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Abstract

AIM: Patients with pulmonary tuberculosis (TB) tends to have limited exercise tolerance and a significant disability affecting their activities of daily living. The importance of exercise in the management of these patients has not been well investigated. This study was designed to assess the cardiovascular fitness of patients with pulmonary TB using the six-minute walk test (6-MWT). METHOD: Sixty five consented patients with Pulmonary TB were consecutively recruited into the study. The patients performed 6-MWT over a 30 meter course on a level walkway at a speed as fast as they could. Data were obtained on participants' physical characteristics, pre and post exercise blood pressure and heart rate, and maximum oxygen consumption. Data were analyzed using descriptive statistics of mean and standard deviation and paired t-test. RESULTS: The post walk test cardiovascular parameters were significantly higher than the resting cardiovascular parameters. The mean VO2 max and MET of the participants were 11.7±0.97 (ml O2kg -1min-1) and 3.35±0.28 (mL/Kg) respectively. The means 6-MWT distance for male and female participants were 502.0±43.0m 481.7±68.3m respectively. CONCLUSION: The result implies that the 6-MWT is capable of evoking a significant cardiovascular change among patients with pulmonary TB. The 6-MWT may be useful in the assessment of functional capacity of patients with pulmonary TB. [TAF Prev Med Bull 2010; 9(2): 99-106]

Assessment of Cardiovascular Fitness of Patients with Pulmonary Tuberculosis Using Six Minute Walk Test

[Akciğer Tüberkülozlu Hastaların Kardiyovasküler Sağlıklarının, Altı Dakikalık Yürüme Testi Kullanılarak Değerlendirilmesi]

SUMMARY

AIM: Patients with pulmonary tuberculosis (TB) tends to have limited exercise tolerance and a significant disability affecting their activities of daily living. The importance of exercise in the management of these patients has not been well investigated. This study was designed to assess the cardiovascular fitness of patients with pulmonary TB using the six-minute walk test (6-MWT).

METHOD: Sixty five consented patients with Pulmonary TB were consecutively recruited into the study. The patients performed 6-MWT over a 30 meter course on a level walkway at a speed as fast as they could. Data were obtained on participants' physical characteristics, pre and post exercise blood pressure and heart rate, and maximum oxygen consumption. Data were analyzed using descriptive statistics of mean and standard deviation and paired t-test.

RESULTS: The post walk test cardiovascular parameters were significantly higher than the resting cardiovascular parameters. The mean VO2 max and MET of the participants were 11.7±0.97 (ml O2kg -1min-1) and 3.35±0.28 (mL/Kg) respectively. The means 6-MWT distance for male and female participants were 502.0±43.0m 481.7±68.3m respectively.

CONCLUSION: The result implies that the 6-MWT is capable of evoking a significant cardiovascular change among patients with pulmonary TB. The 6-MWT may be useful in the assessment of functional capacity of patients with pulmonary TB.

ÖZET

AMAÇ: Akciğer tüberkülozu hastaları, azalmış egzersiz toleransı ve günlük yaşamsal aktivitelerini gerçekleştirmede yetersizlik yaşamaktadırlar. Bu hastalar incelenirken egzersizin önemi yeterince araştırılmamıştır. Bu çalışma, akciğer tüberkülozlu hastalarinin alti dakikalik yürüme testi (6-MWT) kullanilarak kardiyovasküler sağlıklarının değerlendirilmesi amacıyla gerçekleştirilmiştir.

YÖNTEM: Altmış beş gönüllü akciğer tüberkülozu hastası çalışmaya dahil edilmiştir. Katılımcılar, 6-MWT testini 30 metrelik yürüme parkurunda yapabildikleri kadar hızlı yürüyerek uygulamışlardır. Katılımcılardan toplanan veriler; fiziksel karakteristikleri, egzersiz öncesi-sonrası kan basıncı ve kalp hızı ölçümleri ve maksimum oksijen tüketimi şeklindedir. Elde edilen bulgular, tanımlayıcı analizler, ortalama ve standart sapma ve bağımlı gruplarda t testi kullanılarak analiz edilmiştir.

BULGULAR: Yürüyüş sonu kardiyovasküler bulguların dinlenme sırasındaki bulgulardan anlamlı bir şekilde yüksek oldukları bulunmuştur. Ortalama VO2 max ve katılımcıların MET değerleri sırasıyla; 11,7±0,97 (ml O2kg -1min-1) ve 3,35±0,28 (mL/Kg). Ortalama 6-MWT uzaklığı erkeklerde ve kadın katılımcılarda sırasıyla, 502.0±43.0 m. ve 481.7±68.3 m. bulunmuştur.

SONUÇ: 6-MWT testi sonuçlarına gore, akciğer tüberkülozu hastalarında anlamlı kardiyovasküler değişimler olduğu değerlendirilmiştir. 6-MWT testi akciğer tüberkülozu hastaların fonksiyonel kapasitelerini değerlendirmek açısından kullanışlı olabilir.

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Key Words: Cardiovascular Fitness, Pulmonary Tuberculosis, Six Minute Walk Test.

Anahtar Kelimeler: Kardiyovasküler Sağlık, Akciğer Tüberkülozu, Altı Dakikalık Yürüme Testi.

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INTRODUCTION

The global burden of pulmonary tuberculosis (TB) has been reported to be on the rise (1,2) and it is still endemic in the largest Asian countries, Eastern Europe and Africa, thereby causing a significant socio-economic impact (1,2). Nigeria has the world's fourth largest tuberculosis burden among the 22 countries where TB prevalence is highest worldwide, with nearly 374,000 estimated new cases annually (3,4) and with a prevalence of 9.2% as reported in a study by Salami and Oluboyo (5). TB was considered of passing historical significance to emergency physicians practicing in developed world, but resurfaced due primarily to newly recognize HIV epidemic in 1985 and growing indigent population (6). Other factors that have made TB perennial especially in Africa include; crowded and unsanitary living conditions and poor nutrition, exposure to untreated case, drug resistant strains of TB, and poor socioeconomic factors among others (1,7–13).

people each year (1). Also, it is the leading cause of death among people who are HIV positive and it accounts for about 13% of AIDS death world wide with the highest mortality per capita in the Africa region (2). Delay in the diagnosis of TB and commencement of treatment has been reported to be common in Nigeria and other Sub-Sahara Africa countries (5,14,15) which in turn increase the risk of death and enhance tuberculosis transmission in the community. A low level of knowledge and awareness about the disease has been implicated among these patients as they often present at local private medical facilities and traditional healers despite the WHO efforts at eradicating the disease (16).

Patients who have post TB lung disorder usually show stable restrictive or mixed ventilatory disorders and seldom show pure obstructive disorder. Like Chronic Obstructive Pulmonary Disease (COPD), patients with non-COPD have limited exercise tolerance and a significant disability affecting their activities of daily living (17). An individualized disease specific and carefully progressed pulmonary rehabilitation exercise programmes have been reported to help build up the respiratory endurance and physical conditioning of patients with COPD (18, 19, 20) and, also non-COPD patients such as post TB lung disorders, cystic fibrosis, pulmonary fibrosis and restrictive thoracic disease (17,21). Physical therapy employs therapeutic exercise in the evaluation and treatment of all patients with acute or chronic lung conditions (18,20,22,23,24). The exercise programmes have been reported to help to improve or maintain physical well-being and also establish a baseline by which improvement can be measured (25).

Owing to the importance of exercise capacity assessment in the management of patients with COPD, the 6-minute walk test (6-MWT) has been reported to be important in the objective evaluation of functional exercise capacity in pulmonary rehabilitation (26,27). A recent review of functional walk tests has concluded that the 6-MWT is easy to administer, better tolerated, and more reflective of activities of daily living than other walk tests (28). Sian et al (29) also reported that 6-MWT may be better tolerated because it is self paced and there is capacity to rest.

Though patients with pulmonary TB tends to have limited exercise tolerance and a significant disability management of these patients has not been well investigated. Patients with TB and other COPD cases are not routinely referred for rehabilitation in Nigeria. Sub Saharan Africa (SSA) such as Nigeria that has a high prevalence of TB needs evidence to proof the importance of exercise in the routine rehabilitation of these patients. This study was designed to assess the cardiovascular fitness of patients with pulmonary TB using the 6-MWT.

MATERIALS AND METHODS

Participants

Sixty five consecutive patients diagnosed by a chest physician as having chronic TB and are receiving treatment at the communicable disease department of the Obafemi Awolowo University Teaching Hospitals Complex (OAUTHC); Ile-Ife, Nigeria participated in this study. The diagnosis was based on 3 samples of sputum analyzed for acid-alcohol fast bacilli (AAFB). Patients provided the samples on the spot at initial presentation. Subsequently, they were given sputum containers to take home for early morning samples where 2 other AAFB tests were conducted. The presence of AAFB in any 2 samples or presence of AAFB in 1 sample couple with radiographic pattern consistent with pulmonary TB confirmed the diagnosis. The research protocol was approved by the ethical committee of the OAUTHC, Ile-Ife, Nigeria. The inclusion criteria required that the patients have clinically stable pulmonary TB and be on stable drug regimen. All the patients were already placed on an 8 months anti-tuberculosis regimen divided into an initiation phase which lasted for 2 months and continuation phase of 6 months. Four drugs such as Isoniazid (75mg), Rifampizin (150mg), pyrazinamide (150mg) and ethambutol (400mg) in fixed dose combinations were administered based on the weight during the initiation phase. In the continuation phase, they receive isoniazid and ethambutol in fix dose combination for 6 months. This regimen was based on WHO recommendation for patients in low resources countries. All the subjects were certified cured before being recruited for the study. Patients with diagnosed heart condition or requiring oxygen support or patients with cerebrovascular disease or musculoskeletal abnormality (that could prevent

Procedure

The informed consent of the participants was obtained before the commencement of the study and the purpose of the study was explained. The participants were educated on the risk of possible short term discomfort during the test; but on reported feeling of severe exhaustion or discomfort as assess by the Borg rating scale, the exercise programme was terminated immediately and such participants were not required to complete the test protocol. Data were obtained on participants' age, sex, height and weight. After 10 minutes of quiet sitting, the baseline blood pressure (systolic and diastolic) and heart rate were assessed. After about 10 min of quiet sitting, an electronic blood pressure monitors (Omron Healthcare Inc., Vernon Hills, Illinois, USA) was used to measure the blood pressure. The device equally displays the heart rate concurrently. The mean BP value was used for analysis. In the pilot study, good agreement was found between the readings from the automatic BP device and measurements taken with a conventional sphygmomanometer (r=0.97).

The 6-MWT was performed over a 30 meter course in a level enclosed corridor with chair placed at both ends of the course (30). The participants were asked to walk back and forth around two cones placed at the starting and ending point of the course. The participants were asked to walk as far as they can for 6 minutes and the distance covered were measured for each participant. Participants were prompted during the test with a standard phrase for encouragement "do your best" (30). The post walk test blood pressure (systolic and diastolic) and heart rate were assessed immediately following the completion of the test.

Computations

The speed (mmin-1) of the participants was calculated by dividing the distance covered in meters by time (6 minutes).

Maximum Oxygen Consumption was calculated using the formula:

VO2 max (ml O2kg -1min-1) = speed (mmin-1) X 0.1m/O2/Kg + 3.5m/O2/Kg/min (31).

Data analyses

Data was analysed using the Statistical Package for Social Sciences [SPSS] version 13.0. Descriptive statistics of mean and standard deviation were used to summarize the data. Paired t-test was used to compare the cardiovascular variables of the participants at rest and in response the walk test. Level of significance for all tests was set at 0.05.

RESULTS

The physical characteristics of the participants are presented in Table 1. The participants' ages ranged between 17 to 70 years with the mean age of 34.78±13.10 years. The mean height and weight of the participants were 1.64±0.07m, 52.72±6.72Kg respectively. The mean distance walked by all the participants was 491.88±57.47m. The means 6-MWT distance for male and female participants were 502.0±43.0m 481.7±68.3m respectively. The 95% confidence interval for distance covered was (484.0 m - 518.0 m) and 456.2 m – 507.2 m) for males and females respectively.

The resting cardiovascular parameters of the participants were compared with the post walk test cardiovascular responses in Table 2. There were significant differences in the mean cardiovascular parameters of the participants following 6-MWT compared with the baseline values ($p < 0.01$).

Table 1. Physical characteristics of the participants and the distance walked.

Variable	Males (mean±SD)	Females (mean±SD)
Age (yrs)	34.9±13.4	34.7±13.0
Weight (Kg)	55.7±5.2	49.8±6.8
Height (m)	1.7±0.1	1.6±0.1
Distance walked (m)	502.0±43.0	481.7±68.3

**indicate significant difference at p<0.01, SBP=Systolic blood pressure
DBP=Diastolic blood pressure

Table 2. Paired t-test comparison of the resting and post isometric exercises cardiovascular parameters of all the participants

Variables	Pre-Walk Mean±S.D	Post-Walk Mean±S.D	t-value	P value
SBP	114.50±13.20	121.85±12.92	-1.263	0.001**
DBP	76.88±8.17	80.43±8.54	-3.956	0.001**
Heart rate	82.72±12.30	96.12±13.14	-10.716	0.001**

DISCUSSION

This study investigated the cardiovascular fitness of patients with pulmonary TB using the 6-MWT. The result of this study showed that 6-MWT had a significant effect on the heart rate and blood pressure (systolic and diastolic) of patients with pulmonary TB. As should be expected in normal individuals HR, SBP and DBP increase during exercise in the patients. Previous studies on cardiovascular fitness assessment among patients with pulmonary TB appear scant or unavailable. Sian et al (29) opined that there is little evidence on the importance of exercise in the management of patients with pulmonary TB. Originally, timed walk tests have been developed as a submaximal non-laboratory estimate of physical fitness in healthy subjects (32,33,34,35). However, Nobuyuki et al (36) reported no apparent significant difference in systolic BP, diastolic BP and Heart rate pre and post submaximal exercise in normal individuals.

Both systolic and Diastolic BP appears to be important criteria for determining abnormal reactivity to stress (36). Also, heart rate is directly and linearly related to oxygen consumption during exercise and can provide information as to how one's cardiovascular system is adapting to stress (37,38). This cardiovascular response to exercise has been used as a major criterion in exercise prescription for both the patients and healthy population (39,40,41,42). Exercise programmes have been reported to help to improve or maintain physical well-being and also establish a baseline by which improvement can be measured (25).

It has been established that the 6-MWT is strongly indicated in measuring the response to medical interventions in patients with moderate to severe lung diseases, as one time measure of patient's functional status and provides a better index of patient's ability to perform daily activities (30). The 6-MWT has been reported to be important in the objective evaluation of functional exercise capacity in pulmonary rehabilitation (26,27). The finding of this study showed that 6-MWT can be used as an assessment tool in pulmonary rehabilitation of patients with TB. It could also be useful for monitoring progress in the course of treatment by assessing the cardiovascular parameter.

Maximum Oxygen consumption measurement is a reference parameter in the assessment of cardiovascular system among healthy subjects and patients and its prognostic value is well documented (43–47). The mean predicted VO2 max found among patients with pulmonary TB in this study was 11.7±0.97 (ml O2kg -1min-1). However, the mean predicted VO2 max found in this study was lower than the one reported in the literature for normal and sedentary healthy individuals ranging from 14 – 38.5 (ml O_2kg-1min-1) (45, 46).

A MET is defined as the oxygen consumed (millimeters) per kilogram of body weight per minute (ml/min/kg) at rest. It is equal to approximately 3.5mL/Kg per minute (48). It is commonly used to express the workload in various stages of exercise protocol (49). The mean MET for patients with pulmonary TB observed in this study is 3.35±0.28mL/Kg. However, this is lower than light work classification such as strolling for the average 65kg male (6.1–15.2mL/Kg) per minute 50). The mean METs for 6-MWT found in this study is lower than the one reported in the literature for normal and sedentary healthy individuals ranging from 4 – 11 METs (43,45,46).

The mean 6-MWT distance 504 m by male patients with pulmonary TB was more than the average 6-MWT distance 482 covered by their female counterparts. In a similar study among aged patients with post lung TB, Ando et al (17) reported a mean value of 342 SD 77 and 384 SD62 before and after rehabilitation respectively for patients with post TB disorder. The authors did not found significant difference among the COPD patients who served as control with mean distance (333 SD 91m Vs 380 SD

improvement was maintained after 6 months. They concluded that 6-minute walking distance is a better common indicator of the severity of disabilities in both post TB disorders and COPD patients.

The mean 6-MWT distance covered in this study is lower than the one reported among healthy subjects in a previous study by Tsang (51) who reported 645m and 606m for males and females of similar age group respectively. Gibbons et al (52) reported 800 m and 699 m for apparently healthy males and females respectively. The difference might be due to difference in the procedures of the tests. Only the best 6-MWT among 4 tests was reported. Literature has shown that distance walked in 6 minutes is slightly increased in successful tests (53,54).

The mean distance recorded in this study is however higher than the one reported among cardiac patients by Morales et al (55) and Lucas et al (56) with 448m and 393m respectively. The reasons for the differences might be that, first; the population in these studies were older than patients recruited for our study. The results of this study should be interpreted with caution because of several limitations inherent in the study. We did not assess the level physical activity of the participants before engaging them in the 6-MWT and indirect methods of assessing V02 instead of calometric method that analysed oxygen and carbon dioxide concentration from expired gas was adopted in this study. Six minutes walk test has been suggested to be more closely corresponds to the demand of every day activities than any types of sub-maximal testing and has been shown that it is not related to cardiac function and only moderately related to exercise capacity (57). Mckelvic et al (58) hypothesised that subjective attitudes, self motivation and mood may have impact on the performance of the test making it less sensitive to change than the measurement of peak oxygen uptake. Therefore, walking performance does not provide prognostic information that can substitute for that provided by peak V02 (57).

We conclude that the 6-MWT is capable of evoking a significant cardiovascular change among patients with pulmonary TB. However, the energy expended (METs) in 6-MWT among patients with pulmonary TB is considerably lower than energy expended or oxygen consumed while accomplishing light or heavy tasks. The 6-MWT may be useful in the assessment of functional capacity of patients with pulmonary TB. warranted in Nigeria and other Sub-Saharan Africa countries.

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PURPOSE: Patients who have post TB lung disorder usually show stable restrictive or mixed ventilatory disorders and seldom show pure obstructive disorder. This is often associated marked limitation in exercise tolerance and a significant disability affecting their activities of daily living. This study was designed to assess the cardiovascular fitness of patients with pulmonary TB using the six-minute walk test (6-MWT)....

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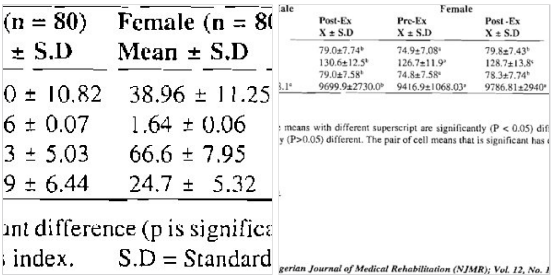

(n = 80)	Female (n = 8(
± S.D	Mean ± S.D
0 ± 10.82	38.96 ± 11.25
6 ± 0.07	1.64 ± 0.06
3 ± 5.03	66.6 ± 7.95
9 ± 6.44	24.7 ± 5.32

ınt difference (p is significa
index. S.D = Standard

	Female		
	Post-Ex X ± S.D	Pre-Ex X ± S.D	Post -Ex X ± S.D
	79.0±7.74[b]	74.9±7.08[b]	79.8±7.43[b]
	130.6±12.5[b]	126.7±11.9[a]	128.7±13.8[b]
	79.0±7.58[b]	74.8±7.58[b]	78.3±7.74[b]
3.1[a]	9699.9±2730.0[b]	9416.9±1068.03[a]	9786.81±2940[a]

means with different superscript are significantly (P < 0.05) dif
y (P>0.05) different. The pair of cell means that is significant has

gerian Journal of Medical Rehabilitation (NJMR); Vol. 12, No. 1

Gender Differences in Cardiovascular Response to Upper Extremities Isometric Exercises in Normotensive Subjects

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Chidozie Emmanuel Mbada

Background and objective: Studies on gender differences in cardiovascular responses to isometric exercise have been numerous and conflicting. The objective of this study was to determine if the cardiovascular responses to upper extremities isometric exercises differ between apparently healthy male end female subjects. Methods: One hundred and sixty apparently healthy adults with the mean age of39.0 ...

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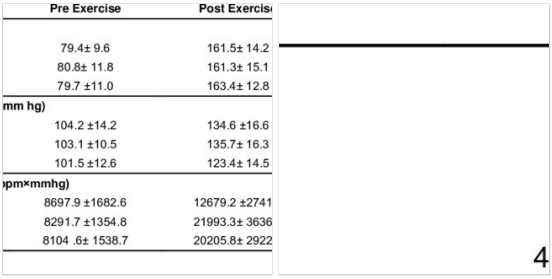

Pre Exercise	Post Exercis
79.4± 9.6	161.5± 14.2
80.8± 11.8	161.3± 15.1
79.7 ±11.0	163.4± 12.8
mm hg)	
104.2 ±14.2	134.6 ±16.6
103.1 ±10.5	135.7± 16.3
101.5 ±12.6	123.4± 14.5
pm×mmhg)	
8697.9 ±1682.6	12679.2 ±2741
8291.7 ±1354.8	21993.3± 3636
8104 .6± 1538.7	20205.8± 2922

4

A Comparison of Myocardial Oxygen Consumption during Three Modes of Sub-maximal Exercise Testing among Patients with Asthma

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TAF Preventive Medicine Bulletin

The purpose of this study was to assess the functional capacity during a 6-minute corridor walk and a 6-minute bicycle ergometry exercise in patients with chronic heart failure (CHF). Thirty five patients with stable CHF were recruited for the study. Each subject performed six minutes corridor walk and 6-minute bicycle ergometry testing. The 6-minute walk required the subjects to walk at a self selected speed on a 20 meter...

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The influence of socio-economic status on casual blood pressures of the adult Nigerians

Article

July 2005 · 328 Reads · 31 Citations

European journal of cardiovascular prevention and rehabilitation: official journal of the European Society of Cardiology, Working Groups on Epidemiology & Prevention and Cardiac Rehabilitation and Exercise Physiology

Rufus Adedoyin · Chidozie Emmanuel Mbada · Olayinka Omotesho Awofolu · Olubunmi M Oyebami

Studies into social inequalities in health tend to focus more on parental socio-economic status (SES) as it affects the children. We aimed to test the hypothesis that socio-economic inequalities would not affect the casual blood pressure among Nigerian adults. Resting blood pressure (BP) and pulse rate of 1067 sedentary adults were measured. Rate pressure product and pulse pressure were later calculated. Second, a structure...

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