Six minute walk test as a clinical parameter to assess the sub maximal exercise capacity in Non Obese and Obese healthy young Indian population

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Abstract

Six minute walk test (6MWT) is the easiest tool utilized for assessing the functional capacity in the routine clinical practice. The present study aims at assessing the cardio-respiratory capacity in non obese and obese subjects using 6MWT. 22 healthy subjects in age group 17-25 years participated in the study (11 non obese, 11-obese). The written consent was taken from those healthy subjects willing to participate in the study. An anthropometric measurement was taken prior the test. Pre test vital parameters like pulse rate (PR), respiratory rate (RR), systolic blood pressure (SBP), diastolic blood pressure (DBP) and rate of perceived exertion (RPE) was noted on modified Borg’s Scale 0-10. General instruction before the 6MWT and the 6MWT was performed according to ATS guidelines. Significant difference was noted between non obese and obese individuals in their cardio respiratory effort and the capacity and also in the actual 6MWD and the Predicted 6MWD calculated.6MWD showed strongest negative correlation with weight, BMI, post test PR, RR, RPE. No significant difference was found between males and females. The 6MWT is a simple reliable tool that can be used routinely for assessing cardio respiratory capacity and prevent from the risk factors associated with obesity.

Keywords: 6MWT, Obesity

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Introduction

Obesity has reached epidemic proportions. It is a worldwide problem affecting million people, with an increasing prevalence in both developed and developing countries. Inactive lifestyle has given rise to serious health conditions especially lifestyle diseases in recent years. Obesity contributes to numerous chronic diseases and early mortality. Obesity and overweight is a major risk factor for metabolic and endocrine dysfunctions such as insulin resistance, fatty liver disease, type 2 diabetes mellitus, and cardiovascular disease in young adult life. This is because of higher consumption of calories, increased sedentary lifestyle, rapid economic development and westernization. Assessing the physical capacity to prevent this risk factor becomes the routine screening in the clinical setup on daily routine. Physical capacity on regular basis can be assessed with a cardiopulmonary exercise testing (CPET) which is the gold standard of exercise testing. It targets the cardiovascular, respiratory and metabolic system and provides the information of the overall physical fitness of an individual or subject. These CPET requires a highly equipped laboratory and the skilled technician. It is expensive and time consuming. Hence it becomes difficult to assess the exercise capacity routinely. Hence simple sub maximal exercise test like six minute walk test (6MWT) can be used to assess the physical activity routinely as it reflects the activity of daily living.

BMI always is with respect to lifestyle and occupation of the population. In the changing scenario of the Indian society, there was a need to change the statistics for the Indian population as every 10 extra kilograms above the stipulated body weight; life expectancy of a person reduces by 3 years.

The 6-minute walk test (6MWT) is a valuable and practical tool to measure exercise performance on a sub maximum level reflecting activities of daily living better than any other functional walk test. It is a self paced walking test. It is a simple, objective, reliable, valid, sensitive and a reproducible measurement of functional capacity. Its principal advantage being its operational simplicity and low cost. It better related to daily-living activities. This test has been used in a variety of chronic disease adult and pediatric populations as well as in healthy adults to measure exercise capacity. It has also been used to detect changes following interventions to improve exercise tolerance for healthy older adults. It has been used with a variety of other conditions such as heart failure, chronic obstructive pulmonary disease (COPD), stroke and Parkinson disease. It is also often used in rehabilitation programs to measure physical fitness or in cases as predictive tool of morbidity or mortality. It is also a good predictor of disability.

According to the WHO, body fatness is classified based on body mass index & is considered healthy if BMI > 18.5, overweight if BMI > 25, obese if BMI > 30 and morbidly obese if BMI > 40. Weight gain leads to greater adverse metabolic changes in certain ethnic groups. As a result Asians should be
considered overweight if BMI > 23 and obese if BMI > 27.5.\textsuperscript{2,3}

1. Grading of BMI\textsuperscript{2,3}
2. 18.5 - 22.9 - Normal
3. 23 - 25 - Overweight
4. Above 25- Obese

Materials and methods

22 healthy subjects in the age 17-25 years were selected for the study. The subjects were explained about the study and consent was taken from them. The samples were collected from Lokmanya Tilak Municipal medical College and Hospital, Mumbai.

The written consent was taken from the subjects willing to participate in the study. All the healthy subjects in 17-25 years willing to participate were included in the study. The exclusion criteria was any chronic disease, smokers etc. Before starting the study, the subjects were given general instruction like not to have any meal 2 hours prior the test. They were instructed to wear loose comfortable clothing and comfortable footwear as per ATS guidelines for 6MWT. 6MWT was demonstrated to the each subject.

Weight was assessed using the weighing scale and height was assessed using the measure tape mounted on the wall. Body Mass index (BMI) was calculated using the formula Weight (kilograms)/ [Height (centimeters)]\textsuperscript{2}

Pre test vital parameters like PR, RR, SBP, DBP was noted prior performing the test. Pre RPE according to modified Borg’s scale on 0-10 was noted.

The 6MWT was performed according to ATS guidelines as follows\textsuperscript{7}

Instruction given for 6 minute walk test \textsuperscript{7}

The subjects were asked to walk as far as possible for 6 minutes, but not to run or jog. They walked back and forth along a straight flat corridor of 30 metres. The subjects were told that they may get exerted over 6 minutes and they may probably get out of breath or become exhausted. They were permitted to slow down, to stop, and rest as necessary and may lean against the wall for resting, but resume walking as soon as they were able to do so. They would be walking back and forth around the cones. They should pivot briskly around the cones and continue back the other way without hesitation.

Six minute walk test procedure \textsuperscript{7}

Each subject was instructed to walk as far as possible during a 6-minute period over a 30-m course in a corridor. The course was identified by two traffic cones, and the corridor was marked every 3 m according to ATS standards. Instructions given to the subjects were standardized as mentioned above. Encouragement was given every minute of the test procedure for 6 minute using the standard ATS phrases in an even tone as follows:

“After the first minute, tell the patient the following: “You are doing well. You have 5 minutes to go.”

When the timer shows 4 minutes remaining, tell the patient the following:
“Keep up the good work. You have 4 minutes to go.”

When the timer shows 3 minutes remaining, tell the patient the following: “You are doing well. You are halfway done.”

When the timer shows 2 minutes remaining, tell the patient the following: “Keep up the good work. You have only 2 minutes left.”

When the timer shows only 1 minute remaining, tell the patients: “You are doing well. You have only 1 minute to go.”

When the stopwatch showed 6 minute the subjects was told to “Stop!” .Go to the subject and mark the spot were the patient stopped. Subjects were asked for any of the following symptoms: chest pain, intolerable dyspnoea, dizziness, leg cramps which were additional criteria for immediately stopping the test. Before and after the test, the following parameters were noted: pulse rate; respiratory rate; blood pressure, and RPE using the Borg scale. The numbers of laps were recorded and the additional distance covered by the subject and then the total 6 minute walk distance was calculated.

After the completion of the test, post test vital parameters like PR, RR, SBP, DBP was noted immediately after the test. Post RPE according to modified Borg’s scale on 0-10 was noted.

This distance was then compared with the predicted distance using the formula given by Enright 8, 9:

\[
\text{Men} = [7.57\times \text{height (cms)}] - [5.02\times \text{age}] - [1.76\times \text{weight (kgs)}] - 309
\]

\[
\text{Women} = [2.11\times \text{height (cms)}] - [2.29\times \text{weight (kgs)}] - [5.78\times \text{age}] + 667
\]
Table 1: Descriptive Statistics in Non Obese & Obese subjects

<table>
<thead>
<tr>
<th></th>
<th>Non Obese (N=11)</th>
<th>Obese (N=11)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>19.36±1.80</td>
<td>21.18±2.39</td>
<td>0.095</td>
</tr>
<tr>
<td>Weight</td>
<td>52.09±3.53</td>
<td>78.72±6.70</td>
<td>0.000</td>
</tr>
<tr>
<td>Height</td>
<td>159.00±3.60</td>
<td>181.27±5.10</td>
<td>0.242</td>
</tr>
<tr>
<td>BMI</td>
<td>20.54±1.43</td>
<td>30.27±1.79</td>
<td>0.000</td>
</tr>
<tr>
<td>Pre RR</td>
<td>16.90±1.81</td>
<td>17.63±1.74</td>
<td>0.350</td>
</tr>
<tr>
<td>Post RR</td>
<td>21.18±1.32</td>
<td>26.00±2.36</td>
<td>0.000</td>
</tr>
<tr>
<td>Pre PR</td>
<td>75.54±8.00</td>
<td>77.63±4.88</td>
<td>0.417</td>
</tr>
<tr>
<td>Post PR</td>
<td>89.81±9.22</td>
<td>99.27±3.13</td>
<td>0.000</td>
</tr>
<tr>
<td>Pre SBP</td>
<td>108.55±5.22</td>
<td>112.73±4.75</td>
<td>0.064</td>
</tr>
<tr>
<td>Post SBP</td>
<td>120.00±7.15</td>
<td>128.00±3.22</td>
<td>0.05</td>
</tr>
<tr>
<td>Pre DHR</td>
<td>73.45±4.56</td>
<td>76.72±3.92</td>
<td>0.037</td>
</tr>
<tr>
<td>Post DHR</td>
<td>77.09±3.61</td>
<td>82.00±3.46</td>
<td>0.04</td>
</tr>
<tr>
<td>Pre RFE</td>
<td>0.00±0.00</td>
<td>0.00±0.00</td>
<td>0.040</td>
</tr>
<tr>
<td>Post RFE</td>
<td>1.45±0.52</td>
<td>2.72±1.10</td>
<td>0.094</td>
</tr>
<tr>
<td>∆MWD</td>
<td>750.45±22.97</td>
<td>583.64±25.69</td>
<td>0.090</td>
</tr>
<tr>
<td>Precoated ∆MWD</td>
<td>757.44±43.82</td>
<td>700.62±21.16</td>
<td>0.02</td>
</tr>
</tbody>
</table>

Result

Statistical analysis was done using SPSS software 16. The mean and standard deviation was calculated. Comparison was made between Non-Obese and Obese. Comparison was made between males and females.
Table 1 shows comparison of non-obese and obese group providing with the descriptive statistics. Comparison between these 2 groups was done using independent t-test. In these 2 groups significant results was obtained between weight, BMI, Post RR, Post PR, Post RPE, Actual 6MWD with p value of 0.000 and post SBP (p=0.05), Predicted 6MWD (p=0.02) and showed that obese group had higher values suggesting increased effort by obese subjects in the study. Overall effect of this is reflected in terms of increased BMI, Post RR, Post PR, Post SBP, Post DBP, Post RPE and 6 MWD in obese group. It also shows significant difference between Actual 6MWD and predicted 6MWD (p=0.02).

Table 2 shows comparison between males and females. It was found that there was no significant difference between these 2 groups.
Table 3: Correlation of 6MWD with different variables

<table>
<thead>
<tr>
<th>6MWD</th>
<th>Gender &amp; Non Obese</th>
<th>Weight</th>
<th>Height</th>
<th>BMI</th>
<th>Post RR</th>
<th>Post PR</th>
<th>Post SBP</th>
<th>Pre DBP</th>
<th>Post DBP</th>
<th>Post RPE</th>
<th>Pred 6MWD</th>
</tr>
</thead>
<tbody>
<tr>
<td>r</td>
<td>0.266</td>
<td>-0.927</td>
<td>-0.914</td>
<td>-0.281</td>
<td>-0.931</td>
<td>-0.783</td>
<td>-0.538</td>
<td>-0.497</td>
<td>-0.461</td>
<td>-0.648</td>
<td>-0.695</td>
</tr>
<tr>
<td>p</td>
<td>0.653</td>
<td>0.000</td>
<td>0.000</td>
<td>0.241</td>
<td>0.000</td>
<td>0.010</td>
<td>0.019</td>
<td>0.631</td>
<td>0.001</td>
<td>0.000</td>
<td>0.003</td>
</tr>
</tbody>
</table>

Table 3 shows correlation of 6MWD with different variables. Significant correlation of 6 MWD with strong negative correlation was found with weight ($r = -0.914, p=0.00$), BMI ($r = -0.937, p=0.00$), Post RR ($r = -0.783, p=0.00$) and moderate negative correlation with Post DBP ($r=-0.461, p=0.00$), Post RPE ($r=-0.695, p=0.00$), Post PR ($r = -0.538, p=0.01$), Post SBP ($r = -0.497, p=0.019$).

Table 4: Correlation of Predicted 6MWD with different variables

<table>
<thead>
<tr>
<th>Obese &amp; Non Obese</th>
<th>Age</th>
<th>Weight</th>
<th>BMI</th>
<th>Post RR</th>
<th>Post PR</th>
<th>6MWD</th>
</tr>
</thead>
<tbody>
<tr>
<td>r</td>
<td>-0.655</td>
<td>-0.545</td>
<td>-0.633</td>
<td>-0.638</td>
<td>-0.513</td>
<td>-0.794</td>
</tr>
<tr>
<td>p</td>
<td>0.01</td>
<td>0.009</td>
<td>0.002</td>
<td>0.001</td>
<td>0.015</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Table 4 shows correlation of Predicted 6MWD between non obese and obese ($r=-0.655, p=0.01$), age ($r=-0.545, p=0.009$), weight ($r=-0.633, p=0.002$), BMI ($r=-0.638, p=0.001$). Post test vital parameters shows a significant correlation of post RR ($r=-0.513, p=0.015$) and post PR ($r=-0.794, p=0.000$)

Discussion

The most important finding in the study is significant difference between Non obese and obese groups as shown in table 1. Actual 6MWD and Predicted 6MWD have shown a significant difference ($p=0.013$) indicating that actual distance covered is less than the predicted 6MWD. This distance might be affected due to factors affecting the 6MWT especially age, weight, height, gender $^{7,8,9}$.  

6MWD has shown a good negative correlation with weight and BMI (table 3) indicating as the weight is increasing, the BMI increases resulting in decrease in 6MWD.

Similar results were noted by Troosters et al. concluded that these variables accounted for 66% of the variance in a sample of 53 healthy Caucasian adults aged 50 to 85 years,
who were not previously hospitalized and did not show any chronic condition affecting physical capacity\textsuperscript{11}. Enright performed the 6MWT in 290 healthy adults aged 40 to 80 years with BMI, 35 kg/m\textsuperscript{2}, finding a significant difference depending on height, sex and age\textsuperscript{8,9}.

Post test vitals has shown a significant difference especially Post test PR, post test RR, Post test SBP and Post test RPE between these two groups. Greater dyspnea and exertion was perceived by obese subject as compared to non obese. Post test PR and SBP was greater in obese. This was because of excess body fat that impairs cardio respiratory functions and decreases mechanical efficiency for a given workload. Obese individuals require greater amount of oxygen and thus places the increase load on the heart \textsuperscript{12,13,14,18,19,20,21}.

Females have put the maximum effort compared to males while performing 6MWT and covered less distance than males (table 2). There was not much difference in the Actual 6MWD and Predicted 6MWD in males.

The 6MWT thus represents a practical, simple, and reliable assessment tool of exercise performance in the population of all the age at the clinical setting thus ruling out the risk factors due to obesity\textsuperscript{7,8,9}.

**Limitations of the study**

The study has sample size which is small. The effect of obesity should be assessed at all age groups and see in which age group obesity has its maximum hazardous effect.

**CLINICAL APPLICATION**

Obesity being dangerous and have its effect on all the systems of the body. Obesity has reached its peak in the entire world is due to sedentary lifestyle, lack of exercises, diet. Though study was carried out on a small population and only young adults, it is seen that obesity has shown its effect on cardio respiratory capacity of this age group as well. The 6MWT is commonly used to assess aerobic capacity. Hence it is used as a tool in routine to assess and evaluate the cardiovascular and respiratory capacity of an individual of all the age groups though the BMI falls within the normal range.

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