0.01(Resting metabolic rate)+0.01(Walk Distance).
- After DBP= 73+0.149 (age) +2.25 (gender)+0.379 (BMI)-2.5(W:H ratio)-0.008(Total body fat)-0.01(skeletal muscle mass)-0.002(RMR)+0.001(WD).

Discussion

The 6MWT variables assessed in the current investigation in healthy volunteers aged 17 to 50 are given reference values. Spirometry was not done since our sample only included those who had never smoked and had no indications of a respiratory illness. Without respiratory disease, the circulatory and musculoskeletal systems, rather than pulmonary function, are what restrict an individual's ability to exercise.

With 80 people in each of the three age groups (17–28 years), (29–39 years), and (40–50 years), the sample was evenly dispersed in terms of age. In this study, we discovered that males had significantly higher heart rates, systolic blood pressure, and diastolic blood pressure readings before and after the 6MWT than did females. Prior research revealed gender-related variations in heart rate and

found that the resting heart rate of women was higher. In addition, Jones 9 found that women's heart rates were greater than men's after submaximal activity. Moreover, differences in heart rate and VO2 response, systolic blood pressure fluctuations, plasma lactate levels, and respiratory rate might all be used to physiologically explain the effect of gender on the distance walked [10,11].

The SpO2 drop at the end of the 6MWT in the current study was limited to 2 points, which is consistent with findings from prior studies that included healthy volunteers. Some studies, however, consider an oxygen desaturation during exercise to be noteworthy when the baseline saturation falls by 4% or more. 3 Healthy persons may be to blame for an oxygen saturation decrease of less than 2%. Diastolic blood pressure (DBP): Before 77.04±6.789 and After 82.9 ±75.340, systolic blood pressure (SBP): Before 114 ±9.812 and After 125.61 ±10.451 alterations were discovered in the current investigation.

During exercise, the heart has to work harder to pump more blood and oxygen to the working muscles, causing systolic blood pressure and heart rate to rise. the majority of people without high blood pressure The results support those of earlier research [12-16]. Racial, cultural, and ethnic disparities as well as variations in daily physical activity can be complicating factors. The psychological state in relation to exercise capacity in healthy People is one such source. The results of the current study supported previous findings that a variety of demographic and anthropometric variables can affect participants' performance on the 6MWT. Also, the older study participants walked a shorter distance than the younger participants, which may be explained by alterations to their skeletal muscles. We were able to obtain the following parameters for the prediction of post SpO2, systolic blood pressure, and diastolic blood pressure in normal healthy individuals by using difference variables in the Appling multiple regression equation.

Conclusion

The six-minute walk test (6MWT) is a straightforward functional capacity assessment instrument that is widely used to assess the likelihood of success and efficiency of any therapeutic or medical intervention. The statistical analysis of the data makes it abundantly evident that following the 6-minute walk test, all of the metrics, including SpO2, Systolic BP, Diastolic BP, and heart rate, all considerably increase. With the exception of WHR, the differences in 6MWD between various variables including visceral fat, subcutaneous fat, skeletal muscle mass, total body fat, and BMI were statistically significant. SpO2, Systolic BP, Diastolic BP, and Heart Rate were all statistically significant physiological response metrics before and after the intervention. ($P \leq 0.05$).

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