# Assessment of Functional Capacity in Patients with Hypertension Using the Six Minute Walk Test

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## ABSTRACT

**Objectives:** Assessment of functional capacity (FC) is useful in monitoring patient's progress and also predicts the prognosis. However, sophisticated laboratory equipments are usually required which are not readily available in the clinical settings. This study assessed FC of patients with hypertension using the 6-Minute Walk Test (6-MWT).

**Method:** This cross-sectional study employed purposive sampling technique to recruit 396 patients with mild to moderate hypertension from the Cardiac Care Unit of a Nigerian university teaching hospital. Anthropometric characteristics and cardiovascular parameters were measured using standard procedures. All participants underwent a 6-MWT and the total distance covered was recorded whilst maximum oxygen consumption ($VO_2$ max) was estimated using a predictive equation. Data were analyzed using descriptive and inferential statistics at $p<0.05$ of significance.

**Results:** Males and females were comparable in physical characteristics and cardiovascular parameters ($p>0.05$). The total distance walked and estimated $VO_2$ max were 368.9±60.5m and 9.6±0.9mL/kg/min respectively. Cardiovascular parameters were increased significantly ([SBP: t=2.499; p=0.025]; [DBP: t=-3.114; p=0.023] and [HR: t=2.055; p=0.016]) post 6MWT. Furthermore, there was a significant inverse correlation between FC and body mass index (r =-0.342; p=0.002).

**Keywords:** Cardiovascular parameter, functional capacity, hypertension, 6-minute walk test

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**Conclusion:** The participants in this study demonstrated a moderate functional capacity. The six minute walk test produced significant changes in the cardiovascular parameters among patients with controlled hypertension. A significant inverse relationship exists between functional capacity and body mass index. The six minute walk test may be useful as a reliable clinical tool for assessing functional capacity.

## INTRODUCTION

Hypertension is a single modifiable and leading risk factor for cardiovascular disease worldwide (1). The prevalence of hypertension is on the increase and risk factors such as but not limit to obesity, sedentary lifestyle or physical inactivity, rapid urbanization and westernization have been identified. Globally, based on 160/95 mmHg cut-off point, the prevalence of hypertension is about 26.6% while, its prevalence in Nigeria is 11.2% (2). Furthermore, Adedoyin et al, (3) reported a prevalence rate of 36.6% among elderly individuals using the 140/90mmHg cut-off point with a distribution ratio of male-to-female distribution of 15.6 and 20.0%, respectively

Evidence from several interventional and observational studies have shown that adequate level of blood pressure (BP) control using pharmacological treatment helps to delay or regress target organ damage (4, 5). Nonetheless, owing to labeling and drug adverse effects, patients with hypertension often complain of mild symptoms including dizziness, general body fatigue and poor exercise tolerance (6). Poor aerobic exercise performance is associated with low functional capacity (FC) and may predict morbidity and mortality in cardiovascular disease (CVD) (7).

Exercise plays significant role in improving body composition, cardiorespiratory fitness and reduces CVD risk by 15 - 30% (8), however, many people especially patients with cardiovascular challenges are apprehensive of engaging in regular exercise believing that

exercise might exacerbate their condition. Thus, for effective exercise prescription, training and safety, a baseline assessment of FC is considered important prior to exercise intervention.

Several techniques have been designed for the assessment of FC in patients with hypertension which include cardiopulmonary exercise testing using bicycle or treadmill and gas analyzer methods (9). However, laboratory assessment of FC is expensive, time consuming, inaccessible and oftentimes not practicable in clinical settings of many health facilities (10). Furthermore, experts in this area of assessment using high-tech equipment in developing nations are lacking (11). Hence, assessment techniques that are simple to administer, cheap, well tolerated and not time consuming for both patients and clinicians especially in countries with limited resources will be an added advantage.

The 6-Minute Walk Test (6-MWT) has been reported to be effective for assessing FC in different conditions leading to reproducible and valid results (12). Adedoyin et al, (9) used the 6-MWT among patients with chronic heart failure and concluded that the test could be useful to evaluate exercise tolerance in the population. Furthermore, Adedoyin et al, (13) in another study among patients with pulmonary tuberculosis, affirmed that the 6-MWT was capable of evoking a significant cardiovascular change. However, few studies have investigated FC among Nigerian patients with hypertension using the 6-MWT. This study investigated FC among Nigerian patients with mild to moderate hypertension using the 6-MWT with a view of establishing objective measures of cardiovascular response during exercise training and supervision.

## SUBJECTS AND METHODS

### Study centre

This cross sectional study was carried out at the Obafemi Awolowo University Teaching Hospitals Complex (OAUTHC), Ile – Ife, Osun State, Nigeria. Participants for this study were patients with mild to moderate hypertension (≥140/90 ≤ 179/109 mmHg) and were recruited from the Cardiac Care Unit of a Nigerian university teaching hospital. The hospital is a referral centre for more than one million people in the five neighbouring states including Ondo, Ogun, Oyo, and Lagos in Southwestern Nigeria. The study protocol was approved by the Health and Research Ethics Committee of the Institute of Public Health, Obafemi Awolowo University, Ile-Ife, Nigeria. The study was carried out in accordance with the ethical standards laid down in the Helsinki Declaration of 1975 and revised 2002. Informed consent was obtained from all patients. The sample size for this study was based on sample size formula for studying population greater than 10,000 (14). Hence, a total of 400 patients with mild to moderate hypertension were recruited for this study.

*Sampling/patient selection:* Patients with hypertension were purposively technique selected in the Cardiac Care Unit, Medical Outpatient of the OAUTHC.

*Inclusion criteria:* Eligibility for inclusion into the study were patients whose ages ranged between 30 and 70 years with clinical diagnosis of mild to moderate hypertension and were receiving treatment at the hospital's Cardiac Care Unit. Furthermore, participants were on regular antihypertensive medications and whose blood pressure is under control were specifically recruited.

*Exclusion criteria:* participants with reported severe medical conditions such as unstable angina, peripheral arterial disease, asthma, neurological conditions or knee arthritis that may limit self-paced walking were excluded from the study.

## Procedure

*Assessment of functional capacity*

Socio-demographic characteristics such as age, sex, occupation, monthly income and level of education were recorded. Anthropometric characteristics such as height, body weight, and hip and waist circumferences were measured using standard procedures while body mass index and waist to hip ratio were calculated. Furthermore, duration of hypertension onset and prescribed antihypertensive medications were recorded. Baseline cardiovascular parameters including systolic, diastolic blood pressures and heart rate were measured while rate pressure product was calculated. All participants underwent a 6-MWT on a 30m level corridor for 6 minutes. The modified Borg's scale was administered to determine post exercise level of exertion of the participants.

*Assessment of functional exercise capacity: six minute walk test*

The 6-MWT was conducted using a standardized procedure according to ATS (15) (2002). A 30-metre corridor within the cardiac care unit of the hospital was marked out by two cones for the test. Participants were allowed to rest for a period of 10 minutes in sitting position before the commencement of exercise test. Patients were instructed to walk from the starting point to the end at their own selected pace while attempting to cover as much ground as possible in six minutes. They were encouraged every 30 seconds or so in a standardized manner by saying: "You are doing well" or "Keep up the good work". Participants were reminded of the time

remaining for the completion (9). At the end of 6MWT test, participants were asked to rate his or her exertion level using the 10 – point modified Borg scale while heart rate, systolic and diastolic blood pressures were recorded immediately. The distance covered was recorded to the nearest meter while functional exercise capacity (maximum oxygen consumption ($VO_2$ max) was estimated using the American College of Sport Medicine (16) predictive equations during level ground walking.

*Computation:* $VO_2$ max = Speed (m/min) x 0.1 + 3.5 mL/$O_2$/kg/min.

**Statistical analysis**

Descriptive statistics was used to summarize socio-demographic and physical characteristics data while inferential statistics of independent t-test was used to determine the difference between male and female patients. Furthermore, paired t-test was used to determine the difference between pre and post cardiovascular response to 6-MWT. Pearson's product moment correlation was used to assess the relationships between FC, anthropometric characteristics (BMI) and cardiovascular parameters. Statistical Package for Social Sciences (SPSS) version 16 was used for the data analysis. Alpha level was set at $p < 0.05$ of significance.

**RESULTS**

Table 1 presents socio-demographic and clinic profile of participants. There were more females; 218(55.1%) than males; 178(44.9%) of which a majority were artisans. More than half, 236(59.6%) were classified as having mild hypertension. More than half, 240(60.6%) have less

than five year onset of hypertension. Diuretic (71.2%) and aspirin (87.1%) were mostly prescribed antihypertensive and antiplatelet medications respectively. Table 2 shows comparison of physical characteristics, cardiovascular parameters, 6-minute walk distance and estimated $VO_2$ max between male and female participants. The mean age of male and female participants was 54.8±8.4 and 53.9±8.8 years respectively. Males and females were comparable in cardiovascular parameters and physical characteristics except waist to hip ratio (WHR) and body mass index (BMI) ($p < 0.05$). Furthermore, the average 6-minute distance walked and the estimated $VO_2$ max between males and females were 368.9±60.5 versus 385.7±67.5m and 9.6±0.9 versus 9.9±1.1mL/kg/min respectively. There was no significant difference in the 6 minute walk distance between male and female ($t = -1.431$; $p = 0.159$) and also for functional exercise capacity ($t = -1.431$; $p = 0.159$) (Table 2).

Comparison of pre and post 6MWT cardiovascular parameters showed that there were significant changes in heart rate (77.8±12.1 vs. 88.4±11.9 beat/minute; $t = 2.055$; $p = 0.016$), systolic (130.2 ± 15.1 vs. 139.9 ± 13.1 mmHg; $t = 2.499$; $p = 0.025$) and diastolic blood pressures (85.5 ± 11.5 vs. 90.1 ± 9.6 mmHg; $t = -3.114$; $p = 0.023$) except the rate pressure product (RPP) ($p > 0.05$) (Table 3). Table 4 showed results of correlation between FC, BMI and cardiovascular parameters. There was a significant inverse relationship between FC and BMI ($r = - 0.342$; $p = 0.002$) but not with cardiovascular parameters ($p < 0.05$).

## DISCUSSION

It is becoming increasingly crucial for health care professionals to use valid and reliable tests and measures in practice to determine outcomes of various health conditions. Physiotherapists

equally have to depend on outcome measures with high validity to ensure that patient progress is well-monitored and accurate. It is necessary to have valid tests that are simple and quick to perform in the clinic in order to preserve time management, efficiency, and to have a way to retest and monitor progress easily. While it is known that using $VO_2$ max is a valid measure of functional capacity for patients with CHF, it is difficult if not impossible, for most physical therapists to acquire this information in the clinic (17).

The mean 6-minute walk distance (6-MWD) is considered a valid and reliable tool in assessing exercise capacity (18). The 6-MWD for males and females in this study were 379.2±56.1 and 363.2±62.9m respectively. These values are lower compared to reported values among healthy male and female subjects in some previous studies. Tsang (19) reported a range of 645m and 606m for males and females of similar age group while Gibbons et al (20) reported 800m and 699m for apparently healthy males and females respectively. The low functional capacity recorded among the participants might be as a result of underlying cardiac condition. Many patients with cardiovascular challenges are often scared of performing exercise because they believe that physical activity could exacerbate their condition. On the contrary exercise has been found to improve functional and physical performance and as well improve quality of life. In agreement with our findings, Morales et al, (21) and Lucas et al, (22) reported a 6-MWD of 448m and 393m respectively among patients with cardiac challenges. Although comparison of reference values across population is believed to be difficult because of individual and racial differences, self-motivation and mood, and demographic variations. However, the mean 6-MWD value obtained in our study is still within the range reported for patients with cardiac conditions without gender bias.

The 6-MWT is highly related to walking patterns in adults and is similar to daily activity which could be used to evaluate patient's ability to perform activity of daily living (15). Although there are many timed walk tests that have been developed for the evaluation of functional capacity in healthy subjects (23, 24), the 6MWT appears to be easy to administer, more objective and correlates significantly with functional capacity in patients with cardiopulmonary challenges (25, 26).

In addition, the maximum oxygen consumption ($VO_2$ max) is a measure of cardiorespiratory fitness and body's capability to utilize oxygen during exercise, studies have shown that its prognostic value is valid and reliable (27, 28). The mean estimated $VO_2$ max for males and females in our study were 9.8±0.9 and 9.5±1.0 mL/kg/min. This is however; lower than values reported in previous studies for active and sedentary healthy individuals ranging from 14.0 – 38.5 mL/kg/min (29, 30). Lower $VO_2$ max in our study may not be unconnected to sedentary lifestyle associated with hypertension and disease progression. Impairment of endothelial function in hypertension may also contribute to poor oxygen utilization among this population.

High body mass index (BMI) is associated with hypertension, findings from our study show that there is an inverse significant relationship between functional capacity and body mass index. This is consistent with the findings of previous studies that high BMI has been suggested to contribute to a poor health and low aerobic exercise performance (31, 32). It is possible that higher body weight contributes to reduced exercise capacity.

Cardiovascular response to exercise is commonly used as a major criterion in exercise prescription for both patients and apparently healthy individuals (33, 34). During exercise, the

heart rate starts to rise progressive and the rate of oxygen consumption is directly proportional to each other. Similarly, the systolic and diastolic BP also rise as exercise progresses. This implies that energy expenditure during exercise has linear relationship with exercise performance. Studies have shown that cardiovascular response to exercise could be used to determine body's adaptation and abnormal reactivity to stress (35, 36). It implies that the 6-MWT is capable of challenging the cardiovascular system, even though it is a submaximal exercise test.

The 6-MWT has been reported to be objective in the evaluation of functional capacity in pulmonary and cardiac rehabilitation; however, walking performance does not provide prognostic information that can substitute for direct methods for assessing peak $VO_2$ commonly used in the laboratory with the aids of gas analyzer estimating oxygen and carbon dioxide concentration from expired gas (37). Nonetheless, the finding of this study showed that 6-MWT can be used as an assessment tool in cardiac rehabilitation of patients with hypertension owing to its capability to effect cardiovascular changes and increased energy expenditure. It could also be useful for evaluating treatment progress.

The results of this study should be interpreted with cautions due to some inherent limitations. First, the level of physical activity of the participants was not assessed before engaging them in the 6-MWT. Although our patients were recruited from cardiac care clinic in the teaching hospital with evidence of controlled hypertension, this finding may be different from sample of patients with uncontrolled hypertension. Furthermore, patients in our study were placed on different anti-hypertensive medications and it has been reported that some anti-hypertensive medications might mask functional capacity, thus affecting the outcome of this study. Also, this study design is cross-sectional *Assessment of functional capacity* and may limit its generalizability to other patients with hypertension in another setting. In conclusion, the six

minute walk test lead to higher significant changes in the cardiovascular parameters and increased energy expenditure of patients with hypertension post exercise. The six minute walk test could be used as a reliable clinical tool for assessing functional exercise capacity among patients with controlled hypertension.

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**AUTHORS' NOTE**

The authors declare that they have no conflicts of interest concerning this article.

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Table 1: Socio-demographic characteristics and clinical profile of all participants (N = 396)

| Variable | N | (%) |
|---|---|---|
| Gender | | |
| Male | 178 | 44.9 |
| Female | 218 | 55.1 |
| Occupation | | |
| Artisan | 168 | 42.4 |
| Civil Servant | 99 | 25.0 |
| Retiree | 129 | 32.6 |
| Income (monthly) | | |
| <N50, 000 | 138 | 34.8 |
| N50, 000 – N100, 000 | 166 | 42.0 |
| >N100, 000 | 92 | 23.2 |
| Education | | |
| Primary | 102 | 25.8 |
| Secondary | 204 | 51.5 |
| Tertiary | 90 | 22.7 |
| Hypertension classification | | |
| Mild | 240 | 60.6 |
| Moderate | 156 | 39.4 |
| Onset of hypertension | | |
| < 5 years | 160 | 40.4 |
| > 5years | 236 | 59.6 |
| †Prescribed medication | | |
| Diuretics | 282 | 71.2 |
| ACE-I | 169 | 42.7 |
| CCB | 148 | 37.4 |
| ARB | 102 | 25.8 |
| ASA | 345 | 87.1 |

† Total may not add up to 100.0% due to combined medications

Key: ACE-I: Angiotensin converting enzyme- inhibitor, CCB: Calcium channel blocker, ARB: Angiotensin receptor blocker, ASA: Aspirin

Table 2: Comparison of age, anthropometric characteristics, cardiovascular parameters and 6 minute walk distance between male and female (N = 396)

| Variable | Male (N=178) Mean ± S.D. | Female (N=218) Mean ± S.D. | t-cal | p-value |
|---|---|---|---|---|
| Age (years) | 54.8±8.4 | 53.9±8.8 | -0.051 | 0.960 |
| Weight (kg) | 74.0±11.9 | 75.2±15.2 | -0.300 | 0.765 |
| BMI ($Kg/m^2$) | 25.3±4.2 | 29.4±5.7 | -2.705 | 0.009* |
| HR (beat/min) | 77.2± 6.3 | 78.7±3.9 | 0.821 | 0.369 |
| SBP (mmHg) | 131.6±9.6 | 132.8±7.4 | -0.684 | 0.207 |
| DBP (mmHg) | 84.1±4.2 | 85.9±4.8 | -0.209 | 0.635 |
| RPP ($X10^3$) | 10.2±0.6 | 10.4±0.3 | 0.032 | 0.482 |
| 6MWD (m) | 379.2±56.1 | 363.2±62.9 | 1.235 | 0.223 |

*Significant at $p<0.05$

Key:
BMI: Body mass index; RPP: rate pressure product SD: Standard deviation, SBP: systolic blood pressure; DBP: diastolic blood pressure; HR: heart rate, WHR; Waist Hip Ratio; 6-MWD; 6-minute walk distance

Table 3: Comparison of baseline and post six minute walk test cardiovascular parameters (N = 396)

| Variable | Pre-6MWT Mean ± S.D | Post 6MWT Mean ± S.D | t-cal | p-value |
|---|---|---|---|---|
| HR (beat/min) | 77.8±12.1 | 88.4±11.9 | 2.055 | 0.016* |
| SBP (mmHg) | 130.2±15.1 | 139.9±13.1 | 2.499 | 0.025* |
| DBP (mmHg) | 85.5±11.5 | 90.1±9.6 | -3.114 | 0.023* |
| RPP($X10^3$) | 10.4±1.5 | 11.6±1.6 | 0.262 | 0.701 |

*$p<0.05$
Key:

SBP: Systolic blood pressure; DBP: diastolic blood pressure; HR: Heart rate, 6MWT: 6-Minute Walk Test; RPP: rate pressure product

Table 4: Relationship between functional capacity, body mass index and cardiovascular parameters (N = 396)

| Variable | Functional Capacity r | p |
|---|---|---|
| BMI ($kg/m^2$) | -0.342 | 0.002* |
| HR (beat/min) | 0.035 | 0.625 |
| SBP (mmHg) | 0.073 | 0.129 |
| DBP (mmHg) | 0.002 | 0.831 |
| RPP | 0.099 | 0.384 |

*$p < 0.05$

Key:
BMI: Body mass index; HR: heart rate; SBP: systolic blood pressure; DBP: diastolic blood pressure; RPP: rate pressure product