INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

ISSN: 2454-132X
Impact factor: 4.295
(Volume 5, Issue 1)
Available online at: www.ijariit.com

Comparison of the physiological responses and distance walked during 6-minute walk test on level ground and on a treadmill in normal healthy middle age group individuals

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ABSTRACT

Ageing changes in the cardiovascular, respiratory, central nervous system and musculoskeletal systems etc results in an overall reduction of functional capacity, which may affect daily activities in middle age group individuals. So assessment of functional capacity is an important aspect in this population group. The 6 Minute walk test is extensively being used to assess the functional capacity as it is more reflective of activities of daily living than the other walk tests and it is easy to administer and better tolerated. Treadmills can be an efficient, and space-saving alternative for performing the standard 6 MWT, as it saves the space, and enables constant hemodynamic surveillance that is necessary for the safety test performance, and will also minimize the errors in calculating the various parameters during the 6MWT. The aim of the study: This study is aimed at comparing the physiological responses and the distance walked during the 6MWT on level ground (LG) and on a Treadmill (TM) in normal healthy middle age group individuals. The results showed a statistically significant increase in blood pressures, heart rate, respiratory rate and RPE on Borg's scale (P < 0.001) and, statistically significant decrease in six-minute walk distance (P < 0.001) after the TM 6MWT as compared to the LG 6MWT. The present study was attempted to analyze the comparative effects of TM 6MWT and LG 6MWT on physiological responses and distance walked in healthy middle group individuals. There was a significant increase in physiological responses from the baseline after TM 6MWT as compared to LG 6MWT in healthy middle group individuals. There was a significant decrease in 6-minute walk distance after TM 6MWT as compared to LG 6MWT in healthy middle group individuals.

Keywords— *6MWT, RPE, Borg's scale, TM (Treadmill)*

1. INTRODUCTION

Walking is convenient; it needs no special equipment, is self regulating and inherently safe. Walking is as natural as breathing[1]" {John butcher in 1999}

Walking as an exercise is a daily routine for millions of people around the world. In today's 21st century people who are health conscious, use walking as the simplest mode of exercise to keep fit. Functional walking is very essential to maintain the independence and quality of life. Walking capacity is affected by age-related changes in the cardiovascular, pulmonary, and musculoskeletal systems and is there by one of the activity to measure the functional capacity[2].

Population of ageing adults is associated with an increase in the incidence of chronic conditions that may affect the functional capacity[3]. Extensive research has demonstrated that, evaluation of functional capacity is very essential in terms of diagnostic, therapeutic and prognostic information in various disease states of ageing population[4].

The 6 Minute walk test is extensively being used to assess the functional capacity and is more reflective of activities of daily living than the other walk tests and is easy to administer and better tolerated[5]. It is useful in evaluating the responses to therapeutic interventions as well as to predict morbidity and mortality.[6]

Sherra Solway et.al. (2001) performed a qualitative systematic overview of the measurement properties of the most commonly utilized walk tests and concluded that the measurement properties of the 6MWT are more reliable as compared to the other walk tests.[5]

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2. PROCEDURES FOR DATA COLLECTION

The purpose and methodology of the study was explained to all the patients in detail and they were also informed about the risks, in a language that they understood. They were made aware about the right to terminate the participation at any time during the procedure. All patients acknowledged their understanding of the study and their willingness to participate by providing a signed consent form. The patients' demographic details like age, gender, occupation, contact number and address were recorded as per proforma.

2.1 Subjects and Methods

For the study a total of 56 subjects were screened, out of which 4 subjects had difficulty of walking on a treadmill and therefore refused to participate in the study. Two subjects did not come for the second day test method and thereby were excluded. So the data of 50 participants was subjected to statistical analysis. They were selected from Lata Mangeshkar medical college, Nagpur outpatient department. There ages range from 45-60 years, who fulfilled the guidelines of American Thoracic Society for six minute walk test. On the day of assessment the subjects were allotted the test protocol randomly by choosing odd number and even number. Odd numbers were enrolled for LG 6MWT on day1 and TM 6MWT on the subsequent day. Even numbers were enrolled for TM 6MWT on the day1 and LG 6MWT on the subsequent day.

2.1.1 For LG 6MWT: Each subject performed 6- minute walk test in well equipped cardio- respiratory physiotherapy lab with an attached indoor hallway, along a long, flat, straight, enclosed corridor with a hard surface. The walking course was 30 m in length. The length of the corridor was marked every 3 m. The turnaround end points were marked with a cone. A starting line, which marked the beginning and end of each 60-m lap, was marked on the floor using brightly colored tape. Subjects were then made to walk along the marked hallway with their self-selected pace for a period of six minutes. The subjects were instructed to report any discomfort, chest pain, and intolerable dyspnea, leg cramps, staggering, and diaphoresis, pale or ashen appearance and allowed to stop if any of this symptoms produced. Immediately after completion of the test for six minutes, the post test parameters i.e. heart rate, blood pressure, respiratory rate, RPE on Borg's scale and total distance walked by the subject were recorded. Total distance covered at the end of the 6 minutes was calculated by multiplying number of laps x 60 meters + final partial lap distance. The subjects were monitored till all the parameters recovered to normal.[6]All the participants performed the LG 6MWT without taking the rest.

Fig. 1: LG Six minute walk test

2.1.2 For Treadmill 6MWT: The 6 MWT was performed on the treadmill without inclination**.** Participants were asked to self-select the TM start speed. Then Heart rate, Blood pressures, RR , RPE as recorded by Borg's Scale & distance walked were recorded immediately after the TM 6MWT. The subjects were monitored till all the parameters recovered to normal.

All the subjects received similar encouragements during both the tests. All the subjects performed the TM 6MWT without taking rest. The data obtained was then subjects' statistical analysis.

Fig. 2: TM Six minute walk test

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3. DATA ANALYSIS

Following dependent variables were used for statistical analysis:

- Blood pressures (SBP & DBP), Heart rate (HR), Respiratory Rate (RR), RPE on Borg's scale and six minute walk distance (6MWD).
- The data was analyzed statistically by using Graph Pad InStat-3 software.
- Various statistical measures such as mean, standard deviation (SD), and tests of significance were calculated for this purpose. The sample data failed the normality test, so nonparametric test i.e. Wilcoxon matched-pairs signed-ranks test was used with $P < 0.05$.
- The parametric test i.e. paired t-test was used for the comparison of difference in means of physiological responses and distance walked in LG 6MWT and TM 6MWT.
- The level of significance was set at **$P < 0.05$.**

Table 1: Showing comparison of mean pre-test & post-test SBP in six minute walk test for LG 6MWT and TM 6MWT

	LG 6MWT		TM 6MWT	
	Pre	**Post**	**Pre**	**Post**
Mean (Std. Deviation)	121.96 (±7.618)	129.04 (± 7.889)	119.76 (±7.213)	137.02 (± 9.354)
P Value	< 0.0001***		< 0.0001***	
Mean Change (Std. Deviation)	7.080 (± 1.816)		17.260 (± 5.086)	
P Value	< 0.0001***			

Interpretation: There was statistically significant increase in SBP after six minute walk test in both the test methods but SBP increased more after TM 6MWT.

4. DISCUSSION

The present study was designed to compare the physiological responses and distance walked in TM 6MWT and LG 6MWT in normal healthy middle age group individuals.

Ageing changes in cardiovascular, respiratory, central nervous system and musculoskeletal systems etc. results in an overall reduction of functional capacity, which may affect daily activities in middle age group individuals[2]. So assessment of functional capacity is an important aspect in this population group.

6-minute walk test (6MWT) is more reflective of the activities of daily living than the other walk tests. ATS guidelines suggests that, the 6MWT should be typically performed in a long and straight hallway which should be at least 30 meter long and 3 meter wide, not be carpeted and free of obstacles and traffic.[6] However many clinical set ups do not have these standardized criteria's prescribed by ATS to execute the 6 MWT and it is difficult to constantly monitor the parameters during the LG 6MWT.

Treadmills can be an efficient, and space saving alternative for performing the 6 MWT, [12] which enables the continuous hemodynamic surveillance that is necessary for the safe test performance.[10]

So this study was undertaken to compare the various physiological responses and distance walked during the LG 6MWT & TM 6MWT in 50 normal healthy subjects aged between 45-60 years in Indian population, with a mean age of 52.8 years and of SD ± 4.571. All the subjects were assessed for pre and post test differences in physiological responses and distance walked for both the test methods.

The result of our study showed statistically significant increase in the physiological responses and a decrease in the distance walked when the subjects performed TM 6MWT as compared to LG 6MWT.

Lenssen AF et. al. (2012) studied the interchangeability of treadmill and hallway 6-MWT. They performed the TM 6 MWT followed by hallway 6 MWT in 69 subjects in which they analysed the 6MWD, Heart rates, Blood pressures and RPE on Borg's scales for both the tests methods and observed significant increase in the physiological responses and decrease in the distance walked by subjects during TM 6MWT. They stated that experience of fear of falling and difficulty in adjusting with the treadmill speed negatively affected the performance of the subjects during treadmill walk test.[17]

The result of the present study showed that, during the TM 6MWT, there was significant increase in the Blood pressures (SBP and DBP) as compared to the LG 6MWT. This is explained by the study of James V. Freeman on autonomic nervous system interaction with the cardiovascular system during TM walk, who stated that anxiety and fear felt by the subjects because of the unfamiliarity with the TM walk, led to the hyperactivity of the autonomic nervous system resulting in the secretion of noradrenaline, which caused increase in the force of cardiac contraction along with vasoconstriction of the blood vessels, which resulted increase in the blood pressures (SBP and DBP).[36]

The result of the present study showed, there was a significant increase in HR of the subjects when they performed TM 6MWT as compared to LG 6MWT. Imai K et.al, stated that initiation of the treadmill walk increases the vagal withdrawal and further increases in the heart rate because of increased sympathetic and decreased parasympathetic activity.[36,37]

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5. CONCLUSION

- The present study was performed to analyze the comparative effects of TM 6MWT and LG 6MWT on physiological responses and distance walked in healthy middle group individuals.
- There was a significant increase in physiological responses from the baseline after TM 6MWT as compared to LG 6MWT in healthy middle group individuals.
- There was a significant decrease in 6 minute walk distance after TM 6MWT as compared to LG 6MWT in healthy middle group individuals.

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