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Original Research Article

Reference values for the six-minute walk test in obese Indian population

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ABSTRACT

Background: The six-minute walk test is one of the most powerful test used to measure the functional capacity in various chronic conditions such as in Obesity. There are very few reported studies on SMWT on Obese population all over the world, and there is no reference equation for SMWD. The aim of present study is to propose a Reference equation which could predict the distance walked in SMWT by obese individuals.
Methods: 150 obese individuals free from any cardiorespiratory disease were randomized into 2 groups. SMWT data from group A was used to propose the reference equation and SMWD for Group B was predicted. Significance of difference between predicted and original values for group B was found.
Results: Mean SMWD for Group A was 304.56 (SD= 68.28) which significantly correlated to (by using linear regression method) age (r = -0.32, p <0.001), BMI (r = -0.43, p <0.001) SpO_2* (r=-0.35, p<0.001). These could explain 56% of the total variance in 6MWT. Though the difference between predicted and original values for group B wasn't found to be statistically significant. The proposed Reference equation is:
6MWT distance = (6.8) O_2 saturation-(4.3) BMI-(0.6) age-170.64.
Conclusions: SMWT is a simple, safe and powerful test to assess the functional status. The standardized SMWD values for Indian obese population would serve as benchmark to assess baseline functional capacity, prescribe proper and safe exercise intensity and monitor changes after rehabilitation interventions.

Keywords: Obese, Six-minute walk test, Six-minute walk distance

INTRODUCTION

The Six Minute walk test (6MWT) is a useful performance based measure of functional exercise capacity in obese individuals. This test measures the distance that a patient can quickly walk on a flat hard surface in a period of 6 minutes (6MWD).[1] Various studies have found reference values for SMWD in healthy individuals but very less is known for healthy obese individuals. The aim of this study is to find reference values for 6MWT in adult obese population.

- Correlation of anthropometric measures with SMWD
- To find the Reference equation to predict the distance walked during SMWT in obese individuals.

Six-minute walk test

In the early 1960s, Balke developed a simple test to evaluate the functional capacity by measuring the distance walked during a defined period of time.[2] There are several modalities available for the objective evaluation of functional exercise capacity. Walking is an activity performed daily by all but the most severely impaired patients. A recent review of functional walking tests concluded that "the 6MWT is easy to administer, better tolerated, and more reflective of activities of daily living than the other walk tests."[3] The 6MWT is a practical simple test that requires a 100-ft hallway but no exercise equipment or advanced training for technicians.

This test measures the distance that a patient can quickly walk on a flat, hard surface in a period of 6 minutes (the 6MWD). It evaluates the global and integrated responses of all the systems involved during exercise.

Technical aspects of the 6MWT

The 6MWT should be performed indoors, along a long, flat, straight, enclosed corridor with a hard surface that is seldom traveled. The walking course must be 30m in length. A 100-ft hallway is, therefore, required. The length of the corridor should be marked every 3m. The turnaround points should be marked with a cone (such as an orange traffic cone). A starting line, which marks the beginning and end of each 60-m lap, should be marked on the floor using brightly colored tape.

Rationale

A shorter corridor requires patients to take more time to reverse directions more often, reducing the 6MWD. Most studies have used a 30-m corridor.

Interpretation

Most 6MWTs will be done before and after intervention, and the primary question to be answered after both tests have been completed is whether the patient has experienced a clinically significant improvement. With a good quality-assurance program, with patients tested by the same technician, and after one or two practice tests, short-term reproducibility of the 6MWD is excellent.[4] We recommend that change in 6MWD be expressed as an absolute value (e.g., the patient walked 50 m farther).

The 6MWT is a useful measure of functional capacity targeted at people with at least moderately severe impairment. The strongest indication for the 6MWT is for measuring the response to medical interventions in patients with moderate to severe heart or lung disease.[1] The test has been widely used for preoperative and postoperative evaluation and for measuring the response to therapeutic interventions for pulmonary and cardiac disease. The standard guidelines provide a standardized approach to performing the 6MWT.

SMWT evaluates the global and integrated responses of all the systems involved during exercise including the pulmonary and cardiovascular systems, systemic circulation, peripheral circulation, neuromuscular units and muscle metabolism.

METHODS

Source

The study was conducted on 150 healthy obese individuals (BMI >30kg/m2) and (65 Male and 35 Female in group A and 28 males, 22 females in group B) who visited SAIMS and MOHAK Hospital for multidisciplinary rehabilitation, after oral consent. The 6MWT was performed according to the guidelines of ATS. Baseline blood pressure, heart rate, respiratory rate and oxygen saturation were measured. The total distance walked in 6 minutes was noted.

In a prospective study total 150 Healthy Obese individuals of age 20-60 years with BMI>30 kg/m^2 were included and they were randomized into 2 groups.

- Group A comprised of 100 individuals whose data was used to create the Reference Equation.
- Group B had 50 individuals whose predicted six-minute walk distance was compared with original SMWD.

Known cases of pre-existing cardiovascular or respiratory disease were excluded.

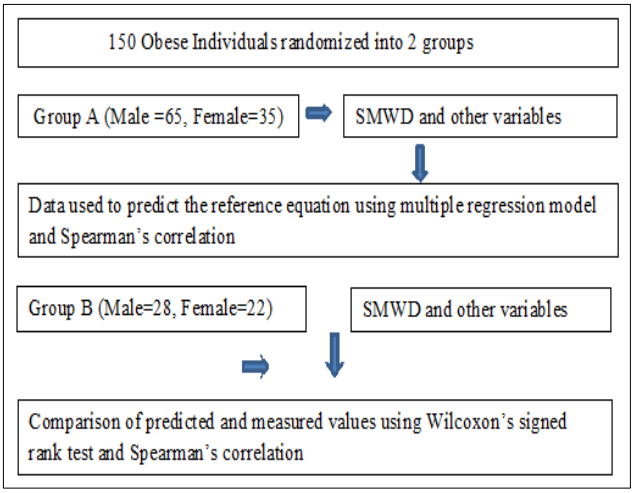

Figure 1: Sequence of data analysis.

RESULTS

There were 65 males in group A and 35 females in group B, while there were 28 male and 22 female in group B. Mean age of obese in Group A was 39.82 which had individuals from 20 to 60 years of age while Group B had mean age of 37.56 which varied from 21.4 to 58.8 years.

Mean BMI in Group A was 45.72 with standard deviation of 7.12 and mean weight was 128.64 kg. Group B had mean BMI of 44.62 and standard deviation of 5.64 with mean weight as 125.84 kg. Mean oxygen saturation of group A was 96.5% while of Group B was 95.24%.

Mean SMWD for Group A was 304.56 (SD=68.28) which significantly correlated to (by using linear regression method) age (r= -0.32, p <0.001), BMI (r = -0.43, p <0.001) SpO_2* (r= -0.35, p<0.001). These could explain 56% of the total variance in 6MWT. There was no significant difference between males and females in terms of age and BMI.

Unlike to previous studies gender is not correlated significantly.[6] Between variables SBP was positively correlated with BMI.

"The proposed reference equation is:

6MWT distance =
(6.8) O_2 saturation- (4.3) BMI- (0.6) Age-170.64

(Evolved from linear regression coefficient table and model summery R value)

In the multiple regression analysis, age, oxygen saturation and BMI explained 56% of the total variance in 6MWT.

For the Group B (50 subjects), we calculated the predicted values for the 6MWT using the regression equation proposed in the present study. The average difference between predicted and measured 6MWT values (15.46 m; SD = 58.32 m) did not reach statistical significance (p = 0.72).

DISCUSSION

The SMWT checks the submaximal exercise capacity of an individual which is an indirect assessment of his cardiorespiratory status. It is non-invasive and a powerful modality to assess the functional capacity of an individual. Reference values of normal weight individuals cannot be applied in obese population as the average distance walked by them would be shorter, which is attributed to their higher metabolic cost of gait and reduced tolerance to exercise. Obesity is associated with reduced aerobic capacity and mobility disability but no reference equation for predicting the distance walked in SMWT has been proposed for Indian Population. The aim of present study is to provide the Reference equation which could be used in day to day practice.

Several studies have already highlighted the correlations between distance walked in 6 min and factors as age, gender, height and BMI.

In our study, age, BMI and Oxygen saturation at rest significantly affected the test results. Multiple linear regression analysis of our data served to develop a new predictive model including the three variables affecting test results. The equation proposed in this study explained 56% of the variation in 6MWT results.

Capodaglio et al, in their study on 323 obese subjects, found that distance walked during the 6MWT was significantly correlated to age, gender and BMI.[5] Though we found strong correlation of SMWD with SpO_2 (at rest) but no relation with gender was found.

Enright et al, found that age, body weight/BMI, and height (for men) were independently associated with the distance walked during 6MWT.[6] Enright's equation had been calculated from a sample of healthy subjects aged 40-80 years. About 60% of the variance in 6MWT distance remains unexplained by his gender-specific models. Enright's equations were originally validated for BMI <35 kg/m2 and therefore, although they have been used in clinical practice on subjects with different BMI, the conversion factors in the formula are not reliable.

Earlier studies in India like Ramanathan et al, focused on deriving equation for older subjects, we have derived a Reference equation specific for obese population.[8]

From a mathematical point of view, the correlation with the distance covered in 6 min would certainly benefit from the inclusion of several other factors in the predictive formula, as already suggested by Hulens et al.[9] Among the predictors of the distance walked, other physiological (heart rate, oxygen saturation, blood pressure, muscle strength) and life style (physical activity levels) factors may well play a role, but their inclusion in an equation appears unpractical for clinical use. Such considerations might also in part explain why no reference values for the obese population are available till now. In our study, we have found statistically significant correlation between the distance walked in SMWT and the oxygen saturation at rest in obese and that is why included it in the reference equation.

Troosters et al, found that age, gender, height and weight explained 66% of the 6MWT distance variability in 51 healthy adults.[9] We have a sample size of 150 healthy obese individuals and found significant correlation with BMI and age, but not gender.

Limitations

The 6MWT does not determine peak oxygen uptake, diagnose the cause of dyspnea on exertion, or evaluate the causes or mechanisms of exercise limitation.[10,11] Reasons for statistically insignificant difference between predicted and measured SMWD in Group B could be different encouragement levels, mental status of patients, lung capacities and muscle strength. Reason can be genetically different South Asian population from European Caucasian Populations which were used in previous studies. Also, the difference in results from other studies as done by Capodaglio et al, may be due to different geographic areas and Demographic profile in study population.

CONCLUSION

The present study has taken the Indian Obese Population as reference population. With the help of the reference equation, we can quantify the changes in performance in SMWT according to the age, BMI and SpO_2. It would serve as benchmark to assess baseline functional capacity, prescribe proper and safe exercise intensity and monitor changes after rehabilitation interventions. Also a comorbid condition could be guessed on the basis of

performance in SMWT that may imply further work up. Physicians can use the Reference equation in day to day practice to assess the cardiorespiratory status of obese individuals.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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