International Journal of Science and Research (IJSR)
ISSN: 2319-7064
Impact Factor 2024: 7.101

# To Assess Reliability and Validity of 2-Minute Walk Test in Healthy Adults

**Dr. Manisha[1], Dr. Shakshi Naithani[2], Dr. Barkha Khurana[3], Dr. Tripti Pandey[4], Dr. Waseem Raja[5]**

[1]Clinical Physiotherapist, Max Hospital, Vaishali, manishahm32016[at]gmail.com
[2](PT), Assistant Professor, Uttarnchal (PG) College of Biomedical Sciences & Hospital, D.Dun, naithani3shakshi[at]gmail.com,
[3](PT), Professor, Uttarnchal (PG) College of Biomedical Sciences & Hospital, Dun, barkhaakhurana[at]gmail.com
[4](PT), Assistant Professor, Dev Bhoomi Uttarakhand University, d.duntriptipandey3191[at]gmail.com
[5](PT), Clinical physiotherapist, DHFC, Kashmir, waseemraja5038[at]gmail.com

**Abstract:** ***Background**: 2-Minute Walk Test is a measure of self-paced walking ability and functional capacity, particularly for those who cannot manage the longer six-minute walk test or 2-minute walk test. The 2-minute walk test indicates the level of aerobic endurance of the participant. It is associated with the ability to perform lifestyle tasks such as walking and climbing stairs. **Aim**: The aim of the study is to assess reliability & validity of 2MWT in young healthy adults and to find effectiveness of 2-minute Walk Test in healthy adults. **Methodology**: This is the observational study, to study the reliability and validity of 2-minute walk test in young healthy adults. potential participants were identified in the Uttaranchal (PG) College of Biomedical Science and Hospital, Dehradun database. Total 30 participants were taken in this study. 29 male and females (11 male and 18 females) 20-25 years of age with BMI 19.37-24.9kg/m°2) value were added and 1 male participant is excluded from this study because of very high BMI which is 38.54kg/m°2.Participants were included in this study are college students were physical fit, aged between 20-25 years, not having any injury or disease and able to follow basic commands. Participants were excluded if their BMI is not normal, fatty, had any lower limb injury, had undergone any surgical procedure in last 6 months and had any congenital heart disease that affected their ambulation. **Conclusion**: In this study, results show a positive correlation between age and BMI. Positive correlation between distance and BMI when BMI changes it will affect distance. The correlation between age and BMI & correlation between distance and BMI is positive. We can use 2 MWT as Quick examination of cardiorespiratory health rather than to use long test like 6 – or 12-minute Walk test. The 2-minute walk test is practical, simple, quick, and easy to administer. In this retrospective Study, we found the 2-minute walk test was responsive to Change with rehabilitation and was somewhat correlated with Measures of physical functioning and prosthetic use in this Population.*

**Keywords:** 2-minute Walk Test, Functional Capacity, Healthy adults, exercise capacity, validity & reliability

## 1. Introduction

The assessment of fitness components is vital for the correct prescription of exercise. Specifically, cardiorespiratory fitness generates great interest as it is directly related to cardiovascular events and all-cause mortality in adult populations. In clinical practice, different tests are used to evaluate cardiorespiratory fitness, generally requiring sophisticated equipment and treadmills or cycloergometers that are not always readily available, especially in resource-constrained setting. For this reason, Tests based on the ability to perform daily living tasks, such as walking, are becoming more and more widespread and studied. [24].

Treadmills and cycle ergometers can be used to measure exercise capacity, but the devices are not always available outside laboratory settings. As a consequence, other modes of testing have been developed. Among these modes are timed walk test (e.g.-6-or 2-minute walk test), step-up test (YMCA step test) and sit-to-stand test (e.g., 1 minute chair rise test). Timed walk test, if performed according to established protocols, require indoor corridors of length unavailable in many settings. Step-up test and sit to stand tests are dependent on adequate muscle strength and may be painful for individuals with arthritis in lower limbs [2].

An alternative exercise capacity test that that is easily conducted in almost any setting was introduced in by Rikli and Jones as part of the Senior Fitness Test in 1999. The test, known as the 2minute step test (TWMT), simply requires that tested individuals March in place as fast as possible for 2-minutes while lifting the knees to a height midway between there patella and iliac crest when standing. [2]

2-minute walk test is a measure of self-paced walking ability and functional capacity, particularly for those who cannot manage the longer six-minute walk test (6MWT) or 2-minute walk test. The 2 MWT indicates the level of aerobic endurance of the participant.

It is associated with the ability to perform lifestyle tasks such as walking and climbing stairs. This is an alternative test if there is not sufficient space to conduct the 6MWT.

Physical fitness declines along the senescence process, and the lower the fitness profile, the higher the risk of chronic health conditions, and all-cause mortality. Thus, physical fitness measurement is crucial for different reason: First, an accurate exercise prescription must be based on precise physical fitness measurements. Second, the exercise training impact on health outcomes and physical fitness replies on obtaining valid and reliable repeated measurements over time and third, because physical fitness predicts overall mortality, and populational surveillance of this parameter has a public health importance in terms of early detection of a lower physical fitness profile. [1]

Amongst the health-related physical fitness components, cardiorespiratory fitness has robust evidence supporting its association with health. For instance, higher

cardiorespiratory fitness in older adults is related to a reduced length of hospital stay and lower in hospital mortality, better cognitive function, longevity, prevention of cardiovascular disease, disability, and some types of cancers, among others. Furthermore, regular physical activity enhances cardiorespiratory fitness in older adults, and some studies suggest that cardiorespiratory fitness can be improved by more than 20% with systematic training within this population. [1]

Despite providing the most valid and reliable results, the objective determination of cardiorespiratory fitness with maximal or peak oxygen consumption tests is expensive, time-consuming, and requires rigorous training of evaluators. Furthermore, assessed participants, especially older adults, sometimes report discomfort when submitted to gas analyses procedures. Thus, cardiorespiratory fitness assessments using validated submaximal field exercise tests are a proper approach to overcome laboratory procedure constraints, like the six-minute walk test (6MWT). The 6MWT is mainly applied in research and clinical settings, being a symptom-limited test with clinical significance. For instance, PubMed retrieved 18, 082 results with the search "six-minute walk test," on the 28th of March 2023.

Some researchers have proposed the two-minute step test (2MST) as an alternative to overcome the restraints of the 6MWT. Although the 2MST has aroused scientific interest, it has not yet been studied in as much depth as the 6MWT (170 results on PubMed, with the search "two-minute step test," on 28th March 2023).

In addition to the possibility of being applied in very small places, the 2MST is appropriate for older adults with lower physical capacity and incapacity to ambulate for longer distances. Nonetheless, some researchers do not agree that the 2MST might replace the 6MWT for the cardiorespiratory fitness assessment, but as a complementary assessment.

In addition, there are national-adjusted reference values to classify walked distance in the 6MWT, 17, 20-23 but they are missing for the 2MST. Finally, the concurrent validity of the 2MST in estimating cardiorespiratory fitness is confirmed for specific populations (such as obese 24 and older adult's post-coronary revascularization 25), but not for healthy older adults.

Thus, the development of an equation aiming to estimate the 6MWT distance covered from the 2MST steps would contribute to surveilling populations regarding cardiorespiratory fitness. To the best of our knowledge, these equations are still inexistent.

The use of six-minute walk tests (6MWT) for gait analysis has a long history in clinical and research settings. Prior to the 6MWT, the rest published walking measure was the 12-minute performance test in;

1968 by Cooper, demonstrating a close relationship between distance covered and maximal oxygen consumption. Additional work assessed three deferent walking durations, 12-, 6-, and a 2minute walk in people with respiratory disease.

## 2. Aims & Objective

### Need of the study

There are various studies that shows the Comparison between 6 minute and 2-minute walk test & 2-minute walk test in Cardiac diseased patient in children and old patients. But there is no literature which shows the outcome measures of 2-minute walk test in college going students who are fit and not diseased. This study attempts to assess the physical fitness in young healthy adults (college going students) by quick and short assessment method which is 2-minute walk test and try to find it's reliability and validity in young adults.

### Aims

The aim of the study is to assess reliability & validity of 2MWT in young healthy adults and to find effectiveness of 2-minute Walk Test in healthy adults.

### Objectives

To find effectiveness in healthy adults.
To evaluate the young population.

### Hypothesis

Experimental hypothesis

There will be reliability and validity of 2-minute walk test in young healthy adults.

### Null Hypothesis

There will be no validity and reliability of 2minute walk test in young healthy adults.

## 3. Methodology

### Study Design

This is the cross-sectional observational study, to study the reliability and validity of 2-minute walk test in young healthy adults.

### Study Setting

A list of potential participants was identified in the Uttaranchal (PG) College of Biomedical Science and Hospital, Dehradun database.

### Study Duration

The study was performed over a period of two weeks.

### Subjects

Total 30 participants were taken in this study. 29 male and females (11 male and 18 females) 20-25 years of age with

BMI 19.37-24.9kg/m°2) value were added and 1 male participant is excluded from this study because of very high BMI which is 38.54kg/m°2.

Participants were included in this study are college students were physical fit, aged between 20-25 years, not having any injury or disease and able to follow basic commands. Participants were excluded if their BMI is not normal, fatty, had any lower limb injury, had undergone any surgical procedure in last 6 months and had any congenital heart disease that affected their ambulation. All identified participants were provided with verbal information about this study during their classes in college. Participants who were agreed to participate in this study signed an informed consent form prior to test.

**Criteria for Inclusion and Exclusion**

**Inclusion criteria**

Age: 20-25 years
Gender: both (male & female)
BMI: 19.37-24.9kg/m°2

Note: patient should not engage in vigorous activity two hours prior to the test.

**Exclusion criteria**

Volunteers with cardiorespiratory disease (Asthma, COPD, Cystic fibrosis, Congenital Heart Disease, Chronic Bronchitis).
Any orthopedic or musculoskeletal restrictions and cognitive impairment.
Neurological disease (Cerebral Palsy, Muscular Dystrophy, Epilepsy, Encephalopathy) were excluded.
Volunteers whose BMI was 25.0 – 29.9 or above (overweight) and less than 18.4 (underweight) were excluded.

## 4. Procedure

This study followed standard guidelines and protocol for the two-minute walk test described by Pin (2014) and American Thoracic Society Committee. During the test, each participant wore shoes and sat on a chair with their hand and arm supported. The participants were asked not to engage in vigorous activity two hours prior to the test. [3, 21, 22]

The 2Minute Walk Test was performed over 30m out and back course. Set-up materials included phone, a stopwatch, a chalk, cement bricks, a chair, recorded sheets and a clipboard. Before the participant arrived, the examiner used chalk to mark a 30m course in college ground, and put a cemented bricks at either end of the course. A chair was placed near the beginning of the course.

After the consent was obtained, basic demographics (age, sex, height, body mass etc.) Were determined for participants before any performance-based assessment were undertaken. The examiner had the participant rest in the chair near the beginning of the walking course, while giving instructions based on the training manual. Participants were instructed to walk as fast as they could from point A to B until asked to stop (without anyone walking with them). They were also told not to worry if they had to slow down or rest, but that if they stopped, they should start walking again as soon as they felt ready to do so. When 1 minute had elapsed, they were told “you are doing well; you have 1 minute left.” Participants stopped walking at 2-minutes. The examiner mark on the floor behind the participants heel to mark where participant stopped and measure distance from the last lap to the mark. Last, the examiner put distance on the record sheet and later transferred it to computer. The test tool approximately 4 minutes to administer including instructions and practice. Note that participants took the 2MWT as part of the entire NIH toolbox battery under the motor Domain (Reuben et al., 2013). [23]

**Materials used in the study**

- Pen
- Measuring tape
- Cemented bricks
- Chalk
- Record sheet
- Stopwatch
- Mobile phone



**Data Analysis**

- Data analysis was done using Microsoft excel.

- Karl Pearson's correlation coefficient test is used to find the significant correlation.
- Descriptive analysis was done to calculate the mean for age, height, distance and BMI of subjects.
- Descriptive analysis was done to calculate the standard deviation for age, height, distance and BMI of subjects.
- r is the correlation coefficient value.

The data was analyzed for 30 subjects, the descriptive statics was used to analyzed demographic data.
Mean age, height, distance, BMI and weight

Table 1: Demographic data

| Variables | Mean | SD |
|---|---|---|
| Age | 20.9666667 | 1.159171325 |
| Height | 1.632 | 0.106070894 |
| Distance | 147.0736667 | 23.36597489 |
| BMI | 22.40001264 | 3.726785989 |
| Weight | 59.53333333 | 10.32817817 |

Age and distance scale shows a positive correlation

Table 2: correlation between age and BMI

| | Mean | SD | r |
|---|---|---|---|
| Age | 20.9666667 | 1.159171325 | 0.181271213 |
| BMI | 22.40001264 | 3.726785989 | |

Distance and BMI scale shows a positive correlation

Table 3: correlation between Distance and BMI

| | Mean | SD | r |
|---|---|---|---|
| Distance | 147.0736667 | 23.36597489 | 0.204291222 |
| BMI | 22.40001264 | 3.726785989 | |

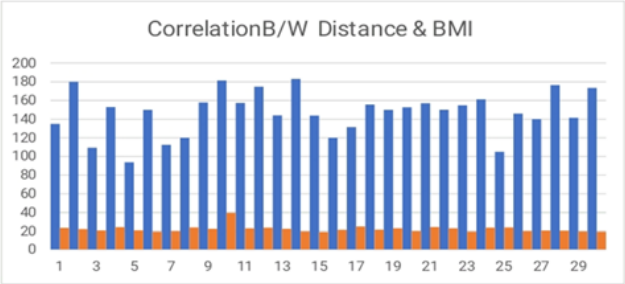



**Table 4:** BMI Range

| BMI range | Frequency | Cumulative frequency |
|---|---|---|
| 15-20 | 12 | 12 |
| 20-30 | 17 | 29 |
| Above 30 | 1 | 30 |

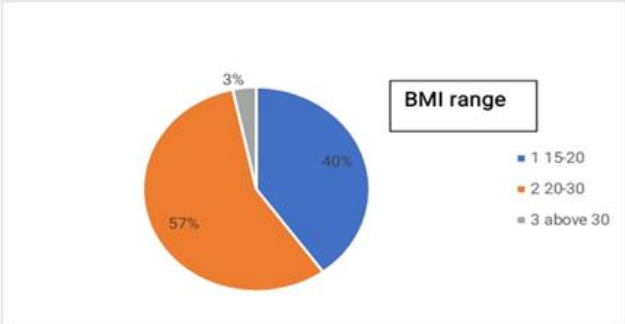
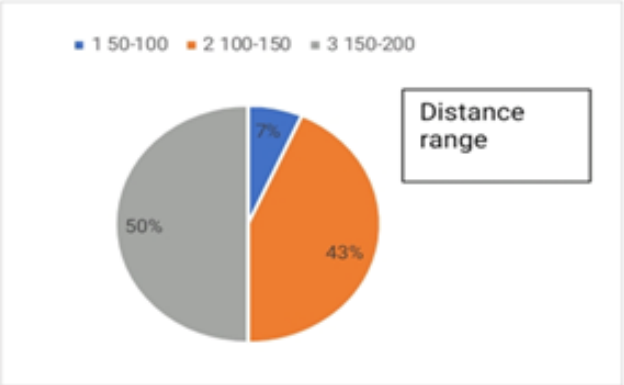



**Table 5:** Distance Range

| Distance Range | Frequency | Cumulative frequency |
|---|---|---|
| 50-100 | 2 | 2 |
| 100-150 | 13 | 15 |
| 150-200 | 15 | 30 |




**Interpretation of Result**

In my study, results show a positive correlation between age and BMI.

Positive correlation between distance and BMI when BMI changes it will affect distance.

**Limitations of the study**

Sample size was small; it can be around 100.
Study was conducted over a short period of time.
Availability of lack of awareness of fitness.

**Future study**

Same study can be done with large sample.
The study could be done with gender specifications.
Subjects might be taken from different college/cities/states.
We can apply therapeutic interventions.
Further studies can be done on physiological changes and functional changes during 2 MWT.

## 5. Discussion

2-minute walk test is a measure of self-paced walking ability and functional capacity, particularly for those who cannot manage the longer six-minute walk test (6MWT) or 2-minute walk test. The 2 MWT indicates the level of aerobic endurance of the participant.

It is associated with the ability to perform lifestyle tasks such as walking and climbing stairs. This is an alternative test if there is not sufficient space to conduct the 6MWT.

Physical fitness declines along the senescence process, and the lower the fitness profile, the higher the risk of chronic health conditions, and all-cause mortality. Thus, physical fitness measurement is crucial for different reason: First, an accurate exercise prescription must be based on precise physical fitness measurements. Second, the exercise training impact on health outcomes and physical fitness replies on obtaining valid and reliable repeated measurements over time and third, because physical fitness predicts overall mortality, and populational surveillance of this parameter has a public health importance in terms of early detection of a lower physical fitness profile. [1]

The 2-minute walk test is one of many alternatives for measuring exercise capacity. First introduced in 1999 as part of the Senior Fitness Test, the TMWT has the advantage of requiring limited space, only a few minutes time, and no expensive equipment.[2]

Amongst the health-related physical fitness components, cardiorespiratory fitness has robust evidence supporting its association with health. For instance, higher cardiorespiratory fitness in older adults is related to a reduced length of hospital stay and lower in hospital mortality, better cognitive function, longevity, prevention of cardiovascular disease, disability, and some types of cancers, among others. Furthermore, regular physical activity enhances cardiorespiratory fitness in older adults, and some studies suggest that cardiorespiratory fitness can be improved by more than 20% with systematic training within this population. [1]

the 2-Minute Step Test (2MST) has been used as an alternative to the 6MWT based on the association between both tests and the time on the treadmill to 85% max heart rate reported by Rikli and Jones for an older adult population. This test is proposed as an option, generally when the 6MWT cannot be used, either because of structural limitations or when it is necessary to prescribe exercise to people who do not have the physical capacity or ability to ambulate. In clinical practice, the 2MWT has been gaining popularity and its usefulness has been studied in different populations, such as older adults without reference to health status or adults with heart failure, chronic kidney disease, osteoporosis, Parkinson's disease, stroke, hypertension, depression, or Alzheimer's disease. However, since the motor activity of climbing stairs may be considered more physically challenging than walking, some authors propose that it should be used as a complement rather than a substitute for other fitness assessments. [24]

Total 30 participants were taken in this study. 29 male and females (11 male and 18 females) 20-25 years of age with BMI 19.37-24.9kg/m°2) value were added and 1 male participant is excluded from this study because of very high BMI which is 38.54kg/m°2.

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Results show a positive correlation between age and BMI. Positive correlation between distance and BMI when BMI changes it will affect distance.

In this retrospective Study, we found the 2-minute walk test was responsive to Change with rehabilitation and was somewhat correlated with Measures of physical functioning and prosthetic use in this Population.

## 6. Conclusion

The prospective study of 30 college going students documented that 2 MWT is valid and reliable test in young healthy adults. The correlation between age and BMI & correlation between distance and BMI is positive. We can use 2 MWT as Quick examination of cardiorespiratory health rather than to use long test like 6 – or 12-minute walk test. The 2-minute walk test is practical, simple, quick, and easy to administer. In this retrospective Study, we found the 2-minute walk test was responsive to Change with rehabilitation and was somewhat correlated with Measures of physical functioning and prosthetic use in this Population.

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## Master Chart

| NAME | AGE | DISTANCE(m) | WEIGHT(kg) | height(m) | BMI |
|---|---|---|---|---|---|
| Rohan | 25 | 135 | | 1.83 | 23.5898355 |
| Rachit | 21 | 180 | 79 | 1.92 | 22.2439236 |
| Harsh | 20 | 109.4 | 82 | 1.64 | 20.8209399 |
| Mehak | 20 | 153 | 56 | 1.61 | 24.3046179 |
| Nautiyal | 21 | 93.82 | 63 | 1.62 | 20.9571712 |
| Brijesh | 20 | 150 | 55 | 1.73 | 19.3791974 |
| Vipul | 21 | 112.5 | 58 | 1.58 | 20.0288415 |
| Shivani | 22 | 120 | 50 | 1.58 | 24.0346098 |
| Rubi | 21 | 157.9 | 60 | 1.55 | 22.4765869 |
| Riya | 22 | 181.5 | 54 | 1.55 | 39.5421436 |
| Hammad | 22 | 157.4 | 95 | 1.64 | 23.0568985 |
| Mohini | 20 | 174.8 | 62 | 1.45 | 23.7812128 |
| Ashra | 21 | 144.1 | 50 | 1.7 | 22.4913495 |
| Arun | 20 | 183.12 | 65 | 1.61 | 19.6751669 |
| Aryan | 22 | 143.9 | 51 | 1.7 | 19.0311418 |
| Satyam | 22 | 120 | 55 | 1.6 | 7 |
| Mansi | 21 | 131.5 | 55 | 1.61 | 21.484375 |
| Neha | 20 | 155.7 | 65 | 1.8 | 25.07619305 |
| Dev | 21 | 150 | 70 | 1.5 | 21.60493827 |
| Yashasvi | 23 | 152.7 | 52 | 1.8 | 23.11111111 |
| Neeraj | 20 | 157.11 | 65 | 1.5 | 20.06172841 |
| Gei Gongo | 20 | 150.1 | 55 | 1.5 | 24.44444444 |
| Liyum | 20 | 154.85 | 52 | 1.65 | 23.11111111 |
| Kamna | 20 | 161.31 | 53 | 1.52 | 19.46740129 |
| Mariya | 21 | 105 | 55 | 1.58 | 23.80540166 |
| Namrta | 20 | 146 | 60 | 1.61 | 24.03460984 |
| Yogita | 21 | 140 | 52 | 1.6 | 20.07722008 |
| Gaytri | 20 | 176.5 | 53 | 1.64 | 20.703125 |
| Anshul | 20 | 141.5 | 55 | 1.64 | 20.52238806 |
| Divya | 22 | 173.5 | 53 | 1.7 | 19.70553242 |
| Shariq | | | 56 | | 19.37716263 |