EFFECTOF STRUCTURED PHYSICAL ACTIVITIY ON BLOOD PRESSURE AMONG HYPERTENSIVE ADULTS ATTENDINGTHE GENERAL OUT PATEINT CLINIC AND MEDICAL OUT PATIENT CLINIC OF AMINU KANO TEACHING HOSPITAL

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CERTIFICATION

This dissertation titled "EFFECT OF STRUCTURED PHYSICAL ACTIVITY ON BLOOD PRESSURE AMONG HYPERTENSIVE ADULTS ATTENDING THE GENERAL OUT-PATIENT CLINIC AND MEDICAL OUT-PATIENT CLINIC OF AMINU KANO TEACHING HOSPITAL, KANO STATE, NIGERIA" by Mohammed Riyad meets the regulations governing the award of the degree of Master in Public Health of Ahmadu Bello University, and is approved for its contribution to knowledge and literary presentation.

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ATTESTATION

I declare that the work in this dissertation titled "EFFECT OF STRUCTURED PHYSICAL ACTIVITY ON BLOOD PRESSURE AMONG HYPERTENSIVE ADULTS ATTENDING THE GENERAL OUT-PATIENT CLINIC AND MEDICAL OUT-PATIENT CLINIC OF AMINU KANO TEACHING HOSPITAL, KANO STATE, NIGERIA" wasperformed by me under the Department of Community Medicine, Ahmadu Bello University, Zaria fully supervised by Dr Aisha A Abubakar. The information derived from the literature has been duly acknowledged. No part of this dissertation was previously presented for another degree or diploma at any university.

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DEDICATION

This work is dedicated to my beloved familyHajiya Zara Sidi (my mother), Alhaji Riyad Mohammed (my father), Aisha Wada Abubakar (my wife) and my four children Maryam, Fatima, Zainab and Khadija, who gave me all the moral support and understanding during the two years of this study.

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LIST OF ACRONYMS

CAD ; Coronary artery disease

CHF ; Congestive heart failure

CVD ; Cardiovascular disease

DALY ; Disability adjusted life years

DM ; Diabetes mellitus

ESC ; European society of cardiology

ESH; European hypertension society

HTN; Hypertension

JNC ; Joint national convention

LVH ; Left ventricular hypertrophy

NCD ; Non-communicable disease

NHS; Nigerian hypertension society

PVD ; Peripheral vascular disease

WHO ; World health organization

SUMMARY

Hypertension (HTN) is a major public health problem because of its rising prevalence worldwide.Globally, prevalence of HTN in adults was around 22% in 2014. In Africa, of19.7% - 30.8% prevalence was reported in 2010. Similarly, in NorthernNigeria, the prevalence of HTN was 32.3% and 39.1%in Maiduguri and Kano respectively.This high prevalence of hypertension prompts primary prevention with lifestylemodification such as increased physical activity.

This study was anexperimental (interventional) study (pre and post) conducted ingeneral out-patient clinic (GOPC) and medical out-patient clinic(MOPC) of Aminu Kano teaching hospital, Kano State Nigeria. A total of 98 adult hypertensiveadultrespondents were recruited using simple random sampling technique and assigned to either intervention or control group by random allocation (balloting). Interviewer administered questionnaire was administered.

Majority of the respondents' were females (64.3%). Their ages ranged between 25 to 62 years with age group 55 – 64 years the majority and mean ages of 48.6 ± 12.7 years. Areduction of 4.01 mmHg(P-value: < 0.05)and 3.15 mmHg(P-value: < 0.05)was observed in systolic blood pressure and diastolic blood pressure among the intervention than the control group after 3 months structured physical activity. Also, there was more decrease in pulse rate of 0.61 beats per minute (P-value of < 0.05)in the intervention group. Similarly, more reduction of 0.003 (P-value: <0.05) in waist hip ratio among females was observed in the intervention than the control group.

Structured physical activity with pedometer reduces blood pressure among hypertensive adults in Kano. Werecommendthe inclusion of structured physical activity using pedometer in the treatment guidelines of hypertension.

Key Words: Hypertension, physical activity, pedometer, AKTH, Kano.

CHAPTER ONE: INTRODUCTION

1.1.Background Information

Hypertension (HTN) or raised blood pressure (defined as systolic and/or diastolicblood pressure ≥140/90 mmHg)is a major public health problem because of its rising prevalence worldwide.[1]Thenumber of people with hypertension rose from 600 million in 1980 to nearly1 billion in 2010and over a billion in 2014.[1,2]Globally, the overall prevalence of HTN in adults aged 18 years and above was around 22% in 2014.[2]HTN caused 7.5 million deaths, about 12.8% ofall deaths in 2008 and 9.4 million deaths by 2014.[1,2]Contrary to popular opinion that majority of non-communicable diseases (NCD) such as HTN occur in developed nations, it is higher in under-developed low income countries.[3]Across the WHO regions, the prevalence of HTN was highestin Africa, at 30% for adults in 2014.[2]

Elevated blood pressure is a prototypic of preventable chronic cardiovascular disease (CVD) risk factors. As demonstrated by the Framingham Study, hypertension is a continuous risk factor for cardiovascular disease (CVD).[4] For every 20/10 mm Hg increase in blood pressure (BP) above 115/75 mm Hg, risk of CVD doubles.[4,5]Hypertension (HTN), is a major modifiable risk factor for cardiovascular diseases (CVD) like coronary artery disease (CAD), left ventricular hypertrophy (LVH), congestive heart failure (CHF), peripheral vascular disease (PVD), stroke, and sudden death.[5]Globally, 51% of stroke (cerebrovascular disease) and 45% of ischaemic heart disease deaths are attributable to high systolic blood pressure. At any given age, the risk of mortality from high blood pressure in low- and middle-income countries is more than double that in high-income countries. In the high-income countries, only 7% of deaths caused by high blood pressure occur under the age of 60 years, while in the African Region, it increases to 25%.[6]

Across the world, the prevalence of HTN in adults varies in from region to region. The prevalence of hypertension in the United States has increased from 24% in 1995, 29% in 2004 and 30.8 in 2012.[7]In a study in India, a prevalence of 30.9% in males and 27.8% among females was reported in 2012.[8]A prevalence of 15.2% was reported in Saudi Arabia in 2014.[9]In a meta-analysis on Africa prevalence's, the overall pooled prevalence of19.7% in 1990, 27.4% in 2000 and 30.8% in 2010 in Africa was reported.[10]In sub-Saharan Africa, hypertension prevalence's of 21.4%, 23.7% and 38.0% in Kenya, Tanzania and Namibia was reported in 2012respectively.[11]In Nigeria, prevalence of hypertension in Nigeria stood at 32.8% in Enugu, south-eastern Nigeria.[12]In Maiduguri, northern-eastern Nigeria, an overall prevalence of hypertension was 32.3%, was identified.[13]Also, a prevalence rate of 39.1% in Kano, north-west Nigeria in 2014, was reported.[14]

Many reasons have been postulated for this high and regional difference in prevalences. Published literature increasingly show a global shift in health conditions due to epidemiological transition. This transition is characterized by changing lifestyle behaviors which includecigarette smoking, excessiveharmful use of alcohol intake, sedentary lifestyle, physical inactivity, poor eating habits characterized by consumption of foods containing too much salt, high fat content, refined carbohydrates, rich in fat/sugar and low in fruit and vegetables.Also, factors such ageing, genetic factors, psychological stress, socioeconomic determinants, poor health care, lack of access to health careand better reporting have been postulated to contribute to this increase.[2,15]Insufficient physical activity causes 20−30% increased riskof mortality compared to physical active individuals. It has been reported that regular physical activity reduces the risk of ischaemic heart disease, stroke,diabetes and breast and colon cancer. Additionally, regular

physical activity is akey determinant of energy expenditure and is therefore fundamental to energybalance, weight control and prevention of obesity.[2]

Owing to the risk of developing, many more individuals the world over are at risk of developing HTN.[16]It was estimated that there is 90% lifetime risk for the development of hypertension among individuals with high-normal blood pressure and also high risk among those with associated risk factors.[16]Hypertension, been a Cardiovasculardiseases (CVD) is defined by other risk factors which increases the vulnerability of acquiring the disease. These risk factors are broadly classified modifiable and non-modifiable risk factors based on intervention and prevention of the disease.Modifiable factors are factors that could be prevented by primary prevention strategy, such as overweight/obese, high sodium intake, low potassium intake, alcohol consumption, diabetes mellitus (DM), dyslipidemias and reduced physical activity.[1,17,18]Non-modifiable factors are inherent individual factors that cannot be prevented by primary prevention such as age, gender (male), genetic factors, and black race.[1]The confluence of epidemiological transition and these risk factors increases the prevalence of HTN prevalence particularly in low-socioeconomic and underdeveloped black nations.

This rapid global escalation of HTN and other cardiovascular diseasesand its risk factorshas challenged researchers to develop new strategies aimed at preventing these growing health problems.[19,20]In the global effort to prevent and manage hypertension, several guideline have evolved over the years. In the wake of the twentieth century, these guidelines keep being updated and adopted to suit the changing trends. Also, guidelines differ according to geographic location because of their peculiar differences. Several current treatment guidelines for the management of hypertension such as the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure seven and eight (JNC-7/JNC-8), the European Society of

Hypertension-European Society of Cardiology (ESH-ESC), British Hypertensive Society (BHS) and Nigerian Hypertensive Society (NHS) recommend pharmacological and non-pharmacological remedy in the both prevention and management of HTN.[21,22,23]Non-pharmacological management like lifestyle modification such as exercise constitute an important aspect.

Efforts to prevent the morbidity and mortality of HTN has been focused mainly on treatment rather than primary prevention strategies such as lifestyle modification. Although the system focused mainly on clinical management of individuals with existing disease, such approach does not address the potential reversible causes of these conditions, primarily poor lifestylessuch as low levels of physical activity and poor dietary habit.[20]Regular programmed physical activity among the general population is regarded as an important component in the management of hypertension and its overall effect in reducing premature morbidity/mortality and burdens of hypertension.[24,25] Aerobic exercises like walking are recommended by major health organizations because of its favorable health effect.[24,26]Pedometer, a small device that counts steps taken, has been used to monitor and motivate physical activity in various populations. The use of a pedometer is associated with significant increase in physical activity and significant decrease in blood pressure.[27]It also aids self-monitoring, quantifying and motivatingindividuals to increase physical activity.[28,29] It is a low cost intervention, encouraging physical activity behavioral change while working.[27]

1.2. Problem statement

Insufficient physical activity is a major risk factor for NCD such as HTN and mentioned among the 10 leading risk factors for global mortality.[2]Insufficient physical activity causes 20−30% increased riskof mortality. Regular physical activity reduces the risk of cardiovascular diseases such as HTN.[2]Contrary to the popular speculation that persons living in under-developed nations are physically active, in 2014, WHO reported that across its regions,lowest prevalence of raised blood pressure was reported in Americas (18%).[2]In Nigeria, the prevalence of HTN ranges between 12.4% to 34.8%and was mainly as a related to physically inactive.[30]

If left uncontrolled, physical inactivity shall cause an escalation of NCDs such as hypertension and its complicationswhich is worst in low income nations such as Nigeria.[2,31]Scientists havedevelopedguidelines which include pharmacological (drugs) and non-pharmacological approach in the management of hypertension.[21,22,23]Although these guidelines are used, health care providers still face challenges in blood pressure control.[32]Most health care providers emphasise pharmacological (drug) rather than non-pharmacological (lifestyle modification like exercise).[33,34]Also, whereadvice on physical activity (exercise) is offered, implementation, motivation, adherence and quantifying the amount of physical activity required is difficult.[35,36,37]

This prompted researchers to develop strategies of quantifying level of exercise required. Pedometer provides a means of motivating and quantifying daily walking steps takento represent physically activity level.[27,28]There is need for more research to determine the effectiveness of

physical activity on blood pressure particularly in Nigeria. If it causes a reduction in blood pressure, this study will help solve the problem of motivation, adherence and quantifying the level of exercise that translate health benefit.

1.3. Justification

Studies have reported the benefit of physical activity such as exercises to reduce blood pressure andcardiovascular events.Physical activity such walking are relatively cheap, practicable,easy to implement and can suit different individuals accordingly.Another important factor in such researches is the use of pedometer in motivating, quantifying and increasing physical activity and ultimately reduce blood pressure among hypertensive persons.[29,38,39]

There is paucity of research on the effect of physical activity on blood pressure among HTN persons in a resource-poor country like Nigeriaas a whole and Kano in particular. Also, there is no research on the effect of pedometer based exercise on blood pressure in Nigeria. Most of the studies conducted in this environment are on prevalence of HTN.Thisleaves a gap in knowledge both nationally and locally. Research is therefore needed to verify and validate the effect of structured physical activity with a pedometer on blood pressure of hypertensive adults in this environment.

Understanding the function of pedometer to motivate individual, increases and quantify physical activity prescription and reduce blood pressure is important in-order to curtail the problem of adherence. Being a low cost intervention, individuals with occupational differences, can perform such walking exercise at different places such as home, work place and local community.This will provide logical information to prescribepedometer based walking exercise in the prevention, control and management of HTN.

Information derived from this study shall assist health care providersrecommend structured pedometer based walking exercise in the prevention, control and treatment of HTN and to ultimately reduce its morbidity and mortalityin Kano.[40]Also, this can form the bases for further research on pedometer-based structured physical activity on a larger scale both locally and nationally.

1.4.Research question

1. What are the blood pressure of hypertensive adults attending Aminu Kano Teaching Hospital (AKTH), and are they comparable at baseline?
2. What are the blood pressure of hypertensive adults attending Aminu Kano Teaching Hospital (AKTH), after 3 months of structured physical activity recommendation?
3. What is the effect of structured physical activity on blood pressure among hypertensive adult patients attendingAminu Kano Teaching Hospital (AKTH), Kano?

1.5. Aim and objectives

1.5.1. General objective

To determine the effect of structured physical activityon blood pressure of hypertensive adult attending GOPC and MOPC of Aminu Kano Teaching Hospital (AKTH), Kano.

1.5.2. Specific objectives;

1. To assess the blood pressure (systolic & diastolic blood pressure) before intervention (pre-intervention) in the intervention and control groups

2. To identify the baseline comparability of the blood pressure (systolic & diastolic blood pressure) before intervention (pre-intervention) in the intervention and control groups
3. To assess the blood pressure (systolic & diastolic BP) after intervention (post-intervention) in the intervention and control groups
4. To determine the changes in blood pressure (systolic and diastolic BP) before and after intervention in the two groups

1.6 Study Hypothesis

The study hypothesis is that there is no (Null hypothesis) difference in blood pressure of hypertensive adult patients attending the AKTH following structured physical activity using pedometer at 80% power and 95% confidence level.

CHAPTER TWO: LITERATURE REVIEW

2.1. Introduction

Hypertension, being a major public health problem and rising prevalence prompted WHO to mark HTN as the theme of world health day in 2013."The theme of World Health Day 2013" (marked on 7 April 2013) was the need to control raised blood pressure (hypertension) known as a "silent killer, global public health crisis" because of its symptomless nature and rising prevalence making it a major public health problem globally.[41]The world health organization (WHO) reported that hypertension contributes to the main burden of heart disease, stroke and kidney failure, and is an important cause of premature death and disability.[42]Globally, WHO reported that the global prevalence of high blood pressure (systolic and/or diastolic blood pressure ≥140/90 mmHg) in adults aged ≥25 was around 40% in 2008.[3]Also, WHO reported that about one in 3 adults have raised blood pressure.It is worth mentioning that the proportion of the world's population with high blood pressure, or uncontrolled hypertension, fell modestly between 1980 and 2010.[3]By the year 2014, up to 22% or more of adults aged 18 years and above have raised blood pressure as reported by WHO.[2]However, because of population growth and ageing, the number of people with hypertension rose from 600 million in 1980 to nearly 1 billion in 2008(over 25 % at that time) and is expected to rise to above 30 % by 2025.Although these prevalence vary according to geographic region, WHO stated that in general, it was higher in low-income countries compared to middle-income and high-income countries.[2,3]

In United States ofAmerica (USA), similar finding was reported. The National Health and Nutrition Examination Surveys (NHANES)assessed the status and progress toward good health termed "Healthy People 2020 goals". The time trendsurvey was between 1999 to 2012 which

assessed adults ≥18 years population. From 1999 to 2012, the prevalence of hypertension was unchanged with a range of between 30.1% and 30.8%.[7]In 2014, WHO reported that across its regions,lowest prevalence of raised blood pressure was reported in Americas, which was about 18%.[2]A systematic review andmeta-analysis of the prevalence of hypertension among Indian adultsfrom 1950 to 2013 was conducted. The researchers searcheddata for 'prevalence of hypertension among Indian adults' aged 18 years and above. They reported overall prevalence for hypertension among Indian population of 29.8%. They also reported a significant difference in the prevalence of hypertension among rural and urban population which were 27.6 and 33.8% respectively in 2014.[43] Comparatively, WHO reported a prevalence of hypertension of about 25% among Indian adult population in 2014.[2]In Kingdom of Saudi Arabia (KSA), Saudi Health Information Survey (SHIS) conducted a national multistage survey on the magnitude of hypertension epidemic, among persons aged 15years or older. They found a hypertension prevalence range of 15.2% and 40.6% among adults in 2014.[9]They equally found that 27.2% of persons aged 30 or older had hypertension.Also, they reported that the risk of hypertension increased amongmen,with age, obesity, diabetes, and hypercholesterolemia.[9] Similarly, WHOin 2014,reported a hypertension prevalence of about 24%among adults in Saudi Arabia.[2]

The burden of hypertension is high in Africa with the exactburden still far from being known. A meta-analysis was conducted on systematic search of population-based studies on prevalence of hypertensionamong persons aged 15 years and above in Africa. They used epidemiological modelling, using United Nations population demographics for the years 1990, 2000, 2010, 2030 and applied it to determine the prevalence rates and number of cases of hypertension in Africa separately for these four years.From the modelling, over 54.6 million cases of hypertension were estimated in 1990, 92.3 million cases in 2000, 130.2 million cases in 2010, and a projected

increase to 216.8 million cases of hypertension by 2030; each with an age-adjusted prevalence of 19.1%, 24.3%, 25.9% and 25.3% respectively.They reported an overall pooled prevalence ofhypertension in Africa was 19.7% in 1990, 27.4% in 2000 and 30.8% in 2010.[10]A similarly meta-analysis identified that Africa has the highest prevalence of HTN, where it was 40% - 46% for both sexes combined in 2013.[44]Also, WHO reported that across its regions, the prevalence of raised blood pressure was highestin Africa, at 30% for all adults combined.[2]In sub-Saharan Africa (SSA), ameta-analysis of population based studies on hypertension between January 1975 and May 2006, reported a varied prevalence between different geographic locations. The study found that most studies reported an average of 40% prevalence of HTN. They found that the prevalence of hypertension was higher in urban than rural areas in all the studies.[45]Also, a meta-analysis in WestAfrica using systematic search for studies on HTN between 1980 and 2014, characterizes workers, blood pressure (BP) levels, prevalence of hypertension, and associated demographic factors. Theprevalence of hypertension increased progressively from 12.9% in 1980s to 34.4% in 2010 and 2014. A prevalence range of 12.0% among automobile garage workers to 68.9% among traditional chiefs was found. Among health care workers, the prevalence ranged from 17.5 to 37.5%. In the study, the average prevalence exceeded 30%.[11]Similarly, in a SSA cross-sectional surveys conducted in four countries; Nigeria, Kenya, Tanzania and Namibia between 2009 – 2011, an age-standardized prevalence of hypertension of 19.3% in rural Nigeria, 21.4% in rural Kenya, 23.7% in urban Tanzania, and 38.0% in urban Namibia was reported.[11]A population-based review of data on hypertension conducted between 1973 and 2009 in Ghana, found a hypertension prevalence ranging from 19.3% in rural to 54.6% in urban areas. The review of several studies showed hypertensionto increase with increasing age.[46]

In this regard, to identify the prevalence of HTN in Nigeria, a population-based meta-analysis on the prevalence of hypertension in Nigeria from 1990 to 2009was conducted. A hypertension prevalence ranging from 12.4% to 34.8%with a combined pooled prevalence rate of hypertension was 22% was reported. There was also gender difference where males had higher prevalence of hypertension.[30]

The prevalence across Nigeria varies considerably. In South-Eastern Nigeria, in Nsukka, Enugu state, a study reported a21.1% prevalence of HTN among persons aged 18 years and above.[47]In South-South Nigeria, Akwa Ibom State, a prevalence of hypertension of 44.3% among rural populace and 28.6% among urban populace was reported.[48]Gezawa al in Maiduguri, Borno state, north eastern Nigeria, reported an overall prevalence of hypertension as 32.3%, with a higher prevalence among women than men.[13] Similarly, Isezuo et al found a prevalence rate of 24.8% among adult Hausa and Fulani ethnic groups in Sokoto, North Western Nigeria in 2010.[14]Also, in a descriptive cross-sectional study in Katsina, North-Western Nigeria, Sani et alreported a hypertension prevalence of 25.7% among adults.[17]

By definition, hypertension refers to elevation of blood pressure above the normally accepted level depending on the guideline used. Several guidelines are used to define, classify and manage hypertension.Currently, treatment guidelines for the management of hypertension include the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure seven and eight (JNC-7/JNC-8), the European Society of Hypertension-European Society of Cardiology (ESH-ESC), British Hypertensive Society (BHS) and Nigerian Hypertensive Society (NHS) provide the bases for defining HTN.[21,22,23]JNC-7 and the recently published report of the Eighth Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC-8) in 2014[7,36]classify HTNin adults above 18 years

of age as normal, pre-hypertension and hypertension.[21]The JNC-7/JNC-8 classification of blood pressure is for adults 18 years and above is given in the table 1.

Table 1: JNC-7/JNC-8 classification of blood pressure for adults 18 years and above

Blood Pressure Classification	SBP mmHg	DBP mmHg
Normal	<120	<80
Pre-hypertension	120–139	80–89
Stage 1Hypertension	140–159	90–99
Stage 2 Hypertension	>160	>100

European Society of Hypertension-European Society of Cardiology (ESH-ESC) 2007 Guidelines, British Hypertensive Society (BHS 2004) and Nigerian Hypertensive Society (NHS) define and classify HTN as optimal, normal and high normal categories to classify blood pressures below 140 mmHg systolic and 90 mmHg diastolic.[22,23]They classify blood pressure in adults above 18 years as given in table 2.

Table 2: ESH-ESC, BHS and NHS classification of HTN in adults above 18 years

HTN guidelines	ESH-ESC 2007		BHS 2004		NHS	
Blood Pressure Classification	SBP mmHg	DBP mmHg	SBP mmHg	DBP mmHg	SBP mmHg	DBP mmHg
Optimal	<120	<80	<120	<80	<120	<80
Normal	120-129 and/or	80 – 84	120 - 129 and/or	80 – 84	120 - 129 and/or	80 – 84
High Normal	130–139 and/or	85–89	130 – 139 and/or	85 – 89	130 – 139 and/or	85 – 89
Grade 1HTN (mild)	140–159 and/or	90–99	140–159 and/or	90–99	140–159 and/or	90–99
Grade 2 HTN (moderate)	160-179 and/or	100 – 109	160-179 and/or	100 – 109	160-179 and/or	100 – 109
Grade 3 HTN (severe)	≥180 and/or	≥110	≥180 and/or	≥110	≥180 and/or	≥110
ISH	≥140 and	<90	≥140 and	<90	≥140 and	<90

Hypertension is also sub-classified.Comparing these guidelines, JNC7/8 uses the term prehypertension for blood pressure within the range of 120-139 mmHg systolic and/or 80-89 mmHg diastolic, while ESH-ESC guidelines, BHS and NHSuse optimal, normal and high normal categories to subdivide blood pressures below 140 mmHg systolic and 90 mmHg diastolic. JNC7/8 distinguishes hypertension stage I, hypertension stage II, and isolated systolic hypertension.The ESH-ESC, BHS and NHS guidelines additionally define a third stage (stage III hypertension) for people with systolic blood pressure exceeding 179 mmHg or a diastolic

pressure over 109 mmHg. In isolated systolic hypertension (ISH), the systolic BP is equal to or above (≥) 140mmHgwhile diastolic BP is less than (<) 90mmHg.Hypertension is classified as "resistant" if medication do not reduce blood pressure to normal levels.Internationally accepted level of blood pressure remains arbitrary. Experts on HTN guidelines management and treatment across the world continue to debate the exact level of BP that constitutes hypertension. This uncertainty exists because the relationship between BP and the risk of a cardiovascular morbid or fatal event is continuous. Theycreated categories below the hypertensive range to indicate a continuum of risk.These recent created international hypertension guidelines categories above the normal range among the different guidelines for HTN indicate a continuum of risk as BP increase.Thus, no definable threshold has been agreed upon or identified unanimously, it all depends on the international hypertension guidelines used.

Aetiologically, hypertension could be further classified into primary and secondary. Primary(or essential)occurs in about 90–95% of cases of HTN, the exact cause of elevated blood pressure is not clear. In secondary HTN, which occurs in 5–10% of cases, it is caused by medical conditions like medications, renal disease, cardiovascular disease or endocrine diseases.[49,50]In primary or essential hypertension, various factors have been associated with it. The most important factors; genetics, age, sex, race (ethnicity), physical inactivity, sedentary lifestyle, obesity, high salt intake, low potassium intake, high alcohol consumption, cigarette smoking and psycho-socio-economic stress.[61,62,63]A complex association exist between genetic and environmental factors exist that influence rise in blood pressure. Also, genetic associations with BP in East Asian, South Asian, and African ancestry individuals has been identified.[49,50,51]The role of other factors such as caffeine consumption, and vitamin D deficiency have also been postulated.[52]Other factors such low birth weight and raised blood pressure in later life has been documented.

According to this hypothesis, an impairment of intrauterine environment deprives the fetus from its optimal development leading to the cardiovascular complications in later life.[53]Syndrome X (metabolic syndrome) have high blood pressure, insulin resistance, obesity, diabetes mellitus as component.[54]

Clinically,hypertensive is a symptomless disease condition, making HTN mostly identified during screening or seeking healthcare for unrelated problem. There is a common misconception that people with hypertension always experience symptoms, but the reality is that most hypertensive people have no symptoms. Sometimes hypertensionpersons may have symptoms such as headache, shortness of breath, dizziness, chest pain, palpitations of the heart and nose bleeds.[41]Also, symptoms such as occipital headache, lightheadedness, vertigo, tinnitus, altered vision or fainting spells have been reported but such symptomsmight be related to other associated diseases such as anxiety rather than the high blood pressure.[55]Although it canbe dangerous to ignore such symptoms, it cannot be relied upon to signify hypertension. Hypertension is a serious warning sign that significant lifestylechanges are required. HTN is sometimescalled the "silent killer" because people of its symptomless nature, yet it can lead to some serious and sometimes even fatal conditions. This condition been a "silent killer" it is important for everybody to know their blood pressure reading and keep monitoring it regularly particularly adult person.[41,55]

2.2. Effects of physical activity on blood pressure of hypertensive patients

All international hypertension guidelines recommend pharmacological and non-pharmacological modalities in the both prevention and management of HTN.[21,22,23]Pharmacological management of hypertension is mostly advocated for persons with established hypertension. Pharmacological

management is targeted at patients with BP ≥140/90mmHg.Blood pressure should be reduced to lower than 140/90 mmHg in all patients, and lower than 130/80 mmHg in those with co-morbidities such as diabetes mellitus or chronic kidney disease.[56]Several medication has been advocated in the treatment HTN. Most commonly, the drugs of first choice are thiazide diuretics such as Bendrofluazide, or hydrochlorothiazide.The second line drugs are; beta-blocker, an alpha-blocker, a calcium channel blocker or an angiotensin converting enzyme (ACE) inhibitor, angiotensin receptor blocker.[56,57] In hypertensive individuals with co-morbidities such as DM, hyperlipidaemia, gout or left ventricular hypertrophy, drug approach should be modified accordingly. Glucose intolerance and hyperlipidaemia low-dose diuretics are required. Diuretics and Angiotensin Converting Enzyme Inhibitors (ACEI) are considered as ideal first line choices for these conditions because of their additional renal protective effect.[56,57]The aim of drug therapy is to achieve and maintain the target blood pressure with minimal drug adverse effects.[56,57]

Non-pharmacological management involves modification of lifestyle or behaviors. An enormous body of evidence supports the effectiveness of non-pharmacological intervention such as lifestyle modifications for HTN and lowering the risk of complications of hypertension. As a result of the accumulating evidence, several guidelines emphasize and recommend lifestyle modification interventions for general health, prevention and treatment hypertension.[21,22,23]Most researches on the effect of lifestyle modification on blood pressure recommend the following:[21,22,23]

- Dietary therapy
- Limited salt intake
- Weight loss in overweight

- Quitting tobacco use
- Moderation of alcohol consumption
- Regular physical activity

Regular physical activity;Non-pharmacological management with lifestyle modification such as regular physical activity/exercise constitute an important aspect in overall health and wellbeing. Physical activity and exercise are beneficial to a wide variety of health conditions. Many researchers have provided clear evidence of the positive effects of exercise on lowering BP in persons with hypertension.[1,21,24]The prescription of physical activity should be generalised to all patients irrespective of age, blood pressure and overall CVD risk. It is recommended that individuals engage in adequate levels of physical activity throughout their lives.[24,58]Common types of exercises include walking, running, jogging, dancing, soccer, volley ball, racket ball, tennis, squash, basketball, netball, swimming and cycling.[59]Physical activity, exercise and physical fitness are the three main classes of physical activity identified. Physical activity is body movement produce by skeletal muscles using energy and producing progressive increase in health benefits. Exercise is planned, coordinated and regular physical activity carried out to improve one or more components of physical fitness. Physical fitness is the ability to meet daily ordinary and unusual requirements safely and effectively without fatigue and still have the energy for recreational and leisure time activities.[58,59]

Exercise prescriptions should be tailored to patient characteristics and goals. Physicians should help patients find a physical activity that they enjoy, because enjoyment will increase their adherence. Brisk walking compares favourably with medical fitness programmes and may be the exercise of choice in our local environment where structured facilities and resources are limited. The intensity of exercise classified as low, moderate and high intensity. Low intensity exercise

are rhythmical aerobic exercise such as walking and dancing. Moderate intensity exercise are running, cycling, swimming etc. High intensity are running, football, basketball, boxing etc. A brisk walking is moderate while jogging or running is vigorous.[58,59]Physicians also could suggest that patients listen to music or religious teachings while walking, which may help to maintain interest level.[7,8]

Several guidelines have offered recommendations on amount of physical activity.The ACSM recommended physical activity of at least 30 minutes of regular, moderate-intensity physical activity on most days of the week. The Canadian Hypertension Education Program recommends 30 to 60 min of aerobic exercise 4-7 days per week.Also, the JNC 7/8 recommends exercise at least 30 minutes per day, four days per week. In general, at least 30 minutes of regular, moderate-intensity physical activity on most days of the week are advocated.[21,22]Advice on physical activity, even-though offered, is generally insufficient. Some studies have demonstrated that physicians often provide insufficient advice, guidance and counselling on physical activity. Among patients that receive health education, only 1 in 4 were advised to increase physical activity.[34]Simple advice to increase physical activity was not enough to produce long term changes in activity patterns. It takes more than simple advice to change behaviors and adhere to physical activity advice.[34,60]Even among those that have been counselled adequately, barriers to physical exercise exist.[60]The most common reasons expressed by adults for not adopting physically active lifestyle include; exercise not enjoyable, inconvenience of exercise, lack self-motivation, no enough time to exercise, lacks confidence in the individual's ability to be physically active, lack self-management skills such as ability to set personal goals, monitor progress, or reward progress towards such goals, lack encouragement, support or companionship

from family and friends, no pleasant walking paths or space to exercise, fear of being injured or had injury recently, insecurity (eg kidnapping, bokoharam), and unfavorable weather.[60]

As a result of these barriers, several ways have been adopted to curtail them.[34,60] Some enhancers to physical activities or exercise include; set aside regular time for exercise, individual should a choose most convenient to perform the exercise, exercise early in the day or later in the evening, choose an aerobic activity that they enjoy, exercise with music, exercise in different places and facilities, listen to your body – if you experience pain or sustain an injury stop, carry out periodic assessment and strife to get to higher category gradually, set goals and share them with close friends, get a pedometer to help you set a target and quantify the exercise, try to accumulate 10,000 steps daily using the pedometer, reward self once a goal or target is reached, ensure adequate hydration if exercising in hot weather (minimum daily fluid requirement wt in kg X 30mls) and wear proper clothing and use appropriate equipment (to avoid excess heat and injury).[34,60]

Despite the health care advice and awareness on the need for increased physical activity, solutions to the problem of physical activity/exercise adherence are difficult to achieve and sustain. The measure of frequency, intensity and duration of physical activity after prescription are often difficult. This presents a challenge, because health benefits are dependent on the duration and intensity of the physical activity. Rhythmical and aerobic exercise such as walking could be performed by most people. This stimulated some researchers to study the benefit of household or work site physical activity. They advocated household and work-site is an appropriate setting for health promotion intervention programs.[15,61,58]Brisk walking has been suggested as a mode of physical activity most likely to increase physical activity levels at a population level and is the most commonly reported mode of physical activity amongst adults in

many populations. Walking performed by almost all individuals with little risk of injury, at no cost can be incorporated into peoples' daily routines. Researchers have identified that self-determined brisk walking (including simple everyday walking activities such as walking at home, workplace or with a dog) produce moderate physical activity at the intensity required to achieve health benefits.Walking interventions can be effective in reducing body weight, body mass index (BMI), waist and hip circumference, body fat, blood pressure, cholesterol and may improve mood and quality of life.[39]

The emergence of pedometer has provided a useful self-monitoring, feedback and motivational aid for increasing physical activity. It has complemented physical activity/exercise adherence as well as increasing physical activity levels.[28,29]A pedometer can be used to accurately track the volume of daily activity using the simple output of steps per day. It serve as a motivational tool because it instantly displays to the user the number of steps taken. A meta-analysis reported that pedometer users increased their levels of physical activity by 27% over baseline levels. Significant decreases in BMI and blood pressure were also reported.[62] The vast majority of commercially available pedometers are relatively inexpensive which may explain why they have rapidly become a centerpiece of many local and national physical activity campaigns. Moreover, individuals appear able to remember pedometer-based recommendations when targeted by public health campaignsand counseling.The most widely recognized step recommendation is to accumulate 5,000 to 10,000 steps per day.[28,63]This would enable national recommendations to be translated easily for pedometer-based interventions and public health campaigns.Researchers have acknowledged that in terms of practicality, pedometers offer a good solution to the problems of physical activity and its adherence. It provides a low cost, objective monitoring and behavioral modification tool and a practical aid for physical activity interventions. Pedometers

have therefore gained popularity for use in physical activity interventions in various settings to facilitate behavioral change, increase physical activity levels and ultimately weight/BMI/BP.[28,62,63]

2.3. Comparing the blood pressure changes among persons on structured physical activity and those without such advice

The significance of physical activity on wellbeing and health cannot be over-emphasized. Initial epidemiological studies in the 1950s and 1960s identified, for the first time, population level evidence that inactivity was a risk factor for cardiovascular disease such as HTN and all-cause mortality.[64] This evidence continued to accumulate, such that by 1987 a systematic review reported a linear relationship between inactivity and cardiovascular disease such as HTN.[65] Three years later, this was confirmed by a formal meta-analysis.[66] This period and the following half dozen years was characterized by increased interest and advocacy by physical activity researchers and organizations, resulting in global consensus statement.[67]

This prompted WHO to recognize the need and commissioned a global strategy on physical activity at its 56th World Health Assembly.[15] An important influencer was the earlier report by WHO/FAO which indicated the health risks of physical inactivity and its contribution to global ill-health. The report also indicated the benefits of physical activity on cardiovascular disease such as HTN prevention. Physical activity was included as an adjunctive idea, obviously contributing to the energy expenditure, energy balance and prevention/treatment of CVS such as HTN.[67]The World Health Organization hasdeveloped a series of recommendations based on factors such as physical activity to prevent/control/treat disease such as HTN on a global scale.

The focus of The Global Recommendations on Physical Activity for Heath is primary prevention of NCDs through physical activity at population level, and the primary target audience for these recommendations are policy-makers at national level.[67]This global mandates for promotion of physical activity carried out by WHO in relation to promotion of physical activity, and the limited existence of national guidelines on physical activity for health in low- and middle-income countries make evident the need for the development of global recommendations that address the links between the frequency, duration, intensity, type and total amount of physical activity needed for the prevention of NCDs.Gradually, some countries engaged with the physical activity agenda, developed guidelines and started to identify physical activity related health targets. However, most countries paid little attention to addressing levels of inactivity in a systematic manner.[68]

Overall, across all the age groups, the benefits of implementing the above recommendations, and of being physically active, outweigh the harms. At the recommended level of 150 minutes per low to moderate-intensity activity, health benefit is ensured. Apopulationbased approach is appropriate to encourage a moderate start with gradual progress and takes into consideration the patient choices, preferences, cultures and environment.[15,67,68]Researches has demonstrated that physical activity reduces risk for cardiovascular diseases such as HTN and has substantial health benefits for many conditions. Physically inactive individuals have a 20–30% increased risk of all-cause mortality compared to those who engage in at least 30 minutes of moderate intensity physical activity on most days of the week.[1]Participation in 150 minutes of moderate physical activity each week (or equivalent) is estimated to reduce the risk of high blood pressure, stroke, ischaemic heart disease and depression by approximately 30%.[1,21]

Blood pressure lowering effects of physical activity/exercise have been well documented in the literature. A meta-analysis of randomized controlled trials found that physical activity such as aerobic exercise reduced BP by about 5/3 mmHg. Among normotensives persons, physical fitness (a physiological response to regular physical activity) was significantly associated with decreased risk of developing elevated BP. The association between physical activity and BP seems to be dose-dependent, but only to a certain level of activity.Those who exercised 61–90 min/week gained more benefit than the 31–60 min/week group.[69]Also, studies have reported that physical activity such as aerobic exercise has positive effects on blood pressure producing average reductions of 4 mm Hg in systolic blood pressure and 3 mm Hg in diastolic blood pressure.[21]Also, a study was conducted to investigate the BP-lowering effect of physical activity/exercise to achieve BP control among individuals on drug therapy in 2013. This study, investigated the effect of physical activity using aerobic dance combined with antihypertensive drug therapy on BP control and number of antihypertensive drugs taken by individuals with essential hypertension who had been on two antihypertensive drugs.There were significant reductions in SBP of the intervention exercise group than the control group, and in DBP among the intervention exercise group than the control group post-12-week intervention. The BP control rates were 56.7% and 35.5% in the exercises and control group respectively.The report demonstrates the tendency of physical activity using aerobic dance to enhance BP control in individuals on two antihypertensive drugs.[26]

The fact that genetic and hereditfactors have been established in the causative of hypertension, there is also the possibility of the effects of genotypes in responses to physical activity/exercise in hypertension. These interpersonal and interracial differences clearly indicate the need for study among black African population, necessitating such study. Sikiru et al conducted a study in

Enugu, Nigeria 2014, to investigate the effect of physical activity on blood pressure in black African subjects with hypertension. The study revealed significant decreased effects of physical activity on SBP, DBP, BMI, WHR, and significant increase in VO2max at $p< 0.05$. This study demonstrated the rationale bases for the adjunct therapeutic role of physical activity such as moderate intensity continuous exercise training in the down regulation of blood pressure, body size and body fat in hypertension among black African population.[70]

Increasing physical activity is one recommendations that is considered a widely accessible, inexpensive, and effective intervention. It can be recreational, performed during free time and to meet personal interests and needs. Also it can be performed at occupational ground and associated with the activity required for one's job. The international recommendations for health promoting physical activity does not distinguish between recreational and occupational physical activity.[38]The persistent emphasis on global differences and strategies for physical activity has often been faced with neglect of geographic, economic, and social differences within populations. Targeting interventions towards the most vulnerable group's particularly lower resource population will hopefully reduce most of these inequities.

2.4. Sociodemographic characteristics and risk factors of hypertension

Sociodemographic characteristics varies among populations and may constitute risk factor for developing hypertension. These risk factors for developing hypertension can be classified as Modifiable and Non-modifiable factors.[71] Modifiable are factors that cannot be changedor treated. Non-modifiable factors are factors that can be changedor treated.[71,72,17]

2.4.1. Non-modifiable risk factors

These are factors that cannot be treated or changed. They include increased age, male gender, black race and family history (genetic factor)of hypertension.[71,72,17]Increasing ageis a risk factor hypertension. Severalstudieshave demonstrated that increasing age predisposes to developing hypertension.[73]In a study done in Sokoto, Northern Nigeria, 2011, Isezou et al reported thathypertension occurred more commonly during the second decade of life and peaked at the fourth decade of life. The study demonstrated that the fifth decade of life may represent the highest period of hypertension.[74]Gender predisposes significant risk of developing pre-hypertension. Several studies observed male sex dominance in the prevalence of hypertension.[73]Sani et al, in a study in Katsina state Northwestern Nigeria, 2010, reported higher prevalence (males 27.9, females 24%,) of HTN among male gender.[17]Blacks race are more at risk of developing pre-hypertension compared to their white race counterpart according to many reports.[75]Higher prevalence was reported among non-Asians, particularly the black African population.Environment, lifestyle and genetic factors was been postulated as reason but whether this pattern is typical in all persons who ultimately develop hypertension need to be established.[75]Similarly, the REGARDS Study demonstrated that hypertension was associated with black raceblack race (62.9% in blacks compared to 54.1% in whites) and cardiovascular complications such as stroke occurs moreblack race.[76]Genetic associations with BP have been demonstrated by several studies.[77]Family history of hypertension has a linear associated with hypertension. In a study on the genetic variants associated with blood pressure, evidence for BP and some genome types was reported.[51]

2.4.2. Modifiable risk factors

These are factors that can be changed or treated. They include physical inactivity, overweight/obese, harmful alcohol consumption, tobacco use (cigarette smoking),unhealthy diet

includinghigh sodium intake and low potassium intake.[71,72,17]Also, other factors have been implicated such as diabetes mellitus (DM), dyslipidemias, metabolic syndrome (syndrome X), stress, socioeconomic status, low birth weight (LBW), maternal smoking and lack of breast feeding.

Physical inactivity; Globally, about 3.2 million deaths and 32.1 million DALYs (representing about 2.1% of global DALYs) each year were attributable to insufficient physical activityby WHO in 2010. People who are insufficiently physically active have a 20–30% increased risk of all-cause mortality compared to those who engage in at least 30 minutes of moderate intensity physical activity on most days of the week.Also, it is the fourth leading risk factor for mortality.[3]Insufficient physical activity is highest in high-income countries, but very high levels are now also seen in some middle-income countries especially among women. In all regions, men were more active than women.Prevalence of physical inactivity was highest in the Americas and the Eastern Mediterranean Region. This was also the case in nearly every individual country. The prevalence of physical inactivity rose according to the level of country income. High-income countries had more than double the prevalence compared to low-income countries. This is because of increase in sedentary lifestyle like motorized transport, labour-saving devices in the home, the phasing out of physically demanding manual tasks in the workplace, and leisure time that is predominantly devoted to physically undemanding pastimes. The increased automation of work and other aspects of life in higher income countries is a likely determinant of physical inactivity.[3]Although, several studies report lower prevalence of physical inactivity in low and lower middle income countries which may be explained by increased physical work for both men and women, there is now a gradual transition in lifestyle. This gradual change from traditional African lifestyle, adoption of western lifestyle,increase in sedentary lifestyles, the growing rate

of urbanization are all directly related to the increasing rate of hypertension, and other CVD/metabolic diseases.[3]Abdulsalam et al in a study in 2014, Oyo state, south western Nigeria, found 24.8% of hypertensive adult persons to be physically inactive.[18]Regular physical activity reduces the risk of cardiovascular disease including high blood pressure. Participation in 150 minutes of moderate physical activity each week (or equivalent) is estimated to reduce the risk of ischaemic heart disease (IHD) by approximately 30% and the risk of diabetes by 27%. Additionally, physical activity lowers the risk of stroke, hypertension and depression. It is a key determinant of energy expenditure and thus fundamental to energy balance and weight control.[3]

Overweight/obese; Obesity is increasingly being recognized worldwide as a major public health problem reaching epidemic proportions. WHO reported that globally in 2005, approximately 1.6 billion adults were overweight and at least 400 million adults were obese.Also, WHO reported that about 20 million children under the age of 5 years were overweight globally in 2005. Accordingly, WHO reported that in 2012, an estimated 33.0% of the world's adult population were either overweight or obese.WHO further projected that by 2015, approximately 2.3 billion adults will be overweight and more than 700 million will be obese.[78]Overweight and obesity leads to serious health consequences. Risk increases progressively as BMI increases. Raised body mass index isa major risk factor for chronic diseases such ashypertension, cardiovascular disease (mainly heart disease and stroke) already the world's number one cause of death, killing 17 million people each year.[78]Initially,overweight and obesity was thought to be a disease of the high-income countries and Western World, this disease is now increasing in the developing low- and middle-income countries, particularly in urban setting.[78]

Fundamentally, the cause of obesity and overweight is an energy imbalance between calories consumed on one hand, and calories expended on the other hand. Global increases in overweight

and obesity are attributable to a number of factors such as;a global shift in diet towards increased intake of energy-dense foods that are high in fat and sugars but low in vitamins, minerals and other micronutrients, a trend towards decreased physical activity due to the increasingly sedentary nature of many forms of work, changing modes of transportation, and increasing urbanization. [78]

The WHO classifies BMI as follows;[79]

- Underweight – from 16.0 to 18.5 kg/m^2
- Normal – from 18.5 kg/m^2 to 24.9 kg/m^2
- Overweight – from 25 kg/m^2 to 29.9 kg/m^2
- Obese I – from 30 kg/m^2 to 34.9 kg/m^2
- Obese II – from 35 kg/m^2 to 39.9 kg/m^2
- Obese III – from 40 kg/m^2 and above

Recently, the International Diabetes Federation (IDF) defined central obesity as waist circumference of ≥94 cm and ≥80 cm in men and women, respectively.[54]Waist- hip ratio of >0.9 for men and >0.85 for women are both used as measures of central obesity.[79,54]A cross-sectional study carried out in an urban area of Lagos city, Lagos State, Nigeria, in 2012, reported a high prevalence of pre-hypertensive among obese Nigerian adults.[80] Similarly, cross-sectional study conducted in the urban city of Katsina, north-western Nigeria, in 2011, reported a prevalence of 53.3% and 21.0% of overweight and obesity respectively with a significantly higher prevalence in females compared to males (overweight was 62.0% vs 41.9%, obesity was 29.8% vs 9.3%).[81]Many factors have been postulated in the pathogenesis of obesity but genetic and environmental factors are most important. The increase in prevalence of obesity among Africans

and other developing countries may be associated to nutritional transition that has been associated with reduced physical activity, sedentary lifestyle, adoption of unhealthy western diet, rapid urbanization and industrialization.[78]

Harmful alcohol consumption; The harmful use of alcohol is a major risk factor for premature deaths and disabilities in the world. Hazardous and harmful drinking was responsible for 2.3 million deaths worldwide in 2004.[3]In 2012, an estimated 5.9% (3.3 million) of all deaths worldwide and 5.1% of disability-adjusted life years as measured in DALYs were attributable to alcohol consumption. More than half of these deaths resulted from NCDs such as hypertension, cardiovascular disease and liver cirrhosis. The level of alcohol consumption worldwide in 2010 was estimated at 6.2 litres of pure alcohol per person aged 15 years and over (equivalent to 13.5 g of pure alcohol per day). The prevalence of heavy episodic drinking is associated with the overall levels of alcohol consumption and is highest in the WHO European Region and the Region of the Americas.[2]A study conducted in Delta state, southeastern Nigeria reported alcohol consumption of 43.4% in 2012.[71]There is a direct relationship between higher levels of alcohol consumption and rising risk of NCDs particularly cardiovascular diseases. The relationship between alcohol consumption and CVD depends on both the amount and the pattern of alcohol consumption. Some epidemiological studies generated mainly in high-income countries, suggest that low-risk patterns of alcohol consumption may have a beneficial effect on selected disease outcomes and in some segments of populations, but these effects tend to disappear if the patterns of drinking are characterized by heavy episodic drinking.[3]

Studies have shown that consumption of one drink daily by women and one or two drinks daily by men was associated with a reduction in mortality of 18%.Intakes of two drinks daily in

women and three drinks daily in men, however, were associated with increased mortality in a dose-dependent fashion. One drink is equivalent to; 12 fluid ounces (360 mls) of regular beer, 5 fluid ounces (150 mls) of 12% alcoholic wine and 1.5 fluid ounces (30 mls) of distilled spirit (e.g. Whisky, Brandy or Gin).[82] Although alcohol consumption is deeply embedded in the cultures of many societies, an estimated 45% of the global adult population has never consumed alcoholic beverages in their lives. An estimated 55% of women never consumed alcohol.[3]There are policy options advocated globallyto reducethe harmful use of alcohol. They include;pricing policies (increasing price of alcohol), reduced availability and marketing of alcohol, improved response by health services, drink-driving policies and countermeasures, individual interventions such as screening for harmful drinking, treatment of alcohol dependence.[2]

Tobacco use;Tobacco use and exposure comes in both smokeless and smoking forms. Smoking tobacco (cigarette smoking), is the most commonly used form globally. Smokeless tobacco is consumed in un-burnt forms through chewing or sniffing. All forms of tobacco has been associated with hypertension, cardiovascular diseases, cancers (oral cancer), and other conditions.[3]There are over 1 billion smokers in the worldwide as reported by WHO in 2010. WHO estimated the prevalence of daily tobacco smoking varied widely across regions. In all regions, men smoked more than women. Among men, the highest prevalence of smoking was in lower-middle-income countries. Almost 6 million people die from tobacco use and exposure each year, accounting for 6% of all female and 12% of all male deaths in the world. Among 6 million annual mortality from tobacco use, over 600 000 deaths were as a result of exposure to second-hand smoke. By 2020, WHO estimates annual tobacco-related mortality to increase to 7.5 million, accounting for 10% of all deaths with almost 10% from tobacco related cardiovascular disease.[2,3]Tobacco use, whether cigarette smoking or chewing tobacco, increases

risks of CVD. Smokers have more than twice the risk of developing cardiovascular disease. Smoking cessation was associated with lower BP.A longitudinal study, "Olivetti Heart Study" was conducted between 1995 and 2004 on the association of smoking and blood pressure. They followed-up participants for 8 yearsand observed the effect of smoking on hypertension. They reported smoking cessation was associated with lower BP increment and minor HTN risk, independent of confounders.[83]Global measures to ensure reduction in tobacco use include:enlightening and warningpeople about the dangers of tobacco use, offering help to those willing to quit tobacco use, protecting people from second-hand smoke through national "100% smoke-free" legislation, enforcing bans on tobacco advertising promotion and sponsorship and raising tobacco taxes.[2]

Unhealthy diet; Globally, about 16 million (1.0%) DALYs and 1.7 million (2.8%) of deaths worldwide were attributable to unhealthy diet consumption such as low fruit and vegetable consumption by WHO in 2010.[3]Also, WHO states that there is convincing evidence that the consumption of high levels of high-energy foods, such as processed foods high in fats and sugars, promotes cardiovascular diseases such as hypertension, diabetes and obesity compared to low-energy foods such as fruits and vegetables.[3]Adequate consumption of fruit and vegetables reduces the risk for cardiovascular diseases, stomach cancer and colorectal cancer.[3]Industrialization, urbanization, economic development and market globalization have caused rapid change in diets and lifestyles. This is having a significant impact on nutritional and the health status of populations, particularly developing countries and countries in transition. While standards of living have improved, food availability has expanded, become more diversified and accessible. Food and food products have become commodities produced and traded in markets that has expanded from an essentially local base to an increasingly global

one.[84]The adverse dietary changes include shifts in the structure of the diet towards a higher energy density diet with a greater role for fat and added sugars in foods, greater saturated fat intake (mostly from animal sources), reduced intakes of complex carbohydrates and dietary fibre, and reduced fruit and vegetable intakes. This changes in diets, patterns of work and leisure often referred to as the ‘‘nutrition transition’’ are already contributing to the causal factors underlying non-communicable diseases even in the poorest countries.The dietary changes that characterize the ‘‘nutrition transition’’ include both quantitative and qualitative changes in the diet.[84]

High sodium intake; Studies over time have demonstrated that high dietary sodium increases BP and is strongly associated with adverse cardiovascular events. It also cause direct vascular and cardiac damage independent of BP. The amount of dietary salt consumed is an important determinant of blood pressure levels and overall cardiovascular risk. There is widespread inexpensive commercial access to salt. Most diets now have about 10 g of dietary salt daily. It is likely that the rapid increase in dietary sodium is contributing to the current epidemic of cardiovascular disease.Sodium is naturally present in small quantities in unprocessed foods, but it is also added to foods either during processing, cooking or at the table. The main reasons for addition of salt in processed food are for flavour, texture, preservation and to improve taste of beverages.[84]WHO recommend dietary salt intake of less than 5 grams per person per day for the prevention of cardiovascular disease. Hence, decreasing dietary salt intake from the current global levels of 9–12 grams per day to the recommended level of 5 grams per day would have a major impact on reducing blood pressure and cardiovascular disease. [3,84]

Low potassium intake;The association of potassium and blood pressure has been described in many studies. Potassium intake was found to be inversely related to both DBP and SBP. An analysis of sodium and potassium intake among US adults based on data from the third National

Health and Nutrition Examination Survey (NHANES) showed higher potassium intake to be associated with lower mortality. A 10mmol increase in daily potassium intake was associated with a 40% reduction in high blood pressure and the risk of stroke-associated mortality.[84,85]Foods rich in potassium are vegetables, fruit, dairy products and nuts. Natural source of potassium is preferable. Currently, pharmacological potassium supplementation is not recommended as a method to obtain the advised daily intake of potassium.[84,85,86]Ijarotimi et al in a descriptive case control study on nutrients intake in hypertensive patients in Ondo State, Nigeria, in 2008, reported an inverse correlation between potassium intake and blood pressure. The study further established a positive correlation between the blood pressure and magnesium and calcium. They also establish an inverse correlation between BP and vitamin C, vitamin D, zinc, sodium and Na/K ratio.[87]

Fruits and vegetables; Fruit and vegetable consumption is one element of a healthy diet. Fruit and vegetable intake varies considerably among countries reflecting economic, cultural and agricultural environments. Insufficient intake of fruit and vegetables is estimated to cause about 11% of hypertensive and ischaemic heart disease deaths and about 9% of stroke deaths worldwide. Most of the benefit of consuming fruits and vegetables comes from reduction in cardiovascular disease and cancer. Rates of deaths and DALYs attributed to low fruit and vegetable intake are highest in low and middle-income countries.[6]Fruit and vegetable diets are known to have ameliorating effects on blood pressure and many diseases.[6]Fruits and vegetables are rich in dietary fibre and they have been reported to have hypotensive effects in some studies done in Nigeria.[88] Similarly, Olugbenga et al in a randomised control trail at Olabisi Onabanjo University, Ikenne, Ogun state, Nigeria, reported that fruits and vegetables were associated with lower BP.[89]For diet, recommendations for populations and individuals should include the

following: achieve energy balance and a healthy weight, limit energy intake from total fats and shift fat consumption away from saturated fats to unsaturated fats and towards the elimination of transfatty acids, increase consumption of fruits and vegetables, and legumes, whole grains and nuts, limit the intake of free sugars, limit salt (sodium) consumption from all sources and ensure that salt is iodized, increase consumption of fruits and vegetables.[15]

Other factors such as diabetes mellitus, dyslipideamia, metabolic syndrome, stress, socioeconomic status and low birth weight have been implicated in HTN. Diabetes mellitus (DM) is a clinical syndrome which comprises a group of metabolic disorders characterized by hyperglycaemia due to absolute or relative insulin deficiency. The lack of insulin affects the metabolism of carbohydrates, fats, and proteins.[41]Dyslipidemias are disorders of lipoprotein metabolism, including lipoprotein overproduction or deficiency. These disorders may be manifested by elevation of the serum total cholesterol, triglyceride, low-density lipoprotein (LDL-C) and a decrease in the high-density lipoprotein cholesterol (HDL-C).[90]Metabolic syndrome (syndrome X);The metabolic syndrome (syndrome X, Reaven's syndrome) is a constellation of cardiovascular risk factors which are; raised fasting plasma glucose, diabetes, abdominal obesity, high cholesterol and high blood pressure. The clustering of these CVD risk factors that typifies the metabolic syndrome is now considered to be the driving force for a new CVD epidemic such as HTN.[54]A chronically stressful life, social isolation, anxiety and depression increase the risk of high blood pressure, CVD and stroke.[61]Socioeconomic status such as being poor, no matter the location in the globe, increases your risk of high blood pressure, heart disease and stroke.[61,91]Studies have also implicated events in early life such as low birth weight in the development of HTN.[53]

2.5 Conceptual framework

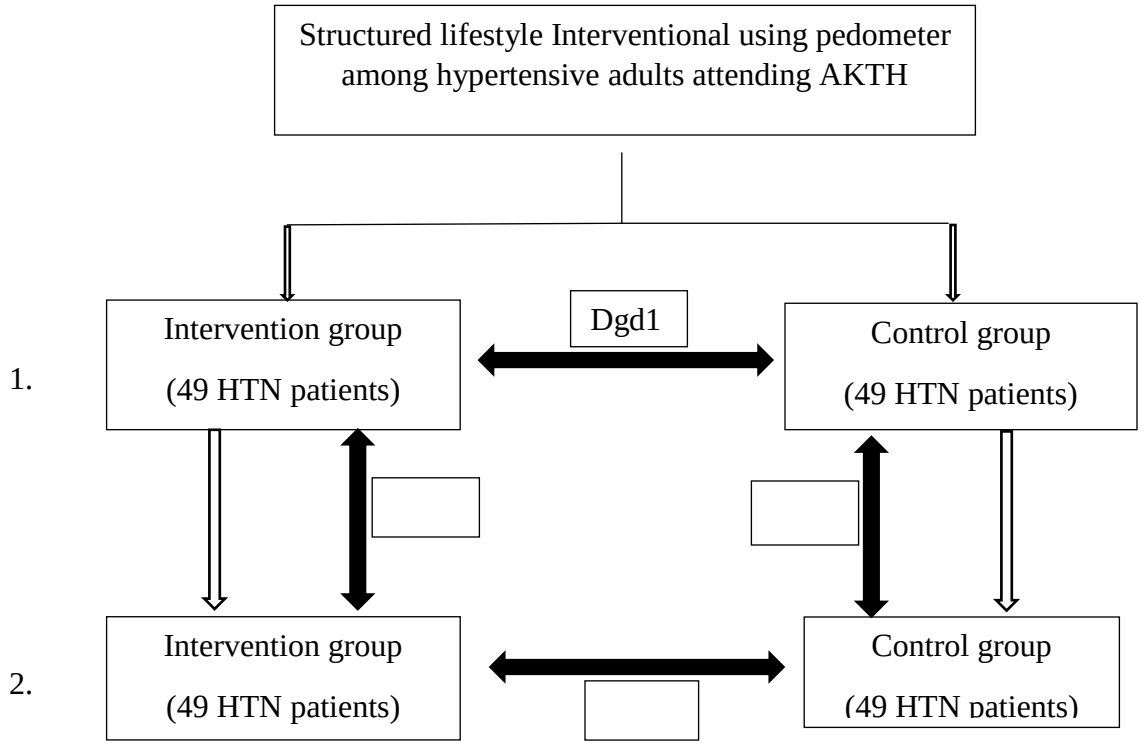


Figure 1; Conceptual framework

1. Baseline; SBP, DBP, PR, BMI, WC, WHR

2. Post intervention; SBP, DBP, PR, BMI, WC, WHR

Key

1. Period of Intervention (3 months) ⇩
2. Comparism ⟷
3. Dgd1 – different group (intervention and control group) to assess comparability between the 2 groups before intervention
4. Sgd1 – same group (intervention group) comparism and percentage difference before and after intervention
5. Sgd1 – same group (control group) comparism and percentage difference before and after intervention
6. Dgd2 - different group (intervention and control group) comparism and percentage difference after intervention

CHAPTER THREE: METHOD

3.1. Study area

Thisstudy was carried out at Aminu Kano teaching hospital (AKTH) is located at Tarauni Local Government areas of Kano State. AKTH is a 750-bed capacity teaching hospital. AKTH provides primary, secondary, and tertiary care to residents of Kano state and it also serves neighboring states of Katsina, Jigawa and Bauchi state. The core function of AKTH is service delivery, teaching, and research. The fact that AKTH, been one among the two tertiary health institution in Kano state, AKTH attends to most of the referrals from various levels of health system and major health problem of the citizens of Kano state. Educated and enlightened persons of Kano state mostly seek care at AKTH probably as a result of better patient attention and better quality of care. As a result of the poor health care seeking behaviors of the populace of Kano and

poorly functioning primary care system, most of the patients prefer to attend to AKTH. This makes AKTH a busy institution with in high number of patient attended to on daily bases.

AKTH has several departments such as medicine, surgery, paediatrics, O/G, pathology and family medicine. Patients are admitted into several departments such as; medicine, surgery, obstetrics and gynaecology and paediatrics.This study was conducted at the General out-Patient Clinic (GOPC) of the department of Family Medicine and themedical out-patient clinic (MOPC) of the medicine department of Aminu Kano Teaching Hospital (AKTH), Kano, Nigeria.The general out-patient clinic (GOPC)of family medicine department see an average of 400 undifferentiated out patients daily.The medical out-patient clinic (MOPC) of medicine department see an average 50 adults on clinic days (Monday and Wednesday). Majority of hypertensive patient are usually attended to at the GOPC where only those with complications are referred to the internal physician for specialist care.

Health services in Kano state and Nigeria in general are provided via three tiers of government namely; primary health care by the L.G.A, secondary health care by the state government and tertiary care by the federal government. Other providers include private sector including traditional practitioners and religious bodies. In spatial terms, there is a very high concentration of health infrastructure, services and personnel in Kano metropolis compared to the rest of the state.About There are 1159 health facilities in the state. With two tertiary, 64 secondary and 1,241 primary health care institutions. Other providers include private sector including traditional practitioners and religious bodies. In spatial terms, there is a very high concentration of health infrastructure, services and personnel in Kano metropolis compared to the rest of the state.

The catchment area, Kano State is one of the 36 States in the Federal Republic of Nigeria. It was created on May 27th, 1967, with its headquarters in Kano. The State is divided into 44 Local Government Areas (LGAs), the highest in Nigeria. The city of Kano serves as capital for the entire state with a population of over 2 million (about 20% of State population). The city of Kano alone has 8 LGAs.Kano State is located in the North-westerngeopolitical zone of the country and lies betweenlatitude 12^0 37' North and 9^0 33 South;longitude 9^0 29 East and 7^0 43 West. It shares borders with Kaduna and Katsina States to the west, Katsina and Jigawa States to the north, Jigawa State to the east and Bauchi and Kaduna states to the east.Kano State is the most populous, second most industrialized state in Nigeria, a centre of commerce and the economic nerve centre of the north. Agriculture is the mainstay of the economy engaging at least 75% of the rural population. There are well over 300 large and medium scale industrial establishments in Kano located in Bompai, Sharada and Challawa industrial estates involved in the processing of basic raw materials such as groundnut, skin and hides, metal work, confectionery, textile goods and garment-making. As the Centre of Commerce, Kano's economy is dominated by commercial activities mainly in trading, banking and transportation.

According to the 2006 censuses, the population of the State was 9,383,682, making it the most populous state in Nigeria. The estimated projected population is over 11 million people from the 2006 census and about 2,420000 women within the reproductive age group.[40]Life expectancy in Kano State is 51 years for male and 52.2 years for female.Administratively, the State has 44 Local Government Areas.The vegetation is Sudan savannah with the hottest months being April and May, the coldest being December and January and the rainy season varies from April to October with an average rainfall of 140mm and 65days per annum.

3.2. Study population

The study population were adults aged 18 years and above with hypertension attending the general out-patient clinic (GOPC) and the medical out-patient clinic (MOPC) of Aminu Kano Teaching Hospital who gave consent.

3.2.1. Inclusion criteria

Adults aged 18 years and above with hypertension on drug treatment attendinggeneral out-patient clinic(GOPC) and medical out-patient clinic(MOPC)of Aminu Kano Teaching Hospital who give consent.

3.2.2. Exclusion criteria

1. Patients with complications such as heart failure (HF),coronary artery disease (CAD), cerebrovascular disease (CVD), as exercise may worsen their conditions.
2. Pregnant women (as theirs may be pregnancy induced hypertension)
3. Age more than 75 years (as they may be able to meet the daily steps needed per day)

3.3. Study design

The study is an experimental (interventional) study (pre and post intervention study with a control).

3.4. Sample size determination

The sample size shall be calculated using the formula for randomized control trial;[92]

$N= (Z_\alpha + Z_\beta)^2 \sigma^2 /(\mu_1 - \mu_2)^2$ (per group)

Where;-

Z_α=is standard normal deviate corresponding to 5% level of significance. The value obtainedfrom the normal distribution table= 1.96

Z_β=is standard normal deviate corresponding to a power of 80%. The value obtained from the normal distribution table = 0.84

σ =is the standard deviation of the mean arterial blood pressure in the population = 10.3mmHg (adopted from the study on prevalence, associated factors and relationship between pre-hypertension and hypertension done in North-Western Nigeria, Sokoto, 2010).[74]

$\mu_1 - \mu_2$ =the difference between the mean systolic blood pressure between the two groups. The assumed difference between the mean systolic blood pressure of the 2 groups = 4.3mmHg(adopted from the from thePREMIER Clinical Trial which was a multicenter study on the effects of comprehensive life style modification on blood pressure control.[93]

Therefore given:

$Z_\alpha = 1.96$

$Z_\beta = 0.84$

$\sigma = 10.3$mmHg

$\mu_1 - \mu_2 = 4.3$mmHg

$N = 2(1.96 + 0.84)^2\ 10.3^2/4.3^2 = 44$

A minimum sample size of 44 per group were enrolled but 10% was added to accommodate for attrition making a total of 49.[93]

Therefore the total sample size was 98 persons, 49 persons per group.

3.5. Sampling technique

From the daily attendance of approximately 400 adults patients aged 18 years and above attending the General Out-patient Clinic and 50 attending MOPC of Aminu Kano Teaching Hospital, Kano, 98 hypertensive persons were recruited after obtaining an informed consent.

Multistage sampling technique was used (first and second stage).

First stage

- Proportionate allocation was used to select participants from each clinic ie out of 400 adults HTN patients attending the GOPC and 50 patients attending MOPC of AKTH.

  Total sampling frame = 450 persons

  GOPD = 400/450 x 98 = 87%

  87 participants were selected from the GOPD

  MOPD = 50/450 x 98 = 11%

  11participants were selected from MOPD

Second stage

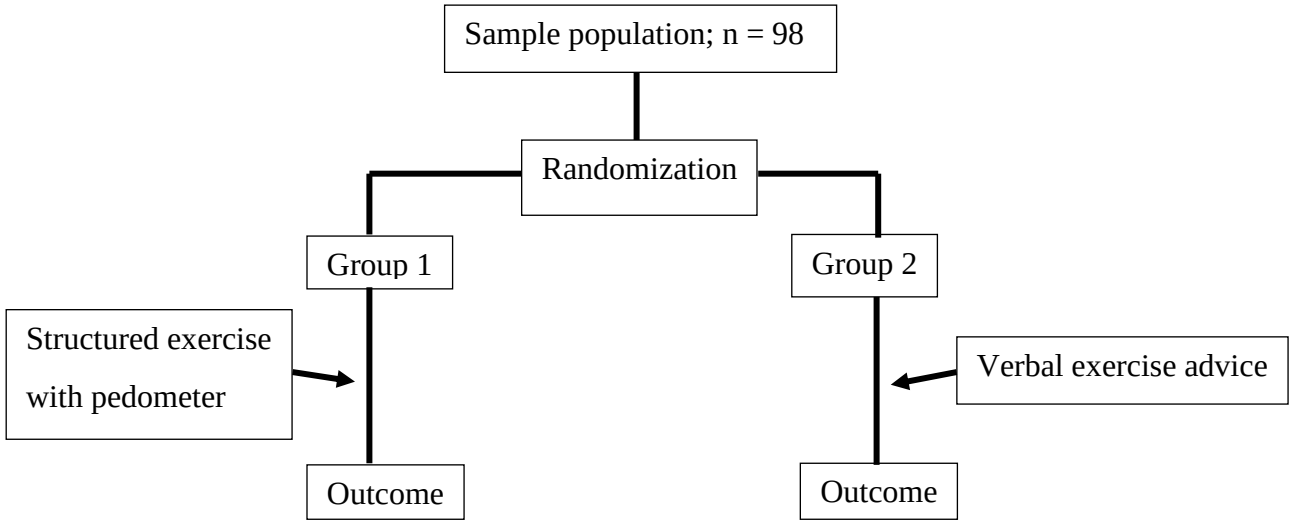
- Systematic sampling technique was used to select 98 participants from the 2 clinics (GOPC and MOPC). The sampling interval was calculated as

  K=450/98 = 5

Thus, after every 5thHTN person that present to the clinics (GOPC and MOPC), one was selected that met the inclusion criteria and consented. The first one was selected by random selection.

Randomization

- Randomization by random assignment (or allocation) was done to allocate participants into either Group A or Group B. We placed 98 sealed brown envelopes, each containing a piece of paper with A or B typed on the table for participants. Upon recruitment, each participant picked one envelope. On opening the sealed envelope, participants were assigned to either intervention group A or B. Thus, 49participants were assigned to group A and 49 to group B.



3.6.Study instruments

Data collection tools were Questionnaire, sphygmomanometer (mm/Hg), stethoscope, weighing scale (kg), stadiometer (m), tape measure (cm).All respondents were physically examined and questionnaire administered.

3.7.Data collection method

Following approval by the health research ethics committee (HREC) of AKTH, the study started with recruitment of participant from the GOPC and MOPC which lasted for 2 weeks(January 2016).

Review of Instruments; Research instruments (questionnaires) was pre-tested in Murtala Mohammed specialist hospital, Kano State to test their efficacy and the ability of the trained research assistants to carry out a satisfactory exercise via practical demonstration and necessary adjustments was made. Also, we determined:

- Reactions of respondents to research procedure and questions
- Appropriateness of research tools, format and wording of the questionnaire
- Time needed to carry out interviews
- Feasibility of designed procedure for data collection and analysis
- Appropriateness of the Hausa wording of the translated questionnaire, physical examination questionnaire and consent form

Recruitment and training of research assistants; Fournurses were recruited as research assistants for this study and they were drawn from health workers of AKTH. They werenurses who participated in similar surveys in the past, be able to take blood pressure correctlyand were conversant with the culture and customs of the areas to be studied. They were fluent in local

language (Hausa language). Training session lasted three days. Translation of major terms to Hausa was made and explained to the research assistants in order to standardize the data collection process.

3.7.1. Pre-intervention data collection (before intervention or baseline)

All the participants that were selected for the study who consented to undergo the study, were administered interview questionnaires and physically examined for blood pressure, pulse rate, height, weight, hip circumference and waist circumference. All baseline data were collected in January 2016.

Administration of questionnaire; A total of 49 persons in each arm of the study were administered questionnaire to generate baseline data on socio-demographic characteristics. The questionnaire was interviewer-administered.All the participants were interviewed using a pre-tested questionnaire. The questionnaire was translated by two independent professional Hausa scholars as it was administered in local (Hausa language).The questionnaire was administered in both English and Hausa languages through a trained researcher's interpreter. The questionnaire had 4 sections; Socio-demographic information, family history (of hypertension), risk factors (of hypertension) and physical examination.

Physical examination; All the respondents had physical examinationby the researcher and given were two weeks follow up.A focused physical examination was done which included; pulse rate, blood pressure, weight, height, waist circumference, and hip circumference.For pulse rate measurement, all the participants were seated on a chair with feet on the floor, and arm resting on a table.The radial artery was used (located at the radial side of wrist) to count the pulse rate for one minute.

Before blood pressure measurement, the participants were asked to abstain from strenuous exercise, cigarette smoking, consumption of alcohol and caffeine - containing beverage for at least 30 minutes prior to blood pressure measurement. Subjects were seated and allowed to rest on a chair for at least 5 minutes, with feet on the floor, and arm supported at the heart level.Blood pressure was taken in mmHg using an Accuson® adult mercury sphygmomanometer.An appropriately sized cuff (cuff bladder encircling at least 80% of the arm) was used to ensure accuracy.The cuff was inflated to 30mmHg above the palpated systolic BP and deflated at a rate of 2 to 3 mmHg per second.The bell of the stethoscope was placed over the brachial artery pulse, proximal to the cubital fossa, and below the bottom edge of the cuff making sure that it is not touching the cuff (ie, about 2 cm above the cubital fossa).The first appearance of Korotkoff sound (phase 1) was used to define the Systolic blood pressure. And the disappearance of Korotkoff sound (phase 5) was used to define Diastolic blood pressure. The pressure was recorded to the nearest 2 mmHg.Two readings separated by 5 minutes was taken and the average used. If the first two readings differ by more than 5 mm Hg, an additional reading was obtained and the average used.

The height was measured in metres (m) using a Hospitex® stadiometer. The weight was measured in Kilogram (Kg) with a Hospitex®scale.The participants were told to remove all heavy objects from their body including their shoes, belts, purses and phones. They stood erect with their hands at their sides when there height (cm) and body weight in Kilogram (Kg) was taken be taken with a Hospitex®stadiometer/scale.

The waist circumference was measured with a non-elastic measuring tape in centimetres (cm). The reference point was the midpoint between the lower margin of the last rib and the upper margin of the iliac crest.[94,95]A waist circumference of >102 cm in men and >88 cm in women

was considered as truncal obesity.[94,95]The hip circumference was measured with a non-elastic measuring tape in centimetres (cm). The reference point was the widest hip diameter.[95]

Waist hip ratio (WHR) was calculated using the formula; weights (circumference/hip circumference) x 100.AWHR of≤0.8 in women and ≤1.0in men was considered normal.[95]Body mass index (BMI) was calculated using the formula Weight (in Kilogram)/height (in metre^2). The WHO classification of obesity was used for the classification.[96]

3.7.2. Intervention

Study groups; followingrandomization the participants were divided into 2 groups; intervention group (group A) and control group (group B).

Intervention group A;

Participants in this group receivedstructured physical exercise advice.The structured physical exercise adviceis using pedometer (Appendix D). A pedometer to record the number of steps taken daily with a one week memory was provided for each participant.

- Structured physical exercise advice; Participants were educated on structured physical exercise programmes verbally and in writing (Appendix C_1). Individual, cultural and religious biases/preferences was taken into consideration. For the purpose of this study, a target of minimum of 5,000steps daily was advised, and theywere also encouraged to increase the steps gradually as time goes on.[63]A pedometer (OK 166P Easy WalkMultifunction Pedometer®from Ultra-Fitness, Taiwan) to record the number steps

taken daily with a one week memory was provided to each participant in the intervention group (Appendix C_2). The pedometer was worn on the body daily. It recorded the total number of steps achieved daily which was charted on the exercise record sheet (Appendix C_2). They came with the exercise record sheet on their follow ups.

The number of steps taken per day was categorised as follows[63]

i.	< 5000	Sedentary
ii.	5000 – 7499	Lowly active
iii.	7500 – 9999	Moderately active
iv.	≥10000	Highly active

Control group B;

The control group were general verbal advice on exercise.

3.7.3. Follow up

All participants were followed up 6times with visits at; 2 weeks, 4 weeks, 6 weeks, 8 weeks, 10 weeks, and 12 weeks. At each visit, Pulse, Blood Pressure, Height, Weight, Hip circumference, Waist circumference were measured. Any co-morbidity detected in the course of the study were managed accordingly.

3.7.4. Expected study duration

Each participant were followed up for 12 weeks(3 months) as was the period of time used in a randomized control trail on the effect of a pedometer-based community walking intervention "Walking for Wellbeing in the West" on physical activity levels and health outcomes.[39]

3.7.5. Post-intervention

All the participants after 3 months of structured physically activity were physically examined for blood pressure, pulse rate, height, weight, hip circumference and waist circumference. All post intervention data were collected in May 2016.

3.8. Data management

3.8.1. Measurement of variables

All data generated from the study were entered into the computer system for analysis. Epi info version 7.0 statistical software (CDC Atlanta, Georgia, U.S.A) and SPSS version 16 statistical software were used to analyze the data.Categorical data were presented as percentages, while quantitative data were described using mean, median and standard deviation as appropriate.

3.8.2.Statistical analysis

Statistical associations between variables was obtained by use of either univariate / bivariate analysis (χ^2, T-test). These test statistics were also used to assess comparability of the 2 groups (intervention and control) before structured physical activity intervention.

T-test was because the dependent variable is a continuous variable. The T-test was used to determine the difference in mean scores of blood pressure between the two groups before and after structured physical activityintervention, and between the pre-intervention and post-intervention scores for each of the two groups. Hence, paired T – test was used to determine the differences in means of blood pressure in the same group (ie intervention or control) before and

after intervention while 2 sample T – test was used to determine the difference in means between the two independent groups (ie intervention and control)after intervention.A probability (p-value) of less than 0.05 was considered as significant for all tests of significance.

3.9. Ethical consideration

Ethical clearance was obtained from the Hospital Research Ethics Committee of Aminu Kano Teaching Hospital, Kano (Appendix E).A written and signed informed consent was obtained from all participants (Appendix A) before enrolment. Confidentiality was maintained by ensuring that only identification number without name and address of participants were included in the questionnaire and data collected would only for the purpose of this research. The results obtained from the study was treated confidentially and communicated to the participants. Data and other information were stored in a password coded computer fordata storage and protection. Beneficence was assured as the structured physical activity in the form of walking is beneficial to health and non-maleficent with has no harmful effect. Justice was also assured as they had the liberty to participant in the study and can decide to leave the study at any time without consequence.

3.10. Limitation of the study

Some participants forgot to use the pedometer on some days making it difficult to quantify their physical activityfor that day. They were advised to be more proactive and find something to make them remember such as alarm or prayers times.

Enthusiasm was highest during thefirst month of intervention in this studyparticipants' but dropped during the final month of intervention. Thorough follow-up, counselling and continuous support among the interventions group were further done.

Thepedometer instrument may have functional problem such as getting spoilt, brokendown or even get lost. We had to replace pedometer to some so the participants can continue to the end of the study. Some participants had battery runs down and couldn't replace even with a spare battery in the pack and had to wait till next appointment for the batteries to be changed.These participants were trained to replace the batteries with the spare one and advised to continue the same level of exercise in-case of pedometer fault.

CHAPTER FOUR: RESULTS

4.1. Sociodemographic characteristics:

Table 3:Sociodemographic characteristics of study participants

Variable	Intervention Frequency (%) N = 49	Control Frequency (%) N = 49
Age		
25-34	5 (10.16)	10 (20.41)
35-44	12 (24.49)	5 (10.20)
45-54	**20 (40.82)**	7 (14.86)
55-64	10 (20.42)	**21 (42.86)**
≥65	2 (4.08)	6 (12.24)
Sex		
Female	**35 (71.43)**	**28 (57.14)**
Male	14 (28.57)	21 (42.86)
Religion		
Christianity	5 (10.20)	2 (4.08)
Islam	**44 (89.80)**	**47 (95.92)**

Address		
Rural	3 (6.12)	11 (22.45)
Urban	**46 (93.88)**	**38 (77.55)**
Marital status		
Married	**43 (88)**	**41 (84)**
Divorced	1 (2)	0 (0)
Single	1 (2)	4 (8)
Widowed	4 (8)	4 (8)
Ethnicity		
Hausa	**32 (65.3)**	**44 (89.8)**
Fulani	7 (14.3)	3 (6.1)
Ibo	4 (8.6)	1 (2.0)
Kanuri	2 (4.1)	0 (0)
Yoruba	1 (2.0)	0 (0)
Others	3 (6.1)	1 (2.0)
Education		
None	1 (2.04)	0 (0.00)
Primary	10 (20.41)	8 (16.33)
Quranic	9 (18.37)	**26 (53.06)**
Secondary	8 (16.33)	9 (18.37)
Tertiary	**21 (42.86)**	6 (12.24)
Occupation		
Civil servant	17 (34.69)	6 (12.24)
Farming	0 (0.00)	1 (2.04)
Housewife	**21 (42.86)**	17 (34.69)
Student	0 (0.00)	1 (2.04)
Trading	8 (16.33)	**20 (40.82)**
Unemployed	3 (6.12)	4 (8.16)
Income per month (naira)		
< 5,000	0 (0.00)	2 (4.08)
5,000-20,000	**22 (44.90)**	**32 (65.31)**
> 20,000-50,000	9 (18.37)	11 (22.45)
> 50,000-100,000	13 (26.53)	2 (4.08)
> 100,000-250,000	2 (4.08)	2 (4.08)
≥ 250,000	3 (6.12)	0 (0.00)

Table 3 above shows mean ages of respondents were 48.6 ± 12.7 years ranged from 25 to 62 years. Majority were age group 45 – 54 years with 20 (40.8%) among intervention and 55 – 64 years with 21 (42.8%) in control group. Majority were female with 64.3%. Islam was the most practiced religion with 44 (89.80%)in intervention and 47 (95.92%)in control groups. Most of respondentsreside at the urban area. The majority were married.Hausa and Fulani tribes constituting the majority. In the intervention group, 21 (42.9%) had tertiary education as highest level of education and the control groups had Quranic education 26 (53.1%).Among the intervention and control groups, 21 (42.9%) were full time housewives and 20 (40.82) were traders respectively. Majority (54, i.e. 55.1%) of the respondents earn 5,000 – 20,000 thousand naira per month. (NB: it is important to note the minimum wage in Nigeria which is 18,000 naira earning per month).

4.2. Comparability at baseline; sociodemographic characteristics

Table 4: Comparability of the sociodemographic characteristics of study respondents' before intervention

Variable	Intervention Frequency (%)	Control Frequency (%)	Chi square	p-value
Age				
≤ 44	17 (34)	15 (30)	2.78	0.10
≥ 45	32 (66)	34 (70)	2.21	0.13
Sex				
Female	35 (71.43)	28 (57.14)	2.10	0.14
Male	14 (28.57)	21 (42.86)	1.61	0.20
Religion				
Christianity	5 (10.20)	2 (4.08)	0.22*	0.42
Islam	**44 (89.80)**	**47 (95.92)**	0.60	0.43

Address				
Rural	3 (6.12)	11 (22.45)	0.02*	0.04
Urban	**46 (93.88)**	**38 (77.55)**	4.01	0.05
Marital status				
Married	43 (88)	41 (83)	0.33	0.56
Not married	6 (12)	8 (17)	0.32	0.55
Ethnicity				
Hausa/Fulani	39 (80.00)	47 (96.00)	3.02	0.05
Others	8 (20.00)	2 (4.01)	0.04*	0.05
Education				
No education	1(2)	0 (0)	-	-
Educated	48 (98)	49 (100)	0.50	1.0
Occupation				
Unemployed	3 (6)	4 (8)	0.50	0.90
Employed	46 (94)	45 (92)	0.15	0.69
Income monthly (naira)				
≤ 20,000	22 (45.00)	34 (69.01)	6.00	0.01**
≥ 20,000	27 (55.01)	15 (31.00)	5.00	0.01**

* Fishers exact test, ** statistically significant

Table 4 above shows that majority of the sociodemographic characteristics of the respondents in intervention and control groups were similar and comparable before structured physical activity intervention (at baseline) showing the differences between the two groups was not statistically significant(p value > 0.05).

4.3. Comparability at baseline; risk factors

Table 5: Comparability of risk factors of Study Respondents' before intervention

Variable		Intervention Frequency (%)	Control Frequency (%)	Chi square	p-value
Smoking					
	Yes	0 (0)	0 (0)	-	-
	No	49 (100)	49 (100)	0.30	0.06
Alcohol					
	Yes	2 (4.08%)	0 (0.00)	-	-
	No	47 (95.92%)	49 (100.00)	0.25	0.49
Diabetes mellitus (in patient)					
	Yes	4 (8.16)	5 (10.20)	0.50	0.90
	No	45 (91.84)	44 (89.80)	0.12	0.73
Exercise					

Yes	61 (62.24)	28 (57.14)	0.68	0.49
No	37 (37.76)	21 (42.86)	0.27	0.48
Exercise type				
Walking	28 (100)	31 (94.00)	0.28	0.49
Others	0 (0)	2 (6.01)	-	-
Exercise frequency				
≤ 3/week	19 (68.00)	22 (67.00)	0.01	0.92
> 3/week	9 (32.00)	11 (33.00)	0.03	0.86
Exercise duration				
≤ 30 min/day	19 (68.00)	28 (85.00)	2.47	0.12
> 30 min/day	9 (32.00)	5 (15.00)	1.60	0.20
Family history of hypertension				
Yes	37 (76)	20 (41)	12.1	0.04**
No	12 (24)	29 (59)	10.7	0.04**
Family history of diabetes mellitus				
Yes	18 (37)	12 (24)	1.72	0.27
No	31 (63)	37 (76)	1.20	0.16
Family history of stroke				
Yes	10 (20)	5 (10)	1.96	0.16
No	39 (80)	44 (90)	1.25	0.26
Family history of cardiac death				
Yes	11 (22)	3 (6)	5.33*	0.02**
No	38 (78)	46 (94)	4.08	0.04**
Family history of heart disease				
Yes	6 (12)	2 (4)	0.13*	0.27
No	43 (88)	47 (96)	1.22	0.26

* Fishers exact test, ** statistically significant

From the table 5 above shows that differences in risk factors of the respondents in intervention and control groups was not statistically significant (p value > 0.05) and were similar and comparable before structured physical activity intervention (at baseline).

4.4. Comparability at baseline; physical examination

Table 6: Comparability of Systolic blood pressure (SBP), diastolic blood pressure, pulse rate (PR), BMI, WC and WHR of study respondents' pre-intervention (baseline)

Variable	Intervention Frequency (%)	Control Frequency (%)	Chi square	p-value
SBP (mmHg)				
120 – 139	17 (34)	19 (38)	0.11	0.73
≥ 140	**32 (66)**	**30 (62)**	0.12	0.72
DBP (mmHg)				
80 - 89	15 (31)	9 (18)	1.98	0.15
≥ 90	**34 (69)**	**40 (82)**	1.37	0.24
PR (beats/minute)				
60-100	**39 (79.59)**	**29 (59.18)**	4.80	0.02**

>100	10 (20.41)	20 (40.82)	4.75	0.04**
BMI				
≤ 29.9	29 (34)	40 (38)	5.9	0.14
≥ 30	**20 (66)**	**9 (62)**	5.8	0.15
WC (Male)				
≤ 102	**11 (78.57)**	**18 (85.71)**	0.30	0.58
> 102	3 (21.43)	3 (14.29)	0.45*	0.66
WC (Female)				
≤ 88	5 (14.29)	11 (39.29)	5.13	0.02**
> 88	**30 (85.71)**	**17 (60.71)**	3.81	0.04**
WHR (Male)				
≤ 0.90	5 (35.7)	4 (19.1)	**0.24***	0.43
> 0.90	**9 (64.3)**	**17 (80.9)**	0.50	0.47
WHR (Female)				
≤ 0.88	10 (28.6)	12 (42.9)	1.39	0.23
> 0.88	**25 (71.4)**	**16 (57.1)**	1.37	0.24

* Fishers exact test, ** statistically significant

Table 6 above, following physical examination majority of the respondents in intervention and control groups, the differences between the two groups was not statistically significant (p value > 0.05) signifying similar and comparable characteristics before structured physical activity intervention (at baseline).

4.5.Comparability of meanphysical examination findings at baseline (Pre-intervention)

Table 7: Respondents baseline mean scores of systolic/diastolic blood pressure, pulse rate, body mass index, waist circumference and waist hip ratio findings at baseline (pre-intervention)

Variable		Intervention group n=49 Mean (SD)	Control group n=49 Mean (SD)	T test
SBP		143.43 (17.03)	145.59 (18.81)	0.55
DBP		90.80 (9.96)	91.02 (7.76)	0.90
PR		83.49 (11.11)	90.31 (13.14)	0.01**
BMI		29.22 (6.86)	25.80 (5.53)	0.01**
WC	Female	98.49 (11.55)	91.79 (12.52)	0.03**
	Male	94.50 (14.79)	86.81 (11.94)	0.12
	Female	0.90 (0.05)	0.92 (0.09)	0.37

WHR	Male	0.95 (0.06)	0.94 (0.05)	0.67

**Statistically significant

Table 7 above shows comparability at baseline of the mean scores of physical examination measurement. After physical examination,the differences in the mean scores of systolic/diastolic blood pressure, pulse rate, body mass index, waist circumference and waist hip ratio between the two groups were not statistically significant (p value > 0.05) making them comparable at baseline in majority of the respondents in intervention and control groups at baseline.

4.6. Post-intervention findings

Table 8: Respondents post-intervention systolic/diastolic blood pressure, pulse rate, body mass index, waist circumference and waist hip ratio findings after 3 months of structured physical activity

Variable	Intervention group			Control group		
	Before intervention (n=49) Mean (SD)	After intervention (n=49) Mean (SD)	Mean difference (SD)	Before intervention (n=49) Mean (SD)	After intervention (n=49) Mean (SD)	Mean difference (SD)
SBP	143.4 (17.0)	133.9 (14.9)	9.6 (12.9)	145.6 (18.82)	140.0 (13.39)	5.59 (14.2)
DBP	90.8 (9.9)	85.1 (7.9)	5.7 (7.9)	91.10 (7.76)	88.47 (5.61)	2.55 (6.66)

PR		83.5 (11.1)	81.92 (10.0)	1.6 (2.7)	90.31 (13.14)	89.35 (9.62)	0.96 (5.17)
BMI		29.2 (6.9)	28.5 (6.1)	0.7 (1.2)	25.80 (5.53)	26.24 (5.49)	-0.44 (0.47)
	Female	98.5 (11.5)	98.1 (11.1)	0.4 (1.2)	91.79	91.96	-0.17 (0.39)
WC					(12.52)	(12.56)	
	Male	94.5 (14.8)	94.4 (14.9)	0.07 (0.27)	86.8 (11.94)	87.4 (11.93)	-0.29 (0.56)
	Female	0.90 (0.045)	0.90 (0.044)	0.001	0.92 (0.09)	0.92 (0.09)	0.002
WHR				(0.22)			(0.004)
	Male	0.95 (0.064)	0.95 (0.066)	0.001 (0.005)	0.94 (0.047)	0.94 (0.046)	0.002 (0.005)

Table 8 shows mean scores of physical examination (systolic/diastolic blood pressure, pulse rate, body mass index, waist circumference and waist hip) after the intervention period. A mean difference in systolic blood pressure of 9.6 mmHg (SD: 12.9) was observed in the intervention group. Similarly, a mean difference of 5.7 mmHg (SD: 7.9) in diastolic blood pressure was observed in the intervention group.The mean difference in pulse rate was found to be 1.6 beats per minute (SD: 2.7). In BMI measurement, a mean difference of 0.7 (SD: 1.2) was found. Among female gender, a mean difference in waist circumference of 0.4 cm (SD: 1.2) was observed. Similarly, in the male gender, the mean difference in waist circumference was 0.07 cm (SD: 0.27) following intervention. Also, among female gender, the mean difference in waist hip ratio was 0.001 (SD: 0.22). Among male gender, mean difference in waist hip ratio of 0.001 (SD: 0.005) was observed.

Among the control group, mean difference of 5.6 mmHg (SD: 14.2) in systolic blood pressure among control group was observed after the period study period. Also, a mean difference of 2.6 mmHg (SD: 6.7) in diastolic blood pressure was observed in the control group. In terms of pulse rate, a mean difference of be 0.96 beats per minute (SD: 5.17) was found. BMI mean difference was -0.44 (SD: 0.47) in the control after the study period. Among female gender, the mean difference in waist circumference was -0.17 cm (SD: 0.39) was observed. Similarly, among male

gender, the mean difference in waist circumference was -0.29 cm (SD: 0.56) was found. Also, among female gender, the mean difference in waist hip ratio was 0.002 (SD: 0.004). Among male gender, mean difference in waist hip ratio of 0.002 (SD: 0.005) was observed in the control group after the study period.

4.7. Comparing the changes (differences) observed before and after the intervention period

Table 9: Comparism of the observed changes (mean differences) between the intervention and control group after the study period

	Observed diff between intervention group and control group			
	Post intervention Mean diff (SD of diff)	Pre-intervention Mean diff (SD of diff)	Observed mean difference	P value
SBP	9.6 (12.9)	5.59 (14.2)	4.01	< 0.001
DBP	5.7 (7.9)	2.55 (6.66)	3.15	< 0.001

PR		1.6 (2.7)	0.96 (5.17)	0.64	< 0.001
BMI		0.7 (1.2)	-0.44 (0.47)	-1.14	< 0.001
	Female	0.4 (1.2)	-0.17 (0.39)	-0.23	< 0.001
WC	Male	0.07 (0.27)	-0.29 (0.56)	-0.36	< 0.001
	Female	0.001 (0.22)	0.002 (0.004)	0.003	< 0.001
WHR	Male	0.001 (0.005)	0.002 (0.005)	-0.004	< 0.001

Three months after structured exercise using pedometer intervention, table 9 above show the comparism of changes observed (mean difference) after the study period between the intervention and control group. A significant difference was observed between the two groups (intervention and control) regarding systolic blood pressure, diastolic blood pressure and pulse rate. There was more systolic blood pressure reduction among the intervention group than the control group after the intervention with a 4 mmHg difference and was statistically significant (P-value: < 0.05). Similarly, there was more reduction observed in diastolic blood pressure among the intervention group of 3.15 mmHg difference which was statically significant with a P-value of < 0.05 than the control group. Also, there was more reduction in pulse rate among the intervention group than the control group after the study period which was 0.61 beats per minute and was statistically significant (P-value of < 0.05).

Although some changes was observed in body mass index (BMI), waist circumference (WC) and waist hip ratio (WHR) between the intervention and control group after the intervention, it was more in the control group than in the intervention group giving rise to a negative difference. There was more change of BMI in the control group compared to the intervention group with a difference of -1.14 (P-value: <0.05). Similarly, WC change was more in the control than intervention group, with -0.61 (P-value: <0.05) and -0.36 (P-value: <0.05) difference among

female and male gender respectively. As for WHR, there was more change observed in WHR of the control than intervention group among the male gender with a difference of -0.004 (P-value: <0.05). On the contrary, changes observed in WHR among female was a little more in the intervention than the control group with a 0.003 (P-value: <0.05).

CHAPTER FIVE: DISCUSSION

The baseline results of this study indicate that the characteristics of respondents were similar and comparable which was to other studies.[93]The premier clinical trial, was one of the first ground breaking randomized control trail on the effects of comprehensive lifestyle modification such as increased physical activity on blood pressure, demonstrated a significant blood pressure reduction among the intervention group compared to the control group. The premier clinical trial was a multicenter where participating institutions included the National Heart, Lung, and Blood Institute Project Office (Bethesda), the coordinating center (Kaiser Permanente Center for Health Research in Portland, Ore), and 4 clinical centers (Johns Hopkins University, Baltimore,

Pennington Biomedical Research Center, Baton Rouge, Los Angeles, Duke UniversityMedical Center, Durham, North Carolina, and Kaiser Permanente Center for Health Research, Portland, Ore). The study participants were hypertensive individuals who are not receiving medication therapy. Also, the intervention recommended in the study included other lifestyle modifications such as the dietary advice to stop hypertension (DASH diet) as well. Although, the study did not include individuals on drug therapy, it showed that comprehensive lifestyle modification such as increased physical activity (non-pharmacological interventions)reduces blood pressure among hypertensive individuals.[93]

The results of this study further showed that structured physical activity using pedometer significantly reduce both systolic and diastolic blood pressure as compared to only verbal advice on physical activity in hypertensive adults in Kano State, Nigeria. Improvements in blood pressure following physical activity have been well documented in previous research.A study conducted in 2012, to determine the effect of 8 weeks of aerobic exercise training on vascular response and blood pressure demonstrated significant improvements in blood pressure and vascular activity.[97]Furthermore,Nualnimet al. reported that 12 weeks of regular swimming exercise in a group of healthy adults with prehypertension or stage 1 hypertension significantly improved blood pressure in 2012.[98] Similarly,Cornelissen et al. demonstrated a significant decrease in blood pressure in following 12 weeks of aerobic exercise in hypertensive patients in 2007.[99]In a meta-analysis of randomized controlled trials on the effects that physical activity such asaerobic exercise among hypertensive adults found that exercise reduced systolic blood pressure by 5 mmHg and diastolic blood pressure by 3 mmHg. Among normotensives persons, physical exercise and fitness was significantly associated with a reduction in blood pressure and risk of developing elevated blood pressure.[69]Similarly, a study reported that physical activity

such as aerobic exercise has positive effects on blood pressure producing average reductions of 4 mm Hg in systolic blood pressure and 3 mm Hg in diastolic blood pressure.[21]

Most of the studies conducted were among the western community. However, none of these published studies included sufficient numbers of African Americans to draw any conclusions about the effect of structured physical activity particularly using pedometer on blood pressure in this population. The present study provides some evidence that physical activity particularly structured using pedometer may also be beneficial in African populations.It is an established that fact that genetic and hereditfactors play active role in the causation of hypertension, thus, there is also the possibility of the effects of genotypes in responses to physical activity/exercise in hypertension. These interpersonal and interracial differences clearly indicate the need for study among black African population. Sikiru et al conducted a study in Enugu, Nigeria 2014, to investigate the effect of physical activity on blood pressure in black African subjects with hypertension. The study revealed significant decreased effects of physical activity on systolic blood pressure, diastolic blood pressure, body mass index and waist hip ratio ($p< 0.05$).[70] Similarly, a study was conducted by Maruf et al, in Ibadan, Oyo state, Nigeria, 2013, on blood pressure effect of physical activity/exercise to amonghypertensive individuals on drug therapy. The researchers offered physical activity in the form of aerobic dance to individuals with essential hypertension who had been on two antihypertensive drugs.The study found a significant reduction in systolic blood pressure and diastolic blood pressure in the intervention exercise group than the control group after 12weeks intervention. The blood pressure control rates were 56.7% and 35.5% in the exercises and control group respectively.The report demonstrates the tendency of physical activity using aerobic dance to enhance BP control in individuals on two antihypertensive drugs.[26]

Although, other studies that assessed effect of physical activity on blood pressure among hypertensive persons have demonstrated similar blood pressure lowering effects, other researches demonstrated inconsistent findings in both resource-rich and resource-poor settings. Huai et al, 2013, in meta-analysis of prospective cohort studies on the association of physical activity and hypertensionfound was no significant association.[38]Researchers have acknowledged that the emergence pedometers have improved physical activity and blood pressure reduction.[28,62,63]Walking interventions as measured by pedometer were found be effective in reducing blood pressure body weight, body mass index (BMI), waist and hip circumference.[28,29,39]Several studies have reported that these walking exercise can be advocated to household and work-site walking intervention with pedometer as an appropriate setting for health promotion intervention programs.[15,61,58]Moreover, individuals appear able to remember pedometer-based recommendations.The most widely recognized step recommendation is to accumulate 5,000 to 10,000 steps per day which is the level considered physically active.[28,63]A meta-analysis reported that pedometer users increased their levels of physical activity and significant decreases blood pressure and body mass index.[62]Similar finding was found in another meta-analysis on the effect of pedometer based exercise intervention on weight loss. [100]

As most studies demonstrated similar blood pressure lowering effects of pedometer based physical activity, other researchers demonstrated a contrary result. Baker et al. in a study on the effect of a pedometer-based community walking intervention"Walking for Wellbeing in the West" on physical activity andhealth outcomes, reported lack of significant beneficial effect on health outcome such as decrease in blood pressure.[39]Despite the fact that emergence of pedometer has provided a useful self-monitoring and motivational aid for increasing physical activity, its use among hypertension have not been studied in African population. Most studies

conducted were on the effect of physical activity on blood pressure in Nigeria. To our knowledge, this was the first study that measured the effect of structured pedometer based physical activity on blood pressure of hypertensive adults in Nigeria, an African population.This study showed a significant reduction in blood pressure following pedometer based structured physical activity, demonstratedthe rationale bases for the adjunct therapeutic role of physical activity such as moderate intensity continuous exercise in the down regulation of blood pressure in hypertensive persons among black African population.[70]

A reduction in pulse rate have been reportedly been a found in most people engage in physical activity to a certain level by studies.[101]Some studies further demonstrated the relationship between variability in pulse rate, heart rate and adverse cardiovascular prognosis such as heart failure and sudden death.[102]Our study shows that physical activity is significantly associated a reduction in pulse rate, supporting previous studies.[103]In our setting, we have anecdotally observed a direct linear relationship between increased physical activity and reduction of blood pressure.Conversely,several studies have demonstrated that relationship between increased physical activity pulse and exercise on pulse rate to be negatively linear. Scaknoff et al., in a study on the effect of exercise training on pulse and heart rate found there was no significant pulse or heart rate variability.[104] Similar finding have been identified a study by Uusitalo et al., in 2008.[105]

The results of this study showed no significant effect of structured physical activity on weight, body mass index, abdominal circumference and waist hip ratio. This is contrary to most studies conducted on physical activity and weight indices. Although in this study, no significant effect of structured physical activity on weight, body mass index, abdominal circumference and waist hip ratio was identified, the changes observed in waist hip ratio among female was statistically

significant (P-value: <0.05). Being female was found to be associated better outcome in terms of waist hip ratio in this study. This may be explained that women may be keen on adhering to exercise advice compared to men. Also, men have busier schedule than female, which may compromise adherence to physical activity recommendations. Most scientific researches have demonstrated a significant reduction in weight, body mass index, abdominal circumference and waist hip ratio. Bakers et al. in Glasgow Scotland, United Kingdom 2008, found a significant reduction in blood pressure, body weight, body mass index (BMI), waist and hip circumference, body fat, and cholesterol following structured physical activity recommendation.[39] Similarly, Xiaochen Lin et al. in a meta-analysis of randomized controlled trials, Indianapolis, 2014, on the effects of exercise on cardiovascular and metabolic diseases, reported a significant positive reduction on cardio-metabolic indices such as blood pressure, weight, body mass index, abdominal circumference and waist hip ratio. In Nigeria, 2014, a study reported a significant decreased effects of physical activity on weight, body mass index, waist hip ratio and blood pressure.[70]On the contrary, the effect of short term physical activity on weight induces such as body weight, body mass index, abdominal circumference, waist circumference and waist hip ratio have not been significantly decreased in some studies. A study conducted on the effects of intermittent exercise and use of home exercise equipment on weight loss by Jakicic et al., demonstrated no significant weight reduction following exercise intervention.[106]

Majority of the study participants were females. The dominance of female respondents' in this study is similar to what has been seen in other studies and may indicate themore health care seeking behavior of females particularly in northern Nigeria.[93,107]Like many pedometer-based community intervention studies, the intervention period started with great enthusiasm. It is important to note that during thefirst month of intervention in this study, participants' motivation

was at its highest. During the final month of intervention, motivation has dropped in majority of the respondents' which may impede further effect of the exercise on health outcome such as reduction in blood pressure, weight, body mass index and waist hip ratio. This is similar to finding of a pedometer study by Tudor et al. [63] Also, Soroush et al. in Sweden 2012, in a study on the effects of a 6-Month walking intervention on blood pressurehad a similar observation.[62] This indicates the importance of a thorough follow-up and continuous support among the interventions group. Although the pedometer is a useful measurement tool with regards to ambulatory physical activity, one limitationof the instrument is that the lack of reliability in its function. On several occasions, the pedometer get lost,spoilt or broken, were we had to be replaced so the participants can continue to the end of the study. In some instances the battery runs down, and the respondents' couldn't replace it but wait till next appointment for the batteries to be changed. During this period, some participants couldn't replicate structured exercise intervention. This may affect the intervention on blood pressure and health indices such as weight, body mass index and waist hip ratio.However, participants were shown how to remove and replace the batteries with the spare one and advised to continue the same level of exercise in-case of pedometer fault. In our study, there were participants that lack of knowledge and information on usage patterns and reasons for owning a pedometer. This is similar to a study by Craig et al. in 2007.[108]Furthermore, some participants couldn't use the pedometer correctly particularly the illiterate among them. Such is demonstrated among the intervention group, where majority of the respondents' had tertiary education, signifying higher the level of education and use of the pedometer. This preponderance of higher education level among the intervention group may limitthe ability of this study to generalize the results. This is similarly demonstrated from other studies.[93]

CHAPTER SIX; CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

The results of this study showed that hypertensive persons that received advice on structured physical activity using pedometer and those on traditional verbal physical activity advice have similar characteristics and are comparable. Also, this results indicate that hypertensive persons that performed structured physical activity using pedometer for a period of 3 month had significant reduction in bothsystolic and diastolic blood pressure as compared to hypertensive adults on verbal exercise advice over the same period. This study also found that pulse rate

among all gender and waist hip ratio among female gender was effectively reduced following structured physical activity of 3 months.

6.2 Recommendations

In view of the findings of this study, the following recommendations were made;

1. Structured physical activity using pedometer recommendation, should be offered to hypertensive adults by health care providers of Kano state.
2. Kano state ministry of health should publicize the benefits of structured physical activity using pedometer to hypertensive adults through public awareness campaigns. Also, the Kano state ministry of health should make the pedometer readily and easily available for individuals to access it.
3. Federal ministry of health should include structured physical activity recommendation using pedometer in hypertensiontreatment guidelines in Nigeria (i.e. Nigerian hypertensive society (NHS)).

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APPENDIX A_1: ADULT COSENT FORM

AMINU KANO TEACHING HOSPITAL (AKTH), AHMADU BELLO UNIVERSITY ZARIA (ABU) AND NIGERIA FIELD EPIDEMIOLGY AND LABORATORY TRAINING PROGRAMME (NFELTP), ABUJA, NIGERIA

Study Title: "Effect of structured physical activity using pedometer blood pressure among hypertensive adults attending Aminu Kano Teaching Hospital (AKTH), Kano."

Name(s) and Affiliation(s) of Researcher: This study is being conducted by Dr. Mohammed Riyad, Cohort 6 resident of the NFELTP and Department of Community Medicine, ABU Zaria.

Purpose of the Study: As a partial requirement for the award of the Master of Public health (MPH) and Field Epidemiology Degree. It is also to identify the effect structured physical activity using pedometer on blood pressure among hypertensive adults attending Aminu Kano Teaching Hospital (AKTH), Kano state.

Procedure of the Research: This study is being conducted atAminu Kano Teaching Hospital, Tarauni LGA, Kano state. You have been selected as one of those to participate in this study. If

you agree to participate in the study, you will be asked some questions concerning you and your family and you will be examined. You shall be given dietary and exercise instruction sheets and may be given pedometer which will measure the number of steps you reach daily.We expect that it may take about 30 minutes of your time.

Risk: The study is risk-free and harmless.You may be uncomfortable with some questions that we would asked. You are free however to choose to answer or not answer any of the questions asked. All responses given will be treated with confidentiality and will only be used strictly for academic purposes.

Benefits: It is going to be at no cost at all to you. You may not benefit directly from this study. Depending on the result, you may becounselled, treated and/or referred for further management accordingly.

Voluntary Participation: Your participation in this survey is voluntary. You may choose to participate or withdraw consent and discontinue your participation at any time without prejudices. Please note that some of the information obtained from you before your decision to withdraw may be used in report and publication.

Statement of the person obtaining informed consent; I have duly explained this survey and have given sufficient information about risks and benefits, to enable participant make an informed decision.

Researcher; Name/Signature/date.....

Statement of the person giving consent; I have read and understood the description of the survey, I also have understood my participation is voluntary. I know enough about the purpose, method, risks and benefits of the research study to judge that I want to be part of it. I understood

that I may freely stop being part of this study at any time. I have received a copy of this consent form.

Participant; Name/Signature/thumb-print/date.....

Witness; Name/Signature/thumb-print/date.....

If you have any question about your participation, please contact the Researcher, Dr. Mohammed Riyad, Aminu Kano Teaching Hospital, Kano state. Telephone 08033475691 and E-mail msriyad99@yahoo.com.

The Ethical research committee of the Aminu Kano Teaching Hospital has approved this study.

APPENDIX A_2 (Hausa language translation of the consent form)

SASHI NA A: **TAKARDAR NEMAN AMINCEWA**

Sunan Bincike: "Bincike akan ampanin motsa jiki a tareda nauran pedometer da rage hawan jinni a masu dauke dacutar hawan jini a marasa lafiyar da ke ziyartar bangaren sha ka tafi na asibitin koyarwa na malam Aminu Kano, Kano."

Sunan ma gudanar da bincike: Ni, Dr. Mohammed Riyad na asibitin mallam Aminu kano, tare da bagare kare lafiya na jamia Amadu Bello na Zaria da NFELTP ke gudanar da wana bincike.

Dalilin bincike: Dalilin wanan binckike shine saboda a cika karatun gaba da jamia na jamiar amadu Bello Zaria da kuma NFELTP. Kuma a na son a gano mahimmancin mosa jiki a masu hawan jin saboda ganowa da magance musabbabin cutar hawan jinni kuma a rage nakasa da cutar hauwan jini yake kawowa a Kano.

Mahimmanci bincike: A nayin wanan bincike a asibitin mallan Aminu kano, a karamar hukumar Taruani, Kano. Ana bukata don raayin kanka, ka amince da shiga cikin wannan shiri sabo da mahimmancinsa na ganowa da magance musabbabin cutar hawan jinni kuma a rage nakasa da cutar hauwan jini yake kawowa. Idan ka amince, zaa yi maka wadansu tambayoyi akan rayuwarka da iyalanka kuma zaa auna ka. Zaa baka kaidodin abinci kuma zaa iya baka nauran pedometer na auna yawan takun tafiya a rana. Zai iya daukan minti talatin.

Hadari; Babu wani hadari idan ka shiga cikin wannan bincike kuma ba biyan kudi. Wadansu tambayoyin zasu iya zama mara dadiji. Idan bakaji dadin tambayoyin ba, zaka iya barin su ko kuma karka amsasu. Sakamakon da bincicen ya haifar zaa yi maka cikakken bayani game dasu kuma zai kasance cikin sirri, ba tare da bayyana wa ba.

Ampani: Baa bukatar kudi daga wurin ka.Sakamakon da bincicen ya haifar zaa yi maka cikakken bayani kokuma a tura wuri likita ya baka magani. Idan bincike ya haifar maka da wata matsala, za a yi maka maganin ta ta hanyar baka magani ko kuma tura ka wajen kwararru bisa amince war ka.

Amincewa; Amincewar shiga wannan bincike ba dole bane sai da yardanka. Rashin amincewar ka shinga cikin wannan binciken, bazai shafi irin kulan da ya kamata ka samu daga wajena ko wani maa kacin asibitin ba. Zaa iya rubuta sakamakon wannan bincike a jarida.

Bayanin mai gunadar da bincike; Na ba da cikaken bayani akan wanan binciken. Na yi bayani akan maihinmanci, ampani da hadarruka akan wannan bincike saboda kayi sawaran siga wannan bincike.

Mai bincike- Sa hannu/rana……

Bayanin mai shiga wannan bincike; Na gani bayani binciken. Na gane cewa shawara na ne shiga ko fita da cikin wanan bincike. I gane mahinmacin, ampani da hadari da ke cikin wanna bincike. Kuma na gane cewa dan iya fita daga cikin wanna bincike ko wani lokaci. Daa bani wanan takardar ceda. Na amince shiga wannan bincike.

Mai shiga binciken-Suna/Sa hannu/dagwala dan yatsa/rana …….....

Shaida- Suna/Sa hannu/dagwala dan yatsa/rana…….

Ko kana da wata tambaya da za kayi mana? Daa iya samuna, dacta Mohammed Riyad akan wannan layin waya 08033475691, da kuma nauran intanet msriyad99@yahoo.com.

Hukumar kula da kaidodin bincike na asibitin malan Aminu Kano sun bamu damar gudanar da wannan bincike.

APPENDIX B_1: QUESTIONNIARE

This questionnaire is part of a study being conducted on the effect of structured physical activity using pedometer on blood pressure among hypertensive adult patients attending the GOPD/MOPD of Aminu Kano Teaching Hospital, Kano. You have been chosen to participate voluntarily in the study. Kindly answer the questions below by ticking the appropriate box. All information will be treated confidentially. Thank you.

Serial number..... Date.....

SECTION A: SOCIODEMOGRAPHIC DATA:

1. Name (initials): .....
2. Age at last birthday (in years): .....
3. Sex: (1) Male □ (2) Female □
4. Residential address: .....(1) Rural □ (2) Urban □
5. Marital status: (1) Single □ (2) Married □ (3) Divorced □ (4) Widowed □
6. Religion: (1) Islam □ (2) Christianity □ (3) Traditional □ (4) Any other (specify) □
7. Tribe: (1) Hausa □ (2) Fulani □ (3) Yoruba □ (4) Ibo □ (5) Others (specify) □
8. Education: (1) None □ (2) Quranic □ (3) Primary □ (4) Secondary □ (5) Tertiary □
9. Occupation: (1) Civil servant □ (2) Trader □ (3) Artisan □ (4) Housewife □
   (5) Student □ (6) Unemployed □
10. Income per month (in Naira): …….

SECTION B: RISK FACTORS

11. Do you Smoke Cigarette: (1) Yes □ (2) No□
12. If yes to (11) above; (1) Sticks per day..... (2) Duration.....
13. Do you take Alcohol: (1) Yes □ (2) No □
14. If yes to (13) above; (1) Type..... (2)Quantity per day..... (3) Duration.....
15. Do you have Diabetes Mellitus: (1) Yes □ (2) No □
16. If yes to (15) above, For how long?; (1) < 1 year □ (2) 1 to (5) years □ (3) 6 to 10 years □ (4) > 10 years □
17. If yes to (15) above, are you on treatment? (1) Yes □ (2) No □

18. Do you do any exercise: (1) Yes □ (2) No □

19. If yes to (18) above, what type? (1) jogging □ (2) walking □ (3) skipping □ (4) swimming□ (5) cycling □ (6) football □ (7) others (specify)□

20. Exercise frequency: (1) Daily □ (2) > 3times a week □ (3) 3 times a week □ (4) < 3 times a week □

21. Duration of exercise; (1) < 30 minutes □ (2) 30 minutes □ (3) > 30 minutes □

22. Are you on any drug? (1) Yes □ (2) No □

23. If yes to (22) above, (1) Type.....(2) Reason.....(3) Duration.....

SECTION C: FAMILY HISTORY:

24. Hypertension - (1) Yes □ (2) No □ (3) I don't know □

25. Diabetes Mellitus - (1) Yes □ (2) No □ (3) I don't know □

26. Stroke - (1) Yes □ (2) No □ (3) I don't know □

27. Sudden cardiac death - (1) Yes □ (2) No □ (3) I don't know □

28. Heart disease - (1) Yes □ (2) No □ (3) I don't know □

SECTION D: PHYSICAL EXAMINATION

Number	Examination	Initial visit	2 weeks	4 weeks	6 weeks	8 weeks	10 weeks	12 weeks
29.	Pulse rate (beats/min)							
30.	Blood pressure (mmHg)							

31.	Weight (Kg)							
32.	Height (m)							
33.	BMI (Kg/m^2)							
34.	Waist circumference (cm)							
35.	Hip circumference (cm)							
36.	Waist – Hip ratio (WHR)							

APPENDIX B_2 (Hausa language translation of the questionnaire form)

SASHI NA: **TAKARDAR TAMBAYA**

Waannan shine takardar tambayoyi na bincike akan kaidiodi amfanin abinci da motsa jiki a masu dauke dacutar hawan jini a marasa lafiyar da ke ziyartar bangaren sha ka tafi na asibitin koyarwa na malam Aminu Kano. Bisa raayin kanka, idan ka amince da shiga cikin wannan shiri, ana

bukatar ka da amsa wadanan tambayoyi kuma zai kasance cikin sirri, ba tare da bayyana wa ba. Mun gode.

Lamba..... Rana.....

SASHI NA A; TAMBAYOYI AKAN KA

1. Suna (nomba).....
2. Shekarun ka (ranan da aka haife ka).....
3. Jinsi: (1) Namiji □ (2) Mace □
4. Unguwa:..... (1) Birni □ (2) Kauye □
5. Aure: (1) Bani da aure □ (2) Ina da aure □ (3) Mun rabu □ (4) ya/ta rasu□
6. Addini: (1) Musulmi □ (2) Kirista □ (3) Gargajiya □ (4) Wani daban (ka fada) □
7. Yare: (1) Hausa □ (2) Fulani □ (3) Bairaba □ (4) Yaruba □ (4) Ibo □ (5) Wani daban (ka fada) □
8. Ilimi: (1) Banyi ba □ (2) Qur ani □ (3) Firamare □ (4) Sacandari □ (5) Jamia □
9. Sanaa: (1)Ma'aikacin Gwamnati □ (2) Siya da siyarwa □ (3) Aikin kai na □ (4) Matan aure□ (5) Bana aiki □
10. Kudin da kake samu a wata (a Naira): ……

SASHI NA B; TAMBAYOYI AKAN ABUBUWAN DA KE HAIFAR DA HUAWAN JINI

11. Kana shan Taba?: (1) Ina sha □ (2) Bana sha □
12. Idan kana da shan taba: (1) Kara a rana..... (2) shekara nawa.....

13. Kana shan Giya: (1) Ina sha □ (2) Bana sha □
14. Idan kana shan giya (1) Wani iri..... (2) Yawa a rana..... (3) shekara nawa.....
15. Kana da cutar ciwon siga: (1) Ina da shi □ (2) Bani da shi □
16. Idan kana da ciwon siga, tun yaushe? (1) < shakara daya □ (2) Shekara daya – shekara biyar □ 3. Shekara shida – shekara goma □ 4. > sama da shekara 10 □
17. Kana shan maganin ciwon siga? (1) Ina sha □ (2) Bana sha □
18. Kana motsa jiki: (1) Ina yi □ (2) Bana yi □
19. Wani irirn motsa jiki ka keyi? (1) Gudu □ (2) Tafiya □ (3) Tsaltsale □ (4) Was an ruwa □ (5) Kake □ (6) Kwalon kafe □ (7) Wani daban (kafada) □
20. Sau nawa: (1) Kulun □ (2) > Sau uku a sati □ (3) Sau uku asati □ (4) < Sau uku asati □
21. Minti nawa (1) < minti 30 □ (2) minti 30 □ (3) > minti 30 □
22. Kana shan wani magani? (1) Ina sha □ (2) Bana sha □
23. Idan kana shan magani: (1) Wani iri..... (2) Dalili..... (3) Tun yaushe(shekara nawa).....

SASHI NA C; TAMBAYOYI AKAN IYAYEN KA

24. Hawan jinni - (1) Akwai □ (2) Babu □ (3) Bansani ba □
25. Ciwon siga - (1) Akwai □ (2) Babu □ (3) Bansani ba □
26. Shan yewar jiki - (1) Akwai □ (2) Babu □ (3) Bansani ba □
27. Mutuwa daga ciwon zuciya - (1) Akwai □ (2) Babu □ (3) Bansani ba □
28. Ciwon zuciya - (1) Akwai □ (2) Babu □ (3) Bansani ba □

SASHI NA D; AUNA KA

Numba	Auna ka	Zuwan	Satin na	Sati na	Sati na	Sati na	Sati na	Sati

		farko	biyu	hudu	shida	takwas	goma	na goma sha biyu
29.	Irga gudun gini (gudu a minti daya)							
30.	Awun jinni(mmHg)							
31.	Nauyi (Kilogram)							
32.	Tsayi (meta)							
33.	Gwajin nauyi bisa tsayi (Kg/m^2)							
34.	Kugu (cm)							
35.	Kwankwaso (cm)							
36.	Kugu bisa kwankwaso							

APPENDIX $C_{1a:}$ EXERCISE INSRUCTION SHEET

1. Exercise regularly: moderate intensity exercise for at least five days in a week. Suggested exercise (but not limited to) include;
    a. Brisk walking for at least 30 minutes each day
    b. Skipping for at least 20 minutes each day
    c. Jogging for at least 20 minutes each day
    d. Swimming for at least 20 minutes each day
    e. Cycling for at least 20 minutes each day
    f. Football for at least 20 minutes each day
    g. Aerobic dancing for at least 30 minutes each day
    h. Racket ball for at least 20 minutes each day

APPENDIX C_{1b}

EXERCISE INSRUCTION SHEET (Hausa language translation)

Takardan sharudodi motsa jiki

1. A dinga motsa jiki akai akai. Motsa jikin madaidaici Kaman saw biyar a sati irin wadannan (ama basu kenan ba);
    a. Tafiyar kafa na minti talatin a kowace rana
    b. Tsala tsale da igiya na minti ashirin a kowacierana
    c. Gudu na minti ashirin a kowace rana
    d. Iwo a ruwa na minti ashirin a kowace rana
    e. Tuka keke na minti ashirin a kowace rana
    f. Kwalon kafa na minti ashirin a kowace rana
    g. Rawa na minti ashirin a kowace rana
    h. Wasan ball na sanda na minti ashirin a kowace rana

APPENDIX $C_{2a:}$PEDOMETER RECORD SHEET

Please record the number of steps achieved on the pedometer each day and come along with the sheet each visit

Week 1	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
<5000							
5000 – 7499							
7500 – 9999							
1000 &>							
Week 2							
<5000							
5000 – 7499							
7500 – 9999							
1000 &>							

APPENDIX C_{2b}

PEDOMETER RECORD SHEET (Hausa language translation of pedometer record sheet)

Pedometer; na'uran auna yawan motsa jikin dan Adam ta hanyar tafiya

A rubuta takun na'uran auna yawan motsa jikin dan Adam ta hanyar tafiya da a keyi kulum a wanan takardan kuma a zo da shi asibiti kullun

Sati na 1	Litinin	Talata	Laraba	Alhamis	Jumaa	Asabar	Lahadi
<5000							
5000 – 7499							
7500 – 9999							
1000 &>							
Sati na 2							
<5000							
5000 – 7499							
7500 – 9999							
1000 &>							

APPENDIX D: PEDOMETER



APPENDIX E: ETHICAL CLEARANCE

AMINU KANO TEACHING HOSPITAL
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NHREC/21/08/2008/AKTH/EC/1495

AKTH/MAC/SUB/12A/P-3/VI/1595 **15th September, 2015**

Dr. Mohammed Riyad
Department of Family Medicine
AKTH, Kano.

Ufs:

The Head of Department
Family Medicine
AKTH, Kano.

ETHICS APPROVAL

Further to your application in respect of your research proposal titled "Effectiveness of Using Pedometer to increase Physical Activity Levels and Reduce Blood Pressure Levels among Hypertensive Adults at Aminu Kano Teaching Hospital, Kano", the Committee reviewed your proposal and noted same as a Prospective Study.

In view of the above, Ethics approval is hereby granted to conduct the research.

However, the approval is subject to periodic reporting of the progress of the study and its completion to the Research Ethics Committee.

Regards

Abubakar S. Mahmud
Secretary, Research Ethics Committee
For: Chairman