

**RISK FACTORS ASSOCIATED WITH HIGH BLOOD
PRESSURE IN THE ADULT POPULATION OF KANG
(KGALAGADI NORTH), BOTSWANA.**

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DECLARATION:

I, Dr Stephane Tshitenge, hereby declare that the work on which this research is based is original (except where acknowledgement indicates otherwise), and that neither the whole work, nor any part of it has been, is being, or is to be submitted for another degree at this or any other university.

Signature:.....

Date:/...../2010

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LIST OF ABBREVIATIONS AND ACRONYMS

ATP III	Adult Treatment Panel III
BP:	Blood Pressure
BMI:	Body Mass Index
DBP,	Diastolic Blood Pressure;
HPT:	Hypertension
IDF:	International Diabetes Federation
SBP:	Systolic Blood Pressure.
WC:	Waist Circumference
WHO	World Health Organization

ABSTRACT

Background: The state of Hypertension disease is universally under diagnosed and/or inadequately treated resulting in extensive target-organ damage and premature deaths. Therefore, sustainable and aggressive population-based programs for hypertension awareness, prevention, treatment, and control are keys of success in limiting this epidemic. The study aims to determine the Kang Adult population's hypertension prevalence and the relationship between high blood pressure, anthropometric measures and their life style factors such as diet, use of tobacco products and alcohol consuming habits.

Methodology: The study, a population based cross-sectional trial, was conducted on adult residents of Kang (18 year-old and above) from November to December 2008. Data was collected using the questionnaire, through physical measurements of weight, height and BP using a modified protocol based on World Health Organization (WHO) STEP wise instruments on chronic disease (Bonita, 2001). The sample consisted of 161 participants between 20 and 82 years of age.

Results: Hypertension was observed in 31.6% of participants (95% CI: 24.6%-39.5%). With regard to the hypertension prevalence rate, no significant differences were observed between males and females (males 28.3% versus females 33.6%, $p = 0.59$). An elevated blood pressure was seen with significantly higher frequency in overweight group compared with the normal weight group ($p = 0.029$), in obese group compared

with the normal weight group ($p = 0.002$), and in obese group compared with the overweight group ($p = 0.045$).

The study found no significant association between hypertension and use of tobacco products ($p=0.46$) or alcohol consumption ($p=0.73$), went in vigorous-intensity activity ($p=0.22$) and moderate-intensity activity that causes large increases in breathing, or heart rate for at least 10 minutes continuously ($p=0.70$).

Conclusions:

It is concluded that hypertension is a common problem in adult Kang population, with a prevalence of 31.6%. Hypertension prevalence was found to be associated with anthropometric measurements such as overweight and obesity. No significant association between hypertension and use of tobacco products, alcohol consumption, vigorous-intensity and moderate-intensity activities that cause increases in breathing or heart rate for at least 10 minutes continuously. However, the present study had the limitation of a small sample size. Further studies are needed to clarify the hypertension magnitude throughout the country, with large samples.

CHAPTER 1- INTRODUCTION

1.1 BACKGROUND:

Hypertension, which is one of the greatest risk factors among the cardiovascular diseases, is the commonest cause of morbidity and mortality today. Developing countries increasingly face the double burden of non-communicable diseases such as hypertension and other cardiovascular diseases, along with infection and malnutrition (Murray *et al.*, 1996; World Health Organization, 2003). Socially and economically, Hypertension places an excessive financial burden on populations and health systems, consuming scarce resources (Collins *et al.*, 1990).

Incidentally, Hypertension is universally under diagnosed and/or inadequately treated resulting in extensive target-organ damage and premature death. It is a result of high blood pressure. Globally, high blood pressure is estimated to cause 7.1 million deaths, about 13% of the total deaths normally experienced by people (World Health Organization, 2002). Among the high blood pressure diseases, about 62% are cerebrovascular; while 49% are ischaemic heart diseases. In fact, 11% of disability adjusted life years are attributable to suboptimal Blood Pressure (systolic >115 mm Hg) (World Health Organization, 2002). Since many people with hypertension are asymptomatic and unaware of their illness, screening may help to identify these hypertension individuals (Cooper *et al.*, 2003).

Hypertension is a common condition in sub-Saharan Africa and is a great risk factor for heart attacks, stroke, left ventricular hypertrophy, renal disease, and blindness (Cooper *et al.*, 2003). Although epidemiological information show that between 10 and 20 million

people in sub-Saharan Africa have hypertension, the true burden of high blood pressure in sub-Saharan Africa remains largely unmeasured (World Health Organization, 2002, Cooper *et al.*, 2003).

Botswana, a developing country, faces the burden of hypertension along with HIV infection. The true Botswana hypertension prevalence is not known. The extrapolated statistics 2004 prevalence in hypertensive patients in Botswana was 301329 compared to the global statistic of 1639231 in 2004 (World health organization, 2005).

The association between hypertension, anthropometric measurements (such as body mass index, waist circumference) and life style (such as diet, tobacco smoking, and alcohol consumption) was reported in several studies (McAlister *et al.*, 2001; Freestone *et al.*, 1982; Lecerof *et al.*, 1990; Xin *et al.*, 2001). Therefore, sustainable and aggressive population-based programs for hypertension awareness, prevention, treatment, and control are key to success in limiting this epidemic in sub-Saharan Africa (Cooper *et al.*, 2003).

This study investigated risk factors associated with high blood pressure in the adult population of Kang (Kgalagadi North), Botswana. It is anticipated that the results will contribute to data on hypertension prevalence in Botswana.

1.2 PROBLEM STATEMENT AND RATIONALE:

The researcher observed an increased number of patients unaware of their hypertension status during his practice in Kang Clinic. Such an observation has motivated the researcher to assess the risk factors associated with high blood pressure in the adult population of Kang (Kgalagadi North), Botswana. The researcher hopes that the public will benefit from this study immensely because it will serve as baseline observation in the distribution of the determinants of hypertension in the adult population of Kang (Kgalagadi North).

1.3 RESEARCH QUESTION:

What are the risk factors associated with high blood pressure in the adult population of Kang (Kgalagadi North, Botswana)?

1.4 DEFINITIONS OF CONCEPTS:

Hypertension: was defined as SBP \geq 140 mm Hg and/or DBP \geq 90 mm Hg and/or use of anti-hypertensive medication. Guidelines such as the Seventh Report of the Joint National Committee on Prevention (Chobanian *et al.*, 2003), the Southern African hypertension Guideline (Southern African Hypertension Guideline, 2006) define “hypertension” as systolic blood pressure (SBP) of 140 mm Hg or greater; diastolic blood pressure (DBP) of 90 mm Hg or greater, or taking antihypertensive medication. The term hypertension or high blood pressure can be used interchangeably.

Risk factors: A risk factor is a variable associated with an increased risk of disease or infection. Sometimes, a determinant is also used, being a variable associated with either increased or decreased risk.

Risk factors or determinants are correlational and not necessarily causal, because correlation does not imply causation (Case, 2009). A variety of risk factors have been associated with essential hypertension (Southern African hypertension guideline, 2006):

- race such as blacks
- age (males >55years and females >65 years),
- family history of premature cardiovascular disease (males <55years and females <65 years)
- obesity (body mass index \geq 30 kg/m²)
- cigarette smoking

- physical inactivity
- dyslipidemia
- microalbuminuria or estimated GFR <60 mL/min
- cardiovascular disease
- type II diabetes mellitus and other chronic diseases

CHAPTER 2 - LITERATURE REVIEW:

2.1 INTRODUCTION:

This section reviewed existing literature on demographic factors, blood pressure measurements, social behavior, anthropometric measurements and physical activity. The discussion below covered studies done around the world, in Africa and in the Southern Africa region.

2.2 THE SOCIO-DEMOGRAPHIC FACTORS:

Beevers *et al.* (1987) reported that blood pressure rises with age. After the age of 50, the diastolic blood pressure tends to fall or remain constant, whereas the systolic blood pressure rises consistently with age. The difference that occurs between men and women is especially noticeable during youth hood. Younger women have generally a lower blood pressure than men do, but after the menopausal years, there appears to be no difference between the sexes. It is known that blood pressure phenomenon between races indicate a difference between blacks and white people, with a commensurate higher average blood pressure in blacks as well as a higher prevalence of hypertension (Hajjar *et al.*, 2003). Although rural blacks in Africa have low blood pressures, hypertension is incidentally common in black people living in African cities. The difference may be less apparent after correction for socio-economic and dietary factors (Beevers *et al.*, 1987).

2.3 BLOOD PRESSURE MEASUREMENTS:

2.3.1 Screening of Blood Pressure:

Though screening is incontrovertibly a necessary tool towards diagnosis of high blood pressure, evidence is lacking to recommend an optimal interval for screening adults for high blood pressure. Although no studies have examined the direct effect of screening for elevated blood pressure on clinical outcomes, there is beneficial effect of treating patients who are enrolled on the basis of elevated blood pressures detected during screening examinations (The sixth report of the Joint National Committee, 1997).

The risk factors associated with elevated blood pressure and the potential benefits of screening and subsequent treatment depend both on the degree of blood pressure elevation, and on the presence of other cardiovascular risk factors such as age, sex, lipid disorders, smoking, and diabetes (The sixth report of the Joint National Committee, 1997). Initially, some studies suggested that screening and labeling individuals with hypertension may result in adverse psychological effects and transient increases in absenteeism (Ameling *et al.*, 1977; Ambrosio *et al.*, 1984; Rudd *et al.*, 1987; Rastam, 1987). However, studies that have measured psychological well-being have found inconsistent effects of screening and diagnosis. Several cohort studies showed mixed effects on rates of absenteeism, and the causes of absenteeism were not well established (Rastam, 1987; Alderman, 1976). The United State Preventive Services Task Force (USPSTF) strongly recommends that clinicians screen adults aged 18 and older for high blood pressure (U.S. Preventive Services Task Force, 1996). The sixth report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure recommends screening for every 2 years for persons with systolic blood pressure and diastolic blood pressure below 130 mm Hg and 85 mm

Hg, respectively. More frequent screening intervals for those with blood pressure at higher levels are recommended (The sixth report of the Joint National Committee, 1997).

2.3.2 Blood Pressure Measurement:

BP measurement is a vital prerequisite clinical skill towards blood pressure condition diagnosis. However, observation on the ground and in practice indicates that it is poorly performed by all health care professional categories (Southern African Hypertension Guideline, 2006). Office blood pressure measurement (using an appropriate upper arm cuff with either mercury, calibrated aneroid, or validated electronic sphygmomanometer) is the standard screening test for hypertension. When performed correctly, sphygmomanometer provides a measure of blood pressure that is highly correlated with intra-arterial measurement and highly predictive of cardiovascular risk (Reeves, 1995). However, office blood pressure measurements exhibit great variability and may not represent the patient's usual blood pressure outside the clinical setting.

Due to the limitations in the reliability of blood pressure measurements, experts commonly recommend that clinicians diagnose hypertension only after obtaining 2 or more elevated readings at 2 or more office visits at intervals of 1 to several weeks (The sixth report of the Joint National Committee, 1997; McAlister, 2001). The relationships between systolic blood pressure (SBP), diastolic blood pressure (DBP) and cardiovascular risk have long been recognized (Chobanian *et al.*, 2003). The United States National High Blood Pressure Education Program guidelines by the seventh Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure defines normal blood pressure as <120/80 mm Hg (Chobanian *et al.*, 2003), A systolic blood pressure of 120 to 139 mm Hg or a diastolic blood pressure of

80 to 89 mm Hg was characterized as “prehypertension” because even this range could be associated with a clear increase in risk.

The hypertension stages consist of stage 1 with a systolic blood pressure of 140-159 mm Hg and a diastolic blood pressure of 90-99 mm Hg; while stage 2 is characterised by a blood pressure of $\geq 160/100$ mm Hg. The Southern African Hypertension Society Guideline defines normal blood pressure as systolic blood pressure of 120-129 mm Hg and diastolic blood pressure of 80-84 mm Hg (Southern African Hypertension Guideline, 2006). A systolic blood pressure of 130 to 139 mm Hg or a diastolic blood pressure of 85 to 89 mm Hg is classified as normal. The hypertension stages consist of stage 1 with a systolic blood pressure, 140-159 mm Hg; diastolic blood pressure, 90-99 mm Hg; while, stage 2 is indicated by a systolic blood pressure of 160-179 mm Hg; a diastolic blood pressure of 100-109 mm Hg; while stage 3 hypertension is indicated by a blood pressure of $\geq 180/110$.

The Southern African Hypertension Society Guideline is in agreement with JNC 7 that indicates that high-normal blood pressure is associated with increased cardiovascular risks. However, the Southern African Hypertension Society Guideline refrains from giving these individuals a disease label and emphasize, as does JNC 7, that lifestyle modification is appropriate for people with high-normal blood pressure to reduce their likelihood of developing hypertension and the need for drug therapy. Regrettably, Botswana does not have hypertension guidelines per se.

2.3.3 Hypertension prevalence:

Generally, the hypertension prevalence rate in developed countries is higher compared to developing countries (Cooper, 2003). In 1999-2000, 28.7% of United States National Health and Nutrition survey III participants were hypertensive (Hajjar, 2003).

Hypertension prevalence was highest in non-Hispanic blacks (33.5%), increased with age (65.4% among those aged 60 years or more), and tended to be higher in women (30.1%) (Hajjar, 2003); while a study of middle-aged populations in Mexico City found hypertension prevalence rate of 17.1% in Mexican men and 17.4% in Mexican women (Ayala *et al.*, 2005). Comparatively, a population based survey, including participants from 15 years old and above, in arid villages of Gachipura and Balarwa (desert part of Rajasthan, state in northwestern India) reported a hypertension prevalence of 20.1% and 10.4% respectively (Haldiya *et al.*, 2005). A similar survey conducted in Ode-Remo (Nigeria) reported a prevalence of 36.9% among respondents (Osibogun, 1999).

In 1998, the first South African Demographic and Health Survey (SADHS) provided the most comprehensive estimates of the prevalence of hypertension in South Africa. Using a cut-off of 140/90 mmHg, the hypertension prevalence rate was estimated at 25% and 26% for men of women respectively, among participants aged 15 years and older (Steyn *et al.*, 2008). In the Heart of Soweto Study, South Africa, 56% of predominantly black Africans who attended the cardiac clinic at a South African public hospital were diagnosed as hypertensive (Sliwa *et al.*, 2008). Regrettably, the Botswana hypertension prevalence is not known. Since 2008, the Botswana Ministry of Health in collaboration with the World Health Organization is undertaking a study on hypertension, diabetes and stroke among those aged 50 years and above. A cross-sectional study done in Botswana on self reported health of the elderly patients (aged 60 - 109 years), found 42% of them to be hypertensive (Clausent *et al.*, 2005).

2.4 SOCIAL BEHAVIOUR:

A set of behaviours, and the sense of self and belonging which these behaviours represent are collectively used to define a given lifestyle (Stebbins, 2009). Lifestyle is a term used to describe the way a person lives, which was originally coined by Austrian

psychologist Alfred Adler in 1929 (Stebbins, 2009). The current broader sense of the word dates from 1961. The lifestyle in this study focuses on tobacco product use, alcohol use, and diet. The studies below show that lifestyle interventions attenuate blood pressure.

2.4.1 Tobacco use:

It is an incontrovertible and a scientifically proven fact that smoking habit increases both cardiovascular and non-cardiovascular morbidity and mortality and no lifestyle modification programme can be seen as complete without a smoking cessation component (Derman *et al.*, 2009). Literature from a score of researchers reported that cigarette smoking can repeatedly produce a transient rise in blood pressure of approximately 5 to 10 mmHg (Freestone *et al.*, 1982; Lecerof *et al.*, 1990). This effect may be most prominent with the first cigarette of the day in habitual smokers. Moreover, a study done on normotensive smokers found that there was an average elevation in systolic pressure of 20 mmHg after the first cigarette (Groppelli *et al.*, 1992). Contrary to the above observation, habitual smokers have generally lower blood pressures than non smokers as observed in a number of studies (Mikkelsen *et al.*, 1997; Green *et al.*, 1986; Primatesta *et al.*, 2001). The mild reduction in blood pressure in smokers is in part related to decreased body weight (Perkins *et al.*, 1989). Support for this observation is the apparent higher body weight and increased blood pressure among former smokers versus that observed among never-smokers (Poulter, 2002). A vasodilator effect of cotinine, the major metabolite of nicotine, also may contribute to the hypertensive response (Benowitz *et al.*, 1989).

One study done among South African women also failed to show a significant association between snuff and hypertension (Ayo-Yusuf, 2008). Despite these observations, it is advisable that smoking should be avoided in any hypertensive patient

because it can markedly increase the risk of secondary cardiovascular complications and appears to enhance the progression of renal insufficiency (Kannel, 1990).

2.4.2 Diet:

A proper and a balanced diet is critical to mitigating the effects of many diseases in one's lifetime.

A variety of dietary modifications have been demonstrated to be beneficial in the treatment of hypertension, including salt and alcohol restriction, weight reduction, and possibly increasing potassium and calcium intake, and ingestion of a vegetarian diet or fish oil supplements (Chobanian *et al.*, 2003).

A different approach was evaluated in the Dietary Approaches to Stop Hypertension (DASH) trial (Appel *et al.*, 1997).

DASH randomly assigned 459 patients with blood pressures of less than 160/80-95 mmHg to a control diet low in fruits and vegetables, a diet rich in fruits and vegetables, or a combination diet rich in fruits and vegetables and low-fat dairy products and low in saturated and total fat (the last is called the DASH diet). The DASH diet is comprised of four-five servings of fruit, four-five servings of vegetables, and two-three servings of low-fat dairy per day, and less than 25 percent fat (Appel *et al.*, 1997). The PREMIER trial assessed the additive blood pressure effects of two different behavioural interventions. Participants were randomly assigned to an "established behavioural intervention" (such as weight loss, physical activity, and limitations in sodium and alcohol intake), the DASH diet plus "established behavioural intervention", and one-time advice only (Nicolson, 2004). The finding was that the absolute effects on blood pressure of DASH plus those of behavioural intervention were not additive. Possible reasons for this less than expected effect of the DASH diet included less rigorous adherence to the diet in this trial than in the other DASH studies (which was intentional), a large blood pressure

decrease in the advice only control group, and a possible similar physiologic mechanism for blood pressure lowering for both interventions (Pickering, 2003).

Observably, there is limited data concerning the relative efficacy of lifestyle interventions (particularly diet) versus antihypertensive agents on blood pressure control or cardiovascular outcomes. To best address this issue, a systematic analysis was performed of 5 randomized controlled trials and one quasi-randomized trial, of which 4 included dietary interventions among the lifestyle changes (Nicolson, 2004). The different diets included low calorie, low sodium, high potassium, weight reduction, and restricted alcohol diets. Given the quality and heterogeneity of the studies, the authors felt that no conclusion could be drawn concerning the relative effectiveness of these interventions, including dietary changes.

Despite this absence of evidence of relative effectiveness, most experts feel that diets play an important role in many susceptible patients in the genesis and maintenance of hypertension (Chobanian *et al.*, 2003).

Multiple meta-analyses have shown benefits with dietary fibre intake on blood pressure (Primatesta *et al.*, 2001; Ascherio, 1992). As an example, a meta-analysis done by Streppel *et al.*, (2005) on 24 randomized placebo-controlled trials published between 1966 and 2003 on the effects of fibre supplementation found an average fall of 1.2/1.3 mmHg with fibre intake (average dose of 11.5 g/day). More significant reductions were observed in older (greater than 40 years) and hypertensive individuals. Some of the benefits of the DASH diet may reflect the increase in high fibre with this particular diet like 9 and 14 grams in the control and DASH diet respectively (Appel *et al.*, 1997). The benefits of increased dietary fibre may also reflect decreases in body weight and plasma insulin levels (Ludwig *et al.*, 1999).

2.4.3 Alcohol use:

Alcohol is one of the drugs that have a huge social acceptance that its side effects are commonly ignored by many people in the world. Xin *et al.* (2001) found that among patients whose alcohol consumption is high (20 to 40 standard drinks per week), reducing alcohol consumption by at least 50 percent produced a 3.3 mm Hg reduction in SBP and 2.0 mm Hg reduction in DBP.

2.5 ANTHROPOMETRIC MEASUREMENTS:

The term anthropometric refers to comparative measurements of the body size. Anthropometric measurements are used in nutritional assessments. Anthropometric measurements used for adults usually include height, weight, Body Mass Index (BMI), waist circumference, waist-to-hip ratio, and percentage of body fat. These measures are then compared to reference standards to assess weight status and the risk for various diseases. Anthropometric measurements require precise measuring techniques to be valid. Anthropometric measurements such as height and weight are the most commonly measured and can be determined with great accuracy. They are important in making clinical decisions regarding treatment of obesity (Lohman *et al.*, 1988).

The discussion below covered literature on body mass index and waist circumference.

Body Mass Index: Weight can be related to height by several methods (Lohman *et al.*, 1988). In addition, several indexes have been proposed to relate height and weight. At the present time, the most widely used is the body mass index (BMI), which is the weight (in kilograms) divided by the height (in meters) squared. Body Mass Index was first used by Adolphe Quetelet in 1870 and was known as Quetelet's Index. Values of BMI in healthy individuals usually fall within the range of 18.5 to 25.9 kg/m² (BMI is always measured in metric). BMI increased with age up until the seventh and eighth decades of life, but the average gains were largest in the younger individuals (Stevens,

et al., 2009). BMI does not separate fat mass from muscle mass, but nevertheless, is highly correlated with both adipose and muscle mass. Both high and low BMI are associated with increased morbidity and mortality. In a systematic review, McAlister *et al.*, (2001) found that interventions to promote weight loss lowered blood pressure. Correlations between BMI and blood pressure in very lean populations in Africa and Asia have also been reported in one study (Tesfaye *et al.*, 2007).

Waist circumference: perhaps the most widely used measure of regional fat distribution is the waist circumference, which has replaced the waist-to-hip circumference ratio because it is easier to measure (Stevens *et al.*, 2009). Currently, there is no universal agreement on the cut points to define a healthy waist circumference, and none of the common guidelines are age-specific (Stevens *et al.*, 2009). However, the most often used definition in the United States and South Africa is The ATP III with cut points of 88 cm for women and 102 cm for men, a 14-cm difference (Southern Africa hypertension Guidelines, 2006; Grundy, et al., 2004). However, the International Diabetes Federation (the most widely used outside the United States, metabolic syndrome definition) uses both gender and ethnic group-specific cut points for waist circumference (International Diabetes Federation, 2006). This definition takes into account research showing that Asian populations have a lower mean BMI compared with the European or American populations (Seidell *et al.*, 2001).

In the IDF guidelines, the waist circumference cut points are 80 cm for women (regardless of ethnic group), 90 cm for Asian men and 94cm for European men. Waist circumference is one of the components of the Adult Treatment Panel III (ATP III) and the International Diabetes Federation (IDF) definitions of metabolic syndrome (Grundy *et al.*, 2004; International Diabetes Federation, 2006). These are the two most widely

used definitions for metabolic syndrome, and waist circumference is the only component of the syndrome definitions with different cut points.

In December 2008, World Health Organization convened a consultation to discuss cut-points for waist circumference. One basic issue that needed to be addressed as part of this effort was the impact of gender and age. BMI and waist circumference are highly correlated, and gender and age associations with BMI, body composition and fat depot distribution are all pertinent to waist circumference. Although associated with other anthropometric measures, waist circumference (WC) remains a simple and valid marker of abdominal and visceral fat. Waist circumference (WC) provides a highly feasible and inexpensive method to monitor body fat distribution and identify individuals at greater risk of disease in a variety of settings (Stevens *et al.*, 2009). There are large differences in body composition in men and women, with women having higher levels of body fat. Fat distribution also differs by gender, with men having a relatively more central distribution of fat. These differences strongly manifest in puberty and are related to sex hormones. In both men and women, waist and waist-to-hip ratio increase with aging (Stevens *et al.*, 2009).

Incontrovertibly, younger adults tend to experience greater gains in waist than older adults, probably due to greater weight gains during young adulthood. With weight gain, WC and waist-to-hip ratio increase, but men have larger increases in WC with weight gain than women. Differences in waist between adult men and women are seen at all ages and levels of fatness. The current practice of using different waist cut-points for men and women, therefore, seems justified (Stevens *et al.*, 2009). Age-related differences in the association of WC with body composition may support the establishment of cut-points that vary by age. However, to fully address this need, examination of the risk associated with specific WC values by age will be required.

Without this type of analysis, the need for age-specific cut off for WC cannot be known, as both WC and risk of several chronic diseases increase with age. In addition, the use of different cut-points for different age groups would impair one of the major strengths that WCs offer as an indicator of disease risk: simplicity (Stevens *et al.*, 2009). It has been reported that WC was the strongest independent predictor (age, gender, BMI, and insulin resistance included) of SBP and diastolic blood pressure in 413 normoglycemic Chinese that included 56% individuals with hypertension (Thomas *et al.*, 2000). In this previous study, WC was found to be the major determinant of blood pressure, accounting for >20% of its variance (Thomas *et al.*, 2000). A similar association has been reported recently between the prevalence of hypertension and intra-abdominal fat accumulation but not with WC in a cohort of 563 Japanese Americans (Hayashi *et al.*, 2003).

2.6 PHYSICAL ACTIVITY:

Physical activity and exercise are not interchangeable terms (Caspersen, 1985). Physical activity is defined as bodily movement produced by the contraction of skeletal muscle that increases energy expenditure above the basal level. Categories of physical activity include occupational, household, leisure time, or transportation (Caspersen, 1985). The term "exercise" is used to denote physical activity that is planned, structured, repetitive, and purposeful in that the main objective is improvement or maintenance of one or more components of physical fitness (Caspersen, 1985).

Physical activity may be measured in terms of METs (metabolic equivalent), a unit used to estimate the metabolic cost (oxygen consumption) of physical activity. One MET equals the resting metabolic rate of approximately 3.5 mL O₂/kg/min, and represents the approximate rate of oxygen consumption of a seated adult at rest. Moderate physical activity includes activity performed at an intensity of three to six METs, or the equivalent

of walking briskly at three to four miles per hour. Pleasure cycling, moderate effort swimming, playing golf (walking), general cleaning at home, or lawn mowing also constitute moderate physical activity (Pate *et al.*, 1995).

Examples of lifestyle exercises includes brisk walking at 4.8 to 6.4 km (3 to 4 miles) per hour for most healthy adults, active yard work, and dancing (Paffenbarger, 1986). Exercises such as bicycling, jogging, and other leisure sports can also be performed.

Strength-developing exercises add to the benefits of endurance-type activity. Resistive exercises with free weights or exercise equipment consisting of 10 to 15 repetitions of each exercise for arms, shoulders, chest, trunk, back, hips and legs should be carried out two to three times a week (Parsons *et al.*, 1992). Arterial blood pressure at rest, blood pressure during sub maximal exercise, and peak blood pressure all decline slightly in endurance trained normotensive individuals. The decreases are actually greater in those with high blood pressure (Fagard, 1994).

Cleroux *et al.* (1999) has also shown moderate physical activity to be more effective than vigorous activity in reducing systolic blood pressure.

Recommendations to reduce blood pressure on exercise can be summarized as follows:

- Type of exercise: this should be predominantly endurance physical activity including: walking, jogging, cycling, swimming, or dancing. Heavy resistance training with high static loads should be avoided in hypertensive patients (exercises with heavy lifting, pushing or pulling).
- Frequency of exercise: most or preferably all days of the week.
- Intensity of exercise: Moderate intensity, 40–70% of age predicted maximal heart rate.
- Duration of exercise: greater than 30 minutes of continuous or accumulated moderate physical activity per day.

- Patients with uncontrolled hypertension should embark on exercise training only after evaluation and initiation of therapy. No exercise should be undertaken if resting systolic BP > 200 mmHg or diastolic BP > 115mmHg.
- Many patients with hypertension are overweight and should therefore be encouraged to follow a programme that combines both exercise training and restricted calorie intake (Chobanian *et al.*, 2003; Southern African Hypertension Guideline, 2006)

CHAPTER 3 - METHODOLOGY

3.1 INTRODUCTION:

This chapter describes the methods that the study used. The chapter contains details of the aim and objectives of the study, the study design, study population, study setting, the sample size and sampling frame.

The chapter further describes the variables, data collection, data analysis, reliability and validity of the study, bias, ethical issues and study limitations that were taken into considerations in this study.

3.2. AIM AND OBJECTIVES OF THE STUDY:

The study aimed to determine the risk factors associated with high blood pressure in the adult population of Kang (Kgalagadi North), Botswana.

The study objectives were:

- To determine the demographic details of the adult Kang population.
- To measure the blood pressure in the adult Kang population
- To enquire on the population's social behavior (e.g. alcohol, smoking)
- To determine the population anthropometric measures
- To enquire on the population's physical activity
- To determine the relationship between high blood pressure and the identified associated risk factors in the Kang adult population.

3.3 STUDY DESIGN:

A population-based cross-sectional study in a survey conducted among adult residents of Kang (18 year-old and above).

3.4 STUDY SETTING:

The study setting was Kang, a village situated in the Northern part of the country in Kgalagadi North in Botswana. Its precise latitudinal and longitudinal being 23.75°South and 22.83°East respectively (Wikipedia, 2010). The 2001 census estimated the Kang population at 3,744, while the population projection in 2008 was 5076 (Kgalagadi District Development plan 6, 2003). The village is situated in the Kalahari desert with calcisols soils (sand clay soils, moderately deep and poor well drained) not conducive for agriculture (Kgalagadi District Development plan 6, 2003).

3.5 STUDY POPULATION:

The survey was conducted on adult residents of Kang (18 year-old and above) from November to December 2008.

3.6 SAMPLE AND SAMPLING FRAME:

3.6.1 Sampling Frame

The sampling frame consisted of all the adult population of Kang village from the age of 18.

3.6.2 Sample Size (unit of analysis), Sample selection and Procedure

The sample size of 161 was calculated using the Statcalc program in Epi info Version 6.

The Kang population projection in 2008 was 5076 (Kgalagadi District Development plan 6, 2003).

Estimation was made that 50% of Kang adult population had hypertension (unknown prevalence). The worst acceptable result was taken to be 40 %. Based on this assumption, a sample size of 94 was found to be sufficient to estimate this proportion to within +/- 5% significance or 95% confidence. To reduce the risk that the sample obtained does not represent the true population value, the figure of 161 (99% confidence level) was selected for sample size.

Participants were enrolled from among the adult residents of Kang (18 year-old and above). The researcher used a systematic random sampling (Olsen *et al.*, 2004). Systematic sampling involves a random start and then proceeds with the selection of every 32nd house from then onwards. The figure 32 was obtained as follow: 5076 (population size) divided by 161(sample size). It was important that the starting point was not automatically the first house from the clinic. The starting house was instead randomly chosen from within the first to the 32nd in the row. The researcher used two dices numbered on their faces with dots from one to six. Those dices were thrown from a cup, and the numbers of dots showing on the top of the dices at rest determined the number of the house chosen as starting point. In this study, it was the house number 23.

3.7 INCLUSION AND EXCLUSION CRITERIA:

The inclusion Criteria:

The consent was sought before recruitment for the study. Subjects included in the study were those aged 18 years old and above. Those already on treatment for hypertension were included as well.

The exclusion criteria were:

- Those known physiological abnormalities (e.g. pregnancy, Cushing syndrome, and Addison's disease).
- Subjects with gross anatomical deformities of the arms (to be used for BP measurement).
- And those who refused to be recruited.
- Participants included in a pilot study.

3.8 VARIABLES:

- Age: in years, Sex: male or female
- Height: was measured in standing position, with shoulders and buttocks against the wall, the subject looking straight ahead, with joined feet, and arms hanging on both sides. Height was recorded in meter to the nearest 0.5 cm. Weight: weight was recorded in kilogram to the nearest 100 g.
- Hypertension: in mmHg
- Body Mass Index: in Kg/m^2
- Waist circumference: WC was obtained using a graduated tape when subjects were in standing position. WC was measured as the narrowest circumference of the trunk. However, when the position of the narrowest circumference could not be identified, the measurement was taken at the level of the last rib (Scarsella *et al.*, 2003; Lemieux *et al.*, 2002).

- Hip circumference was measured at the maximum circumference of the hip, measured in centimeter.
- Waist-to-hip ratio (WHR) was calculated as a ratio of waist and hip circumference.
- Tobacco product use, alcohol use, fruits and vegetable consumption, Work involve vigorous-intensity activity that causes large increases in breathing or heart rate like for at least 10 minutes continuously and Work involve moderate-intensity activity that causes large increases in breathing or heart rate like for at least 10 minutes continuously.

3.9 DATA COLLECTION TOOL:

A questionnaire adapted from the World Health Organization (WHO) STEP a wise instrument on chronic disease (Bonita, 2001) was used for data collection. Data on selected socio-demographic characteristics and lifestyle behaviours, including physical activity, as well as physical measurements such as weight, height, waist and hip circumference, and blood pressure were collected through standardized procedures. The questionnaire was translated in Setswana by someone with expertise.

3.10 DATA COLLECTION PROCEDURE:

Data was collected by a team of five health auxiliaries from Kang clinic with five additional lay assistants hired from the village. The researcher's role was to supervise the team on the ground. Data were collected from the house number 23 then every 32nd house.

Socio-demographic data and lifestyle behaviours, including physical activity as well as physical measurements such as weight, height, waist and hip circumference, were

collected during the first week. Weight and height were measured with participants standing without shoes and wearing light clothing.

Weight was measured using an electronic bathroom scale. Participants stood upright with the head in Frankfort plane for height measurement. Height was recorded to the nearest 0.5 cm, and weight was recorded to the nearest 100 g.

The BMI was calculated as weight in kilograms over height in meters squared [BMI = (mass)/ (height)² = kg (m)²].

Blood pressure was measured for every individual in three consecutive weeks.

For each participant, the average systolic blood pressure (SBP) and diastolic blood pressure (DBP) were determined from the second and third measurements. The following steps were taken.

- A participant sat at a table quietly with both feet flat on the floor and with the back supported and s/he was asked to empty the bladder. It was made sure that the room was comfortable and noise minimized. No tobacco products, alcohol, or caffeine had been consumed within the previous 30 minutes. If this was not possible, it was noted in the data.
- The right arm, which was bare, was placed on the table (at heart level) slightly flexed, with the palm upward. The screener was in position to see the reading at eye level.
- The arm circumference was determined; a cuff was selected and wrapped appropriately.

The following cuff sizes were used:

Small adult' cuff, 12 x 22 cm,

Adult' cuff: 16 x 30 cm,

Large adult' cuff: 16 x 36 cm

- The lower edge of the cuff was 2.5 cm above the elbow joint.
- The screener waited 5 minutes and inflated the cuff.
- Then the screener raised participant's arm above heart level for 15 seconds. The screener rested for one minute and then performed the measurement procedures two more times. The mean of the last two measurements was used.

3.11 DATA ANALYSIS:

All data collected were checked, fed into the computer and analyzed using the Epi info version 3.3.2 software. Mean values of BP, weight, height and body mass index was determined. The population was classified based on behavioural measurements, body mass index quintiles and other conventional cut-off points. Distribution of mean blood pressure and the hypertension prevalence rate at different behavioural measurements, body mass index levels were also presented.

Simple analysis of variance was used to compare the mean differences of systolic or diastolic blood pressure between groups, according to sex, age and nutritional status. The chi-square test or Fisher's exact test were used to assess the association between hypertension and behavioural measurements or anthropometric measurements. The chi-square test is simpler to calculate but yields only an approximate p value (Motulsky, 1995). When the numbers are larger, the p values reported by the chi-square and Fisher's test will be very similar (Motulsky, 1995).

The chi-square is avoided when the numbers in the contingency table are very small (any number less than about six). It calculates approximate p values, and the Yates'

continuity correction is designed to make the approximation better. Without the Yates' correction, the p values are too low (Motulsky, 1995). However, the correction goes too far, and the resulting p value is too high. Statisticians give different recommendations regarding Yates' correction. With large sample sizes, the Yates' correction makes little difference.

The Fisher's test is the best choice as it always gives the exact p value (Motulsky, 1995).

The level of significance was set at $p < 0.05$.

3.12 RELIABILITY AND VALIDITY OF STUDY:

A pilot test of the questionnaire was conducted to make sure it is understandable and acceptable to the intended audience as it is always recommended (Olsen *et al.*, 2004). The BP was measured using a digital automatic apparatus (Welch Allyn OSZ 4 and 5) which were well calibrated. Pilot testing also involved evaluation of other attributes, namely, precision (reliability) and accuracy (validity) (Olsen *et al.*, 2004), hence its application in this study. Test–retest reliability of the BP and anthropometric measurements were assessed during the pilot study. All devices used for BP and anthropometric measurements gave the same readings.

3.13 BIAS:

Bias was minimized as follows:

Selection bias: Although subjects were selected randomly as outlined above, pregnancy and any obviously gross physical deformities was excluded.

Inter-observer bias: Training was conducted by the researcher before the survey to enable and ensure preciseness of the team on methods of identifying eligible study subjects; appropriate methods of interviewing as well as measurement of BP, weight

and height (in a standardized manner). To assess the standardization, a pilot study was carried out on ten subjects at the end of the training. These subjects were excluded in the main study.

3.14 ETHICAL CONSIDERATIONS:

Because of the fact that social based research deals with human beings, legal and ethical considerations are critical in any research study in order to regard the participants' human rights as well as their comfort. The study amply fulfilled all these requirements. The study obtained ethical clearance from the Medunsa Campus Research and Ethics Committee (MREC) of the University of Limpopo. Research License letters were also obtained from the Botswana Ministry of Health and the Kgalagadi District Council; while written Informed consent was obtained from each subject after the study purpose was outlined. To the researcher's relief, the study team did not report any decline to participate among the research respondents.

3. 15 LIMITATIONS OF THE STUDY:

A major limitation of our study is the cross-sectional design. As time takes toll, complications that impede quality and smooth data collection process always unfolds. This design prohibits any inferences of a causal association between the risk factors and hypertension and in addition prevents us from determining the direction of the association between risk lifestyle behaviours and hypertension.

The sample size was small. This made the generalization of the result difficult. Further studies are needed to clarify the hypertension magnitude throughout the country, with a large sample. Sample frame was not stratified for male and female according to sex

ratio of 1 as per the 2009 central statistics estimation (Wikipedia, 2010). This can give a false impression in prevalence.

A further limitation of this study is the recall bias, as individuals could not report accurately some of social behaviour like use alcohol and tobacco use.

CHAPTER 4 – RESULTS

4.1 INTRODUCTION:

A total of 173 participants out of the targeted sample population were involved in the survey. Twelve forms were discarded among them, 5 forms were not properly filled and 7 participants could not be found at second and /or third visits. Blood pressure was the mean of three readings (consecutive weeks).

This section reports results of demographics characteristics, social behaviour such as tobacco reported use, alcohol reported use and diet, anthropometric measurements and physical activity.

4.2 DEMOGRAPHIC CHARACTERISTICS OF KANG POPULATION:

Table I shows the population distribution according to age and sex. The final sample consisted of 161; among them 60 (37.2%) were males and 101(62.7%) were females.

The participants ranged in age from 20 and 82 years old with the mean age of 40.8 years (95% CI 38.1-43.4). As shown in Figure 2, the hypertension prevalence rate increases with age. The mean age for hypertensive participants was 53.4 yrs (95% CI 48.8-57.9 yrs). Participants were classified as hypertensive if the systolic blood pressure (SBP) ≥ 140 mm Hg or diastolic blood pressure (DBP) ≥ 90 mm Hg or self-reported use of antihypertensive medication.

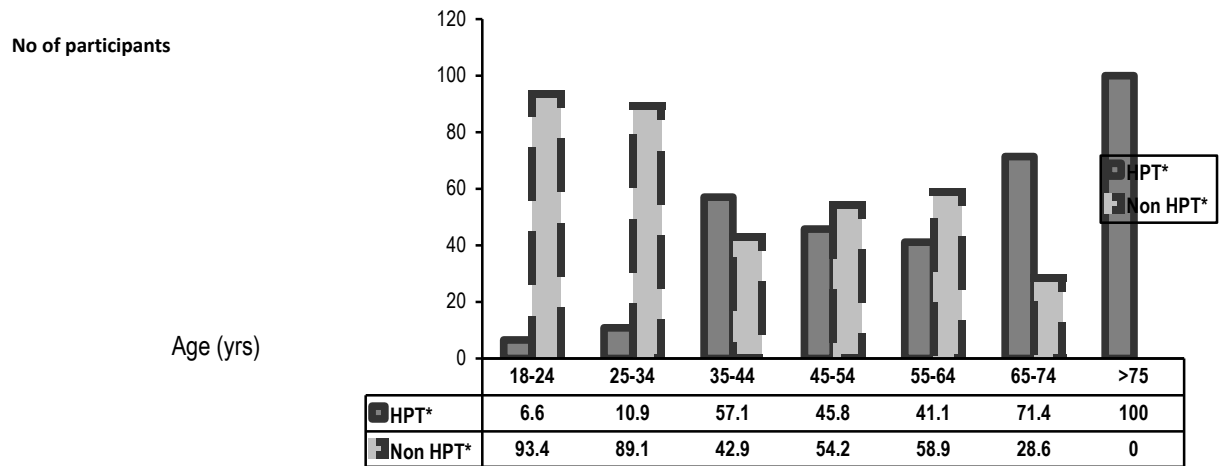
Hypertension was observed in 31.6% of the participants (95% CI 24.6%-39.5%).

The male: female ratio was 1.2:1 among the diagnosed participants. The Botswana population sex ratio is 1 according to the 2009 estimation (Wikipedia, 2010). With regard to the hypertension prevalence rate, no significant differences were observed between males and females (males 28.3% versus females 33.6%, $p = 0.59$).

Table I: Description demographic characteristics of Kang population

	Number=161 (%)	HPT*
Sex		n (%)
Male	60 (37.2)	17 (28.3)
Female	101 (62.7)	34 (33.7)
Age (years)		n (%)
18-24	30(18.6)	2 (6.6)
25-34	55 (34.1)	6 (10.9)
35-44	14 (8.6)	8 ((57.1)
45-54	24(14.9)	11 (45.8)
55-64	17 (10.5)	7 (41.1)
65-74	14(8.6)	10 ((71.4)
>75	7(4.3)	7 (100)

*HPT= hypertensive



*HPT= hypertensive

Figure 1: Prevalence of hypertension by age group

As shown in table II, among the hypertensive participants, 7 (41%) males had a raised SBP, while the raised SBP in females was observed in 10 participants (29.4%); the raise of DBP was observed in 4 males (23.5%) and 5 (14.7%) of females; and both raised SBP and DBP was observed in 7 (11.6%) males and 16 (15.8%) females, respectively. Two participants had their blood pressure controlled in the self-reported group that used antihypertensive medication.

Table II: Frequency distribution of Hypertension by sex and type.

Sex	Hypertensive					Non Hypertensive N (%)	Total
	HPT N (%)	Raised only SBP N (%)	Raised only DBP N (%)	Raised both SBP and DBP N (%)	Self-reported use of antihypertensive medication N (%)		
Male	17 (28.3%)	7(41%)	4(23.5)	7(11.6)	5(8.3)	43(39%)	60
Female	34(33.6%)	10(29.4%)	5(14.7%)	16(15.8)	11(32.3)	67(61%)	101
TOTAL	51(31.6%)	17(33.3%)	9(17.6%)	23(45.0%)	16(31.3)	110(68.3%)	161

Hypertension male x female, Yates corrected chi square, $p = 0.59$.

Abbreviations: HPT, hypertension; DBP, diastolic blood pressure; SBP, systolic blood pressure.

4.3 BLOOD PRESSURE MEASUREMENTS:

The participants mean systolic blood pressure (SBP) and diastolic blood pressure (DBP) were 127.6 mmHg (95% CI: 124.5-130.6 mmHg for males and 79.3 mmHg (95% CI: 77.5-81.1mmHg) for females respectively.

Figure 2 shows how the systolic blood pressure (SBP) and diastolic blood pressure (DBP) were scattered with SBP 78 to 191 and DBP from 50 to 128.

Among the participants with raised blood pressure or on drugs to reduce the blood pressure, the SBP mean was 150.1 mmHg (95% CI: 145.5-154.6 mmHg) and the DBP mean was 91.1 mmHg (95% CI: 88.2-93.9mmHg).

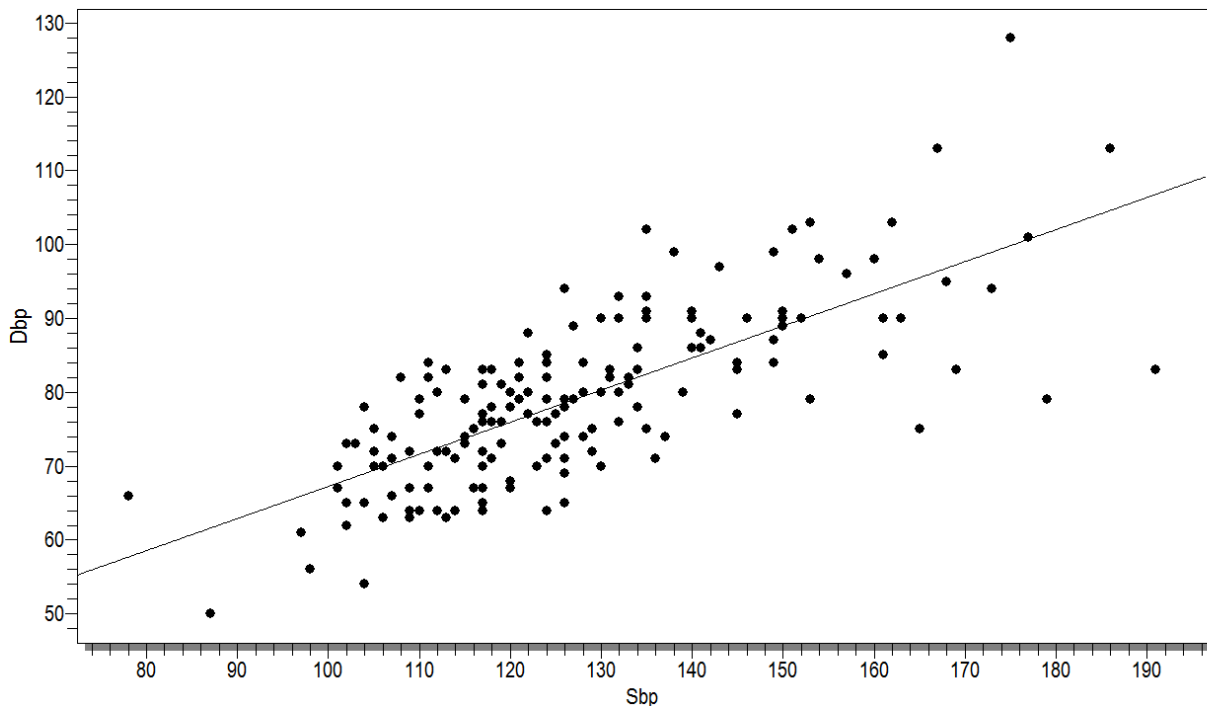


Figure 2: Scatter Systolic blood pressure (SBP) with diastolic blood pressure (DBP)

As shown in table III, there was a significant difference between individuals who checked their blood pressure within the last 12 months and those who never check their

blood pressure for the last five years ($p < 0.0001$). No significant differences were observed, with regard to hypertension prevalence rate, when individuals who checked their blood pressure within the last 12 months were compared to those who checked one to five years ago ($p = 0.95$); when individuals who checked their blood pressure within one to five years were compared to those who never checked their blood pressure for the last five years ($p = 0.28$).

Table III: Blood pressure screening in the past.

	HPT*	Non HPT	N**	% (95% CI)
blood pressure checked within the last 12 months	29	23	N=52	32.5% (95% CI 25.3%-40.3%)
blood pressure checked within one to five years ago	2	3	N=4	2.5 % (95% CI 0.7%-6.3%)
never checked their blood pressure for the last five years	21	83	N=104	65% (95% CI 57.1%-72.4%).

*HPT= Hypertension, **N=number.

Hypertension, blood pressure checked within the last 12 months x blood pressure checked one to five years, two-tailed Fisher's exact test, $p = 0.65$.

Hypertension, blood pressure, blood pressure checked one to five years x never checked their blood pressure for the last five years, two-tailed Fisher's exact test, $p = 0.28$

Hypertension, blood pressure checked within the last 12 months x blood never check their blood pressure for the last five years, Yates corrected chi square, $p < 0.0001$

Table IV shows the determinants of high blood pressure such as diabetes and patients' education by health providers.

There was a significant increasing trend in the proportion of respondents with hypertension as related to use of oral drugs or injectable (like insulin) for the past 2 weeks ($p=0.02$) and to prescription of special diet ($p =0.01$).

However, no significant differences were observed between respondents whose blood sugar was measured in the last 12 months ($p=0.76$), diagnosed for diabetes mellitus in the last 12 months ($p=0.66$), advised or treated to lose weight ($p=0.65$), advised or treated to stop smoking ($p=0.19$), and advised to start or do more exercise ($p=0.90$).

Table IV: Determinants of high blood pressure in the study population

		HPT*	Non HPT*	Number	% (95%CI)	Statistically difference
Blood sugar measured during the last 12 months	Yes	5	9	14	8.8% (4.9%-14.2%)	Fisher exact test 2 tailed P=0.76
	No	46	101	147	91% (85.8%-95.1%)	
Diagnosed diabetes mellitus the last 12 months	Yes	1	5	6	3.1% (1.0% -7.2%)	Fisher exact test 2 tailed P=0.66
	No	50	105	155	96.9% (92.8%-99.0%)	
Took oral drugs or injectable (like insulin) the past 2 weeks	Yes	23	28	51	31.9% (24.7%-39.7%)	Yates Corrected chi square P=0.02
	No	28	82	110	68.1% (60.3%-75.3%)	
Prescribed special diet	Yes	17	16	33	20.1% (14.2% -27.2%)	Yates Corrected chi square P=0.01
	No	34	94	128	79.9% (72.8%-85.8%)	
Advised or treated to lose weight	Yes	2	3	5	3.1%: (1.0%-7.1%)	Fisher exact test 2 tailed P=0.65
	No	49	107	156	96.9% (92.9%- 99.0%)	
Advised or treated to stop smoking	Yes	6	6	12	7.5% (3.9% -12.7%)	Fisher exact test 2 tailed P=0.19
	No	45	104	149	92.5% (87.3%-96.1%)	
Advised to start or do more exercise	Yes	9	17	26	16.3% (10.9%-22.9%)	Yates Corrected chi square P=0.90
	No	42	93	135	83.8% (77.1% -89.1%)	
Took herbal or traditional remedy for diabetes during survey	Yes	0	0	-		-
	No	51	110	161	100%	

*HPT= hypertensive

4.4 SOCIAL BEHAVIOUR:

4.4.1 Tobacco products reported use:

The table V shows that 50 participants (31.3%) reported that they smoke tobacco products or use any smokeless tobacco- like snuff (95% CI: 24.2%-39.0%). Among the participants using the tobacco products, 57.7% of them (n=15/26) did not know for how long they had used tobacco products (95% CI: 36.9%- 76.6%). For those who could remember, the average time of use of tobacco products was 23.5 years for males and 8years for females. The use of smokeless tobacco like snuff was observed in 26% (13/50 participants). No association between hypertension and tobacco use was observed ($p=0.46$).

Table V: Tobacco products reported use

		HPT	Non HPT	Number %(95%CI)	Statistically difference
Smoke any tobacco product or use any smokeless tobacco(snuff)	Yes	18	32	N=50 31.3% (95% CI: 24.2%-39.0%)	Yates Corrected chi square P=0.46
	No	32	79	N=111 68.8% (95% CI: 61.0%-75.8%)	
Currently use tobacco products daily.	Yes	17	28	N=45 93.8% (95% CI: 82.8% 98.7%)	Fisher exact test P=1.00
	No	1	2	3 6.3% (95% CI: 1.3%- 17.2%)	

4.4.2 Alcohol reported use:

Table VI shows the frequency of reported use of alcohol. For the last 12 months, those who responded they took alcohol daily were 52% (95% CI 27.8-77.0%). Findings also indicated that majority of the hypertensive participants alcohol consumers who comprised of 54.8% (95% CI: 36.0%-72.7%) did not know in one day how many drinks they took and for how long they had consumed alcohol in their lifetime. No significant differences were observed on prevalence of hypertension when the different categories of alcohol consumption were compared.

Table VI: Frequency of reported use of alcohol.

For the last 12 months, frequency of alcohol consumption at least daily	HPT			Non HPT		
	n	%	95% CI	n	%	95% CI
Daily	9	52.9%	27.8% -77.0%	8	24.2%	11.1% -42.3%
5-6 day per week	2	11.8%	1.5% -36.4%	4	12.1%	3.4% -28.2%
1-4 day per week	3	17.6%	3.8% -43.4%	11	33.3%	18.0% -51.8%
1-3 day per month	3	17.6%	3.8% -43.4%	7	21.2%	9.0% - 38.9%
Less than once a month	0	0.0%	0.0% -19.5%	3	9.1%	1.9% -24.3%
Alcohol consumption within the last 12 months						
	HPT	Non HPT	Number %(95%CI)	Statistically difference		
Yes	17	33	N=50 31.3% (95% CI: 24.2%-39.0%)	Yates Corrected chi square P=0.73		
No	33	78	N=111 68.8% (95% CI: 61.0%-75.8%)			

HPT= Hypertensive

Hypertension daily alcohol use x 5-6 days per week, two-tailed Fisher's exact test, p = 0.64, uncorrected chi square, p = 0.68

Hypertension daily alcohol use x 1-4 days per week, Yates corrected chi square, p = 0.15

Hypertension daily alcohol use x 1-3 days per month, two-tailed Fisher's exact test, p = 0.42, uncorrected chi square, p = 0.24

Hypertension alcohol 5-6 days per week x 1-4 days per week, two-tailed Fisher's exact test, p = 0.61, uncorrected chi square, p = 0.57

Hypertension alcohol 5-6 days per week x 1-3 days per month, two-tailed Fisher's exact test, p = 1.00, uncorrected chi square, p = 0.88

Hypertension alcohol 1-4 days per week x 1-3 days per month, two-tailed Fisher's exact test, p = 0.66, uncorrected chi square, p = 0.63

4.4.3 Reported fruits and vegetable consumption:

Findings indicated that the mean days that the participants ate fruits was 2.45 days (95% CI: 1.65-3.24) and 2.21 days (95% CI 1.78-2.63%) for hypertensive and non hypertensive respondents respectively.

The mean days that the participants ate vegetables was 2.80 days (95% CI: 2.09-3.50) and 2.53 days (95% CI: 1.80-3.25) for hypertensive and non hypertensive respondents, respectively.

Table VII shows the frequency of fruits and vegetable consumption. No significant difference was observed on the prevalence of hypertension when the different categories of fruits and vegetable consumption were compared except when the group respondents who took fruits 0-2days per week were compared with those who did not know how much fruits or vegetables they took per week ($p = 0.009$).

Table VII: Frequency of reported fruits and vegetable consumption

	Fruits		Vegetables	
	HPT* n (%)	Non HPT * n (%)	HPT * n (%)	Non HPT * n (%)
0-2 days per week	12 (20.0)	48 (80.0)	17 (24.6)	52(75.4)
3-4 days per week	5 (27.8)	13 (72.2)	7(35.0)	13(65.0)
More than 5 days per week	3 (27.2)	8 (72.8)	6(28.6)	15(61.4)
Did not know how much s/he took fruits or vegetables per week	30 (42.8)	40 (51.2)	20(39.2)	31(60.8)

*HPT= Hypertensive

Hypertension Took fruits 0-2days per week X 3-4 days, two-tailed Fisher's exact test, $p = 0.52$, uncorrected chi square, $p = 0.48$

Hypertension Took fruits 0-2days per week X More 5 days, two-tailed Fisher's exact test, $p = 0.6$, uncorrected chi square, $p = 0.5$

Hypertension Took fruits 3-4days per week X More 5 days, Yates corrected chi square, $p = 1.0$

Hypertension Took fruits 0-2days per week X Did not know she took fruits or vegetables per week, Yates corrected chi square, $p = 0.009$

Hypertension Took fruits 3-4 days per week X Did not know she took fruits or vegetables per week, Yates corrected chi square, $p = 0.37$

Hypertension Took fruits more 5 days per week X Did not know she took fruits or vegetables per week, two-tailed Fisher's exact test, $p = 0.51$, uncorrected chi square, $p = 0.32$

Hypertension Took vegetable 0-2days per week X 3-4 days, two-tailed Fisher's exact test, $p = 0.52$, uncorrected chi square, $p = 0.35$

Hypertension Took vegetable 0-2days per week X More 5 days, Yates corrected chi square, $p = 0.93$

Hypertension Took vegetable 3-4days per week X More 5 days, Yates corrected chi square, $p = 0.91$

Hypertension Took vegetable 0-2days per week X Did not know she took fruits or vegetables per week, Yates corrected chi square, $p = 0.13$

Hypertension Took vegetable 3-4 days per week X Did not know she took fruits or vegetables per week, Yates corrected chi square, $p = 0.95$

Hypertension Took vegetable more 5 days per week X Did not know she took fruits or vegetables per week, Yates corrected chi square, $p = 0.55$

4.5 ANTHROPOMETRIC MEASUREMENTS:

Tables VIII and IX show the anthropometric measurements of the study population and the frequency of elevated blood pressure. The body mass index population was as follows: underweight 4.9% (8), normal weight 45.3% (73), overweight 28.5 % (46) and obese 21.1% (34).The body mass index mean of females (26.8) was higher than the males one (22.9). Females were more obese compared to males. An elevated blood pressure was seen with significantly higher frequency in overweight group compared with the normal weight group ($p = 0.029$), in obese group compared with the normal weight group ($p = 0.002$), and in obese group compared with the overweight group ($p = 0.045$) (Table IX).

However, hypertension was seen with no significantly higher frequency in normal weight group compared with the underweight group ($p=0.64$), and overweight group compared with the underweight group ($p=0.14$). (Table IX). The researcher used the international diabetes federation guidelines for waist circumference with cut off point 80 cm for women, 94 cm for men and 90 cm for Asian men) in this study (International Diabetes Federation, 2006).

Findings also indicated 75 females 75 (74.2 %) had waist circumference equal or above the ideal (80 cm); while 13 males (21.6%) had their waist circumference equal or above 94 cm. However, the hypertension prevalence rate showed a significant difference when low waist circumference and high waist circumference were compared, in females and in males with p value 0.04 and 0.03, respectively.

Using the waist-to-hip ratio cut off point of 0.8 for females and 1.0 for males, with regard to hypertension, there was statistical differences between low values and high values for females ($p = 0.04$), but no difference was observed in males ($p = 0.13$).

Participants were found to have waist circumference mean of 81.86 (95% CI: 78.37-85.35) and 91.30 (95% CI: 88.53-94.07) for males and females, respectively. 86 females (85.1%) had a waist-to-hip ratio equal or above the ideal (ratio 0.8); while only 3 males (5%) had their ideal ratio equal or above 1.

Table VIII: Distribution (mean (s.d.)) of anthropometric and BP measurements and BMI among study population

	Male N=60	Female N=101
	Mean (s.d) +/-	Mean (s.d) +/-
Weight (kg)	62.5 (12.5)	66.8 (16.4)
Height (cm)	165 (7.6)	157.5 (8.8)
BMI (kg/m²)	22.9 (4.7)	26.8 (6.1)
SBP (mm Hg)	127.2(17.1)	127.9 (21.5)
DBP (mm Hg)	79.5(11.9)	79.2(11.6)

Abbreviations: s.d., standard deviation; BMI, body mass index; BP, blood pressure; DBP, diastolic blood pressure; SBP, systolic blood pressure

Table IX: Frequency distribution of elevated blood pressure according to their BMI, waist circumference and waist hip ratio:

	Total n (%)	HPT* n (%)	Non HPT n (%)
Body mass index			
Underweight (≤ 18.4 kg/m²)	8 (4.9)	1(12.5) <i>Male: 1 Female: 0</i>	7(87.5)
Normal (18.5-24.9 kg/m²)	77(47.8)	15 (19.5) <i>Male: 7 Female: 8</i>	62 (80.5)
Overweight (25-29.9 kg/m²)	42(26.0)	18 (42.8) <i>Male: 7 Female: 11</i>	24 (57.2)
Obese (≥ 30 kg/m²)	34(21.1)	17(50.0) <i>Male: 2 Female: 15</i>	17(50.0)
Waist circumference**			
Female ≤ 79.9cm	26(25.7)	4(15.3)	22(84.6)
Female ≥ 80 cm	75(74.2)	30(40.0)	45(60.0)
Male ≤ 93.9 cm	47(78.3)	10(21.2)	37(78.7)
Male ≥ 94 cm	13(21.6)	7(53.8)	6(46.1)
Waist Hip Ratio (waist/ hip), n (%)			
≤ 0.79(female)	15 (14.8)	1(6.6)	14(93.3)
≥ 0.8 (female)	86 (85.1)	33(38.3)	53(61.6)
≤ 0.99(male)	57 (95)	15(26.3)	42(73.6)
≥ 1.0 (male)	3 (5.0)	2(66.6)	1(33.3)

*HPT= Hypertension

** Using International Diabetes Federation definition (2006) cut points 80 cm for women and 94 cm for men (90 cm for Asian men)

Hypertension underweight x normal weight, two-tailed Fisher's exact test, p = 1.00, uncorrected chi square, p = 0.64

Hypertension underweight x overweight, two-tailed Fisher's exact test, p = 0.23, uncorrected chi square, p = 0.14

Hypertension underweight x obese, two-tailed Fisher's exact test, p = 0.10, uncorrected chi square, p = 0.053

Hypertension normal weight x overweight, Yates corrected chi square, p = 0.029

Hypertension normal weight x obese, Yates corrected chi square, p = 0.002

Hypertension overweight x obese, Yates corrected chi square, p = 0.045

Hypertension female waist circumference ≤ 79.9 cm x Female ≥ 80 cm, Yates corrected chi square, p = 0.04

Hypertension male waist circumference $\leq 93.9\text{cm}$ x male $\geq 94\text{ cm}$ t, two-tailed Fisher's exact test, $p = 0.03$, uncorrected chi square, $p = 0.02$

Hypertension female Waist Hip Ratio ≤ 0.79 x Female ≥ 0.80 , Yates corrected chi square, $p = 0.04$

Hypertension male Waist Hip Ratio ≤ 0.99 x male ≥ 1.00 , two-tailed Fisher's exact test, $p = 0.13$, uncorrected chi square, $p = 0.19$

4.6 PHYSICAL ACTIVITY:

Findings indicated that the mean days of vigorous intensity activities were 5.23 days (95% CI: 4.07-6.366) and 4.844 days (95% CI: 4.20-5.48) for hypertensive and non hypertensive respondents, respectively; while the mean days of moderate intensity activities was 6.28 days (95% CI: 5.72-6.83) and 5.92 days (95% CI: 5.72-6.11) for hypertensive and non hypertensive respondents, respectively. As shown in table X, the result does not show association between frequency of hypertension and the different categories of physical activities ($p=0.22$ and $p=0.70$).

Table X: Physical activity

		HPT	Non HPT	Total	Statistically difference
Work involve vigorous-intensity activity that causes large increases in breathing or heart rate like for at least 10 minutes continuously	yes	14	44	58	Yates Corrected chi square $p=0.22$
	No	36	68	103	
Work involve moderate-intensity activity that causes large increases in breathing or heart rate like for at least 10 minutes continuously	Yes	36	65	101	Yates Corrected chi square $p=0.70$
	No	24	36	60	

CHAPTER 5 - DISCUSSION

5.1 INTRODUCTION:

In this study, the researcher examined the relationship between high blood pressure and an array of factors such as demographic, social behaviour, anthropometric characteristics and physical activity among the Kang population in Botswana. The findings were discussed in relation to the aim and objectives of the study and are explained where possible in relation to similar studies to develop inference. Thus, the findings from this study population may be different from the situation at the national level.

5.2 DEMOGRAPHIC CHARACTERISTICS:

In this study, the frequency of hypertension increased with age, with a more steep increase at the age group 55–64 years. Similar finding was reported in a population based study conducted in Addis Ababa in which significant linear association between age and SBP as well as DBP was stronger with SBP; $\beta = 0.59$, 95% CI (0.50, 0.68) in males and $\beta = 0.56$; 95% CI (0.45, 0.66) in females, than with DBP; $\beta = 0.20$, 95% CI (0.14, 0.26) in males and $\beta = 0.08$, 95% CI (0.02, 0.14) in females (Tesfaye *et.al*, 2009). These findings are supported by Beevers *et al.* (1987) who reported that after the age of 50, the diastolic blood pressure tends to fall or remain constant, whereas the systolic blood pressure rises consistently with age.

The reason of the rise of blood pressure with age can be attributed to multiple factors such as increase of social stress with age, hardening and shrinking of arteries, obesity as well as keeping of certain life style for long time.

This study failed to show association between hypertension and sex with a prevalence of 28.3% in males versus 33.6% in females, $p = 0.59$. This finding is supported by Tesfaye *et al.* (2009). In the later study, 31.5% of the males and 28.9% of the females had high blood pressure (defined as SBP/DBP $\geq 140/90$ or reported use of anti-hypertensive medication), there was no significant difference between males and females in the prevalence of high blood pressure ($P > 0.05$).

Dissimilar finding is reported in the South Africa's Demographic and Health Survey (SADHS) in 1998 (Steyn *et al.*, 2008). It was observed higher prevalence in women compare to men (51 percent versus 26 percent), using the definition of BP equal or above 140/90 mmHg. Bovet *et al.* (2002), in a study conducted in Tanzania, reported as well high prevalence in female compare to male aged 35 to 64 years. The age-adjusted prevalence (%) among was 30.2 and 27.1 for BP $\geq 140/90$ mmHg or antihypertensive medication, respectively for female and male. These studies did not assess the level of association between prevalence of high blood pressure and sex, so a conclusion cannot be drawn.

On the other end, some studies reported high prevalence of hypertension in Male compare to female. For example, Njelekela *et al.* (2009) observed 50% lower odds of hypertension among women compared to men, despite significantly higher rates of obesity.

5.3 PREVALENCE OF BLOOD PRESSURE:

The study found hypertension prevalence among the participants to be 31.6%. When comparing the prevalence in this study with that from other studies, other factors that might contribute to any observed difference should be taken into consideration.

Prominent among these are the age difference between studied subjects, variability in definition of hypertension (and cut-off level of blood pressure beyond which the disease is diagnosed), time of the study, and urban versus rural characteristics of the populations. Even though there was suggested standardization in methods for hypertension studies, different methods were used in the standardization. That created difficulties for proper comparisons among various populations.

A study conducted by Osibogun (1999) reported a prevalence of 36.9% among respondents in Ode-Remo (Nigeria). In the Heart of Soweto Study, 56% of predominantly black Africans who attended the cardiac clinic at a South African public hospital were diagnosed as hypertensive (Sliwa *et al.*, 2008).

A population based study in South Africa reported a prevalence of 25% among participants aged 15 years and older (Steyn *et al.*, 2008). Mollentze *et al.* (1995) reported that the prevalence of hypertension in an indigenous black population age 25 years and older, in the rural community of QwaQwa (Free State in South Africa) was 29%.

However, low prevalence compare to this study was reported in a population based survey in arid villages of Gachipura and Balarwa (desert part of Rajasthan, state in northwestern India) that reported a hypertension prevalence of 20.1% and 10.4%

respectively. This survey included the population from 15 years old (Haldiya *et al.*, 2005).

It is regrettable that the Botswana hypertension prevalence is not known. This is why studies of this nature are important to the government. Since 2008, the Botswana Ministry of Health in collaboration with the World Health Organization is undertaking a study on hypertension, diabetes and stroke among those aged 50 years and above. A cross-sectional study done in Botswana on self reported health elderly patients (aged 60 - 109 years), found 42% to be hypertensive (Clausent *et al.*, 2005).

This study also found an association between individuals who took oral drugs or injectable (like insulin) and those hypertensive participants who had been put on special diet with hypertension ($p=0.02$ and $p=0.01$, respectively). The association between hypertension and type II diabetes mellitus is known as they are part of the metabolic syndrome definition, since the incidence of hypertension is increased among diabetics (South Africa Hypertension, 2006; Swales *et al.*, 1991).

5.4 SOCIAL BEHAVIOUR:

5.4.1 Tobacco products use

Study finding indicated that the percentage of participants who reported that they were using tobacco products in this study was 31.3%. Similar prevalence of tobacco use was reported by Haldiya *et al.* (2005) in arid villages of Gachipura and Balarwa in Rajasthan (30%) and in a study conducted among Eastern Cape Province students in South Africa with 26% prevalence of smokers (Awotedu *et al.*, 2006).

In our study, smokeless tobacco like snuff was reported in 26% among tobacco users.

The use of tobacco products was not associated with an increase in prevalence of hypertension in this study ($p=0.46$). Similar finding was reported by Ayo-Yusuf *et al.*, (2008) in a study conducted among South African women. The later study failed to show a significant association between snuff use and hypertension. It indicated that heavy snuff use significantly increased BP to levels that have been shown to increase the risk for cardiovascular diseases at a population level and hypertension was more prevalent among snuff users than among non-users of snuff (23.9% vs. 17%; $p<0.001$). After adjusting for potential confounders, although current snuff use as compared to non-current use produced a dose response, it was not associated with a statistically significant increased risk for hypertension (OR = 1.12; 95% CI: 0.84-1.50).

However, dissimilar findings are reported. For example, Kumar *et al.* (2002), in a study conducted in India amongst the employees of a Mega-Industry of South Gujarat, reported that prevalence rates of hypertension were significantly high in persons consuming tobacco (29.6%, $p=.00001$).

Pandey *et al.* (2009) in a study conducted in India among smokeless tobacco users indicated that the prevalence of diastolic hypertension was significantly higher in exclusive smokeless tobacco users as compared to non users (40.9%, 22.9% ; $p = 0.01$) . Prevalence of systolic hypertension was higher in exclusive smokeless tobacco users too though this was not statistically significant (43%, 36.4%; $p = 0.39$).

5.4.2 Alcohol products use

In this study, no association was observed on prevalence of hypertension and the different categories of alcohol consumption. Xin *et al.* (2001) found that among patients whose alcohol consumption was high (20 to 40 standard drinks per week), reducing

alcohol consumption by at least 50 percent produced a 3.3 mm Hg reduction in SBP and 2.0 mm Hg reduction in diastolic blood pressure.

Dissimilarity to our finding is reported by an Indian study conducted amongst the employees of a Mega-Industry of South Gujarat in which prevalence rates of hypertension were significantly high in persons consuming alcohol (37.0%, $p=0.00001$) (Kumar *et al.*, 2002).

The study found that 54.8% of participants did not know how many drinks they took daily and for how many years they had been consuming alcohol. This can play major role in our finding in term of association between hypertension and alcohol consumption.

5.4.3 Fruits and vegetables consumption

The study found no association between the observed frequency of hypertension and different categories of fruits and vegetable consumption except in the group of participants who took fruits and vegetables 0-2 days per week ($p = 0.009$). A meta-analysis done by Streppel *et al.* (2005) on 24 randomized placebo-controlled trials published between 1966 and 2003 on the effects of fiber supplementation found an average fall of 1.2/1.3 mmHg with fiber intake (average dose of 11.5 g/day). More significant reductions were observed in older (greater than 40 years) and hypertensive individuals.

It was not part of the study to assess how much participants took fruits or vegetable per day in terms of servings. Therefore, in this regard, no conclusion could to be drawn.

5.5 ANTHROPOMETRIC MEASUREMENTS:

In this study, females were more obese compared to males. BMI calculations, waist circumference measurements and waist-to-hip ratio exceeded the healthy cut-off point values in females than in males. For example, the body mass index mean of females (26.8) was higher than the males one (22.9), 74.2 % of females were above the healthy

waist circumference cut-off point value compare to male 21.6 % and 85.1% females were above the healthy waist-hip ratio cut-off point value compare to males 5.0 %. Van Zyl *et al.* (2010) reported similar finding in a study conducted in Free State in South Africa. In the later study, 43.3 % females were obese compare to males (7.98 %), 55.8% of females were above the healthy waist circumference cut-off point value compare to males (8.6%); it used the ATP III with cut points of 88 cm for women and 102 cm for men (Southern Africa hypertension Guidelines, 2006; Grundy *et al.*, 2004). This finding of obesity in females compare to males could be explained by more sedentarily life style in females and hormonal factors. Furthermore, cultural believe like female beauty is associated with obesity and a slender build is associated with the stigma attached to the HIV/AIDS pandemic, and therefore people are less inclined to lose weight intentionally, so tending to promote obesity among Botswana women.

In this study, a significant association was observed between hypertension and anthropometric measurements such as BMI, waist circumference for both sex and waist to hip ratio for female (with $p = 0.04$, 0.03 and 0.04 , respectively). This finding is supported by previous studies. For example, Fuentes *et al.* (2000) have shown a relationship between obesity and high blood pressure; a 10 kilogram increase in body weight has been associated with a 3.0 mmHg higher systolic blood pressure and 2.3 mmHg higher diastolic blood pressure.

In a Quebec survey, sample was divided into tertiles of BMI and further stratified on the basis of the 50th percentile of WC (88 cm in men), non obese men in the first BMI tertile ($<23.2 \text{ kg/m}^2$) but with abdominal obesity were characterized by an increased systolic blood pressure (SBP) compared with non obese men with low WC (130 ± 18 versus 120 ± 11 mm Hg; mean \pm SD; $p=0.075$) (Poirier *et al.*, 2005).

However in another study, Tesfaye *et al.* (2007) reported that the prevalence of hypertension in the Ethiopian women did not vary markedly across BMI quintiles, suggesting that BMI might not be an important determinant of BP in this group.

5.6 PHYSICAL ACTIVITY:

The study found no association between hypertension and individuals who were not involved in vigorous-intensity activity or moderate-intensity activity ($p=0.22$ and $p=0.70$, respectively).

Dissimilar findings are reported in several studies. For example, Carnethon *et al.* (2010), in a study conducted in United States, reported that fitness and physical activity were each associated with incident hypertension, and low fitness might account for a substantial proportion of hypertension incidence. The magnitude of association between physical activity and hypertension was strongest among participants in the high fitness (hazard ratio: 0.80 [95% CI: 0.68 to 0.94]) category, whereas the magnitude of association between fitness and hypertension was similar across tertiles of physical activity. The estimated proportion of hypertension cases that could be prevented if participants moved to a higher fitness category (such as preventive fraction) was 34% and varied by race and sex group.

Kang residents are farmers in majority. This could explain why the findings indicated that the mean days of vigorous intensity activities were 5.23 days and 4.844 days for hypertensive and non hypertensive respondents, respectively; while the mean days of moderate intensity activities was 6.28 days and 5.92 days for hypertensive and non hypertensive respondents, respectively.

The failure of our study to support inverse association between vigorous-intensity activity or moderate-intensity activity and hypertension may be attributable to self-report and interviewer bias which could result in non differential misclassification.

CHAPTER 6 – CONCLUSIONS AND RECOMMENDATIONS

6.1 CONCLUSIONS:

The study, a population based cross-sectional trial, was conducted on adult residents of Kang (Botswana) from November to December 2008. A modified protocol based on World Health Organization (WHO) STEP wise instruments on chronic disease (Bonita, 2001) was used. The primary aim of this study was to investigate risk factors associated with high blood pressure in adult population of Kang (Kgalagadi North), Botswana.

The findings were shown and discussed. The results in this research are in agreement with some studies and in disagreement with findings of other studies.

The study participants were between 20 and 82 years old. The frequency of hypertension increased with age, with a more steep increase at the age group 55–64 years.

The study found hypertension prevalence among the participants to be 31.6%. When comparing the prevalence in this study with that from other studies, other factors that might contribute to any observed difference should be taken into consideration.

However, it is regrettable that the Botswana hypertension prevalence is not known. This is why studies of this nature are important to the government.

Study findings indicated that the percentage of participants who reported that they were using tobacco products in this study was 31.3%.

No association was observed on prevalence of hypertension and the different categories of alcohol consumption. However, in this study, 54.8% participants did not know how many drinks they took daily and for how many years they had been consuming alcohol. This makes it difficult to conclude in terms of association between hypertension and alcohol consumption.

The study found no association between the observed frequency of hypertension and different categories of fruits and vegetable consumption except in the group of participants who took fruits and vegetables 0-2 days per week ($p = 0.009$). It was not part of the study to assess how much participants took fruits or vegetable per day in terms of servings. Therefore, in this regard, no conclusion could to be drawn.

In this study, a significant association was observed between hypertension and anthropometric measurements such as BMI, waist circumference and waist to hip ratio. This finding is supported by some studies while other disagreed.

The study found no association between hypertension and individuals who were not involved in vigorous-intensity activity or moderate-intensity activity.

Some participants were probably misclassified as they could not recall for how long they had used tobacco products; how much alcohol they took per day, and for how long in their life they had been consuming alcohol; and also how much fruits and vegetables they were taking per week.

6.2 RECOMMENDATIONS:

Based on the findings of this survey, the researcher recommends the following:

- Placing emphasis on the increased burden of non communicable diseases in Botswana communities during health planning.
- The high prevalence of hypertension; and the possible association with age, anthropometric measurements such as BMI, waist circumference; necessitates that the Botswana health system should put more efforts towards the prevention of hypertension in populations, along with early detection and treatment of individuals with high overall risk of cardiovascular disease.
- Until such time that regular screening for hypertension risk factors become feasible in Botswana, opportunistic screening for hypertension should be promoted at every contact with healthcare providers.
- More attention should be directed towards better control of the disease and towards studying and enhancing compliance. While the effective role of patient education about the disease for improving compliance is debatable, other approaches such as behaviour modification techniques and physician education seem promising.
- Carrying out a follow-up study to investigate risk factors associated with high blood pressure in the adult population of Botswana, with a large sample and community based, using WHO STEP wise approach.

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APPENDIX1: PROTOCOL OF RESEARCH

0. Background:

The true burden of high blood pressure in sub-Saharan Africa remains largely unmeasured.¹ Many people with hypertension are asymptomatic and unaware of their illnesses; screening may help to identify some of the hypertensive individuals. Therefore, sustainable and aggressive population-based programs for high blood pressure awareness, prevention, treatment, and control are keys of success in limiting this epidemic is central¹

Kang is a village of Kgalagadi District of Botswana (latitude: 23.75°S and longitude: 22.83°E).² It is situated in the Kalahari Desert with calcisols soils (sand clay soils, moderately deep and poorly drained) not conducive for agriculture. The population was 3,744 according to 2001 census; while the projected population in 2008 is about 5076 in the Kang catchments area.

The communities are largely rural. Nevertheless, some enjoy many of the facilities of modern life, such as electricity and cars, while retaining their basic dietary and social habits (use of tobacco product, drinking alcohol...). Houses are generally of lower hygienic standards compared to those of urban communities. The predominant source of drinking-water is wells. All houses dispose of sewage in septic tanks just outside the houses. House refuse is collected in plastic bags and placed outside houses for collection by municipal trucks. Cow meat (salty) and mealy meal constitute the major dietary items. Health services are provided by Kang Clinic, a primary health care centre, that operates 24 hours. It has a 24 bed capacity (in patient ward and maternity). The

main source of income is cattle farming. Some communities are still very traditional and do hunting as source of food even though discouraged by the Botswana Government.

1. The study problem (rationale of the study):

The study intends to determine the Kang Adult population high blood pressure prevalence and the relationship between high blood pressure and their life style (associated risk factors) like meat salty diet with not fruits and vegetable, use of tobacco product and alcohol consuming habit...

The study will be an attempt to contribute as a population-based prevalence on high blood pressure in sub-Saharan Africa especially in rural population living in desert environment.

2. Literature Review:

Hypertension is defined as systolic blood pressure (SBP) of 140 mm Hg or greater, diastolic blood pressure (DBP) of 90 mm Hg or greater or taking antihypertensive medication.⁴

The objective of identifying and treating high blood pressure is to reduce the risk of cardiovascular disease and associated morbidity and mortality. To that end, it is useful to provide a classification of adult blood pressure for the purpose of identifying high-risk individuals and to provide guidelines for follow up and treatment.

The positive relationship between SBP and DBP and cardiovascular risk has long been recognized. Therefore, although classification of adult blood pressure is somewhat arbitrary, it is useful to clinicians who must make treatment decisions based on a constellation of factors including the actual level of blood pressure. Table 1 provides a classification of blood pressure for adults (age 18 and older). These criteria are for

individuals who are not taking anti-hypertensive medication and who have no acute illness. ⁴

This classification is based on the average of two or more blood pressure readings taken in accordance with the following recommendations at each of two or more visits after an initial screening visit.

When SBP and DBP fall into different categories, the higher category should be selected to classify the individual's blood pressure. ⁴ The classification is slightly modified from the JNC 7 report in that stage 3 and stage 4 hypertension are now combined because of the relative infrequency of stage 4 hypertension. ⁴

Table 1: Classification of blood pressure for adults (age 18 and older)

Normal	High Normal	Stage 1	Stage 2	Stage 3
SBP 120-129	SBP 130-139	Mild hypertension	Moderate hypertension	Severe hypertension
Or	Or	SBP 140-149	SBP 150-159	SBP ≥160
DBP 80-84	DBP 85-89	Or	Or	Or
mmHg	mmHg	DBP 90-99	DBP 100-109	DBP ≥ 110
		mmHg	mmHg	mmHg

Generally, the prevalence in developed countries is higher compare to developing counties. In the United States of America prevalence of 24% was found in populations aged 18 years and older studied in a recent national survey), ⁵ Black men had the highest adjusted prevalence of high blood pressure (32%). ⁵ While a study of middle-aged populations in Mexico City and in San Antonio, Texas found hypertension prevalence of 17.1% in Mexican men and 17.4% in Mexican women. ⁵

The prevalence in South Africa is around 25% among the adult population; ⁶ while Mostafa A. *et al* showed an overall prevalence was 11.1 % in Saudi Arabia. ⁷

Although reliable, large-scale, population-based data on high blood pressure in sub-Saharan Africa (SSA) are limited, recent studies provide important and worrisome findings in both epidemiology and clinical outcomes.⁸

Although overall hypertension prevalence is between 10%-15%, prevalence rates as high as 30%-32% have been reported in middle-income urban and some rural areas. Importantly, hypertension awareness, treatment, and control rates as low as 20%, 10%, and 1%, respectively have also been found.¹

Although the true burden of high blood pressure in sub-Saharan Africa remains largely unmeasured, compelling preliminary evidence suggests that it is the foundation for epidemic cardiovascular disease in Africa and already contributes substantively to death and disability from stroke, heart failure, and kidney failure in this region. Success in limiting this epidemic in sub-Saharan Africa will depend heavily on the implementation of sustainable and aggressive population-based programs for high blood pressure awareness, prevention, treatment, and control. It will be critical to obtain investments in improved surveillance and program-relevant research to provide the evidence base for policy development and effective hypertension prevention and control.

Many people with hypertension are asymptomatic and unaware of their illness; screening may help to identify some of the hypertension individuals.

It is known that cigarette smoking, obesity (body mass index ≥ 30 kg/m²

physical inactivity, dyslipidemia, microalbuminuria or estimated GFR < 60 mL/min, age (older than 55 for men, 65 for women), family history of premature cardiovascular disease (men under age 55 or women under age 65) are positively and independently associated with morbidity and mortality from hypertension, cardiovascular disease, type II diabetes mellitus and other chronic diseases.⁴ Some studies have documented a

consistent, but modest association between BMI and blood Pressure (BP), whereas others suggested a BMI threshold at which level the relationship with BP begins. Correlations between BMI and BP in very lean populations in Africa and Asia have also been reported in earlier studies. ¹

3. Purpose of the study:

To determine the risk factors associated with high blood pressure in the adult population of Kang (Kgalagadi North, Botswana)

4. Objectives:

4.1. To determine the demographic details of the population

4.2. To measure the blood pressure in adult Kang population

4.3. To enquire on the population social behaviour (e.g. alcohol, smoking)

4.4. To determine the population anthropometric measures

4.5. To enquire on the population's physical activity

4.6. To determine relationship between high blood pressure and the identified associated risk factors in this population.

5. Research Question:

What are the risk factors associated with high blood pressure in the adult population of Kang (Kgalagadi North, Botswana)?

6. Design

A cross-sectional descriptive study

7. METHODS

7.1. Materials

The following equipment and instruments will be used:

- Electronics Blood Pressure machines (Welch Allyn OSZ 4 and 5)
- Tape meters (calibrated in centimetres)
- Electronic Bathroom scale (in kg)
- Wood stick: for height measurement (in meter).
- Show cards: for illustration, as a sample when asking question.
- Forms: for data collection.
- Computer and Printer

7.2. Sample/Study population:

The study population will be enrolled among the adult resident of Kang (18 year-old and above), picked randomly (every 32 houses). The estimate population is 5076.

The minimum sample size of 161 was calculated using Epi info Version 6 [Confidence Level 99%, expected frequency 50% (because of unknown prevalence) and worse acceptable 40%].

7.3. Inclusion Criteria

1. Subjects above 18years old
2. Subjects who consent to be recruited into the study.
3. Subjects who are already on treatment for hypertension will be included.

7.4. Exclusion Criteria

1. Subjects who refuse recruitment
2. Subjects with known physiological abnormalities, e.g. pregnancy, Cushing syndrome, Addison's disease.

3. Subjects with gross anatomical deformities of the arms (to be used for BP measurement)

7.5. Method of data collection:

BP will be measured, according to WHO guidelines.^{5, 9} In addition, participants will be asked whether they were taking any medications for the treatment of hypertension. Average systolic BP (SBP) and diastolic BP (DBP) will be determined from the second and third measurements.

Hypertension was defined as SBP \geq 140 mm Hg or DBP \geq 90 mm Hg or self-reported use of antihypertensive medication, with adaptation of the recent WHO definitions.

1. Participant sits at a table quietly with both feet flat on the floor and with the back supported. The bladder should be empty. The room should be comfortable and noise minimized. No tobacco products, alcohol, or caffeine should have been consumed within the previous 30 minutes. If this is not possible, it should be noted in the data.
2. The right arm, which should be bare, is placed on the table (at heart level) slightly flexed, with the palm upward. The screener should be in position to see the manometer at eye level.
3. Determine arm circumference and select and wrap appropriate cuff size. The lower edge of the cuff must be 2.5 cm above the elbow joint.
4. Wait 5 minutes. Inflate the cuff while palpating the radial pulse to the point where it disappears (estimated systolic pressure).
5. Now inflate the cuff to about 20mmHg above the estimated systolic blood pressure. Auscultate the systolic and the diastolic blood pressures as the cuff is being deflated at the rate of 2mmHg per minute.

6. Finish deflation, then raise participant's arm above heart level for 15 seconds. Rest for one minute and then perform the measurement procedures two more times. Use the mean of the last two measurements.

These are requirement because of automated devices use. Digital automatic apparatus will avoid bias in recording blood pressure and pulse.

Weight and height will be measured with participants standing without shoes and wearing light clothing. Weight will be measured using an electronic bathroom type. Participants stand upright with the head in Frankfort plane for height measurement. Height will be recorded to the nearest 0.5 cm, and weight will be recorded to the nearest 100 g.

BMI will be calculated as weight in kilograms over height in meters squared [BMI = (mass)/ (height)² = kg (m)²]. The conventional BMI cut off point as well as the recent WHO recommendation of BMI cut off points for Asian populations will be used as applicable. The distribution of mean SBP and DBP and hypertension across BMI quintiles will determined separately for male and female subjects. It is believed that the use of conventional cut off points along with the distribution of BMI within the respective populations are complementary to each other, and would enable to examine the BMI–BP relationship from different perspectives.

Data will be collected using the questionnaire (see appendix 2), through physical measurements of weight, height and BP, using the WHO STEPS instruments.¹⁰

The questionnaire is translated in Setswana by someone with expertise. Data will be collected by a team of five health auxiliaries from Kang clinic with five additional lay

assistants hired from the village. Blood pressure will be measured for every individual in three consecutive weeks.

7.6. Analysis:

The WHO-CDC Epidemiologic Information (EPI Info 2004) statistical software will be used to enter data into a computer and for data analysis. Mean values of BP, weight, height and BMI will be determined. The population will be classified based on behavioral measurements, BMI quintiles and other conventional cut-off points. Distribution of mean BP and prevalence of hypertension at different behavioral measurements, BMI levels will be also presented.

The collected data will be stored in a database Epi info and analyzed. Simple analysis of variance will be used to compare the mean differences of systolic or diastolic BP between groups, according to sex, age and nutritional status. The chi-square test and Fisher's exact test will be used to compare prevalence differences in normal-high or high BP between the groups.

A p value < 0.05 will be considered to be statistically significant for all tests.

7.7 Reliability, validity and Objectivity:

The BP will be measured using a digital automatic apparatus (Welch Allyn OSZ 4 and 5). Test-retest reliability of the BP and anthropometric measurements will be assessed.

7.8 Bias:

Bias will be minimized as follows:

Selection bias: Although subjects will be selected randomly as outlined above, pregnancy and any obviously gross physical deformities will be excluded. Three

measurements will be taken with intervals of three minutes between consecutive measurements.

Inter-observer bias: Training will be conducted before the survey to enable the team on methods of identifying eligible study subject, appropriate methods of interviewing as well as measurement of BP, weight and height (in a standardized manner).

At the end of the training, a pilot study will be carried out on ten subjects (these will be excluded in the main study) to assess the standardization.

Interviewers will be sex-matched with respondents.

8. ETHICAL CONSIDERATION:

Written Informed consent will be obtained from each subject after the study purpose has been outlined. Ethical clearance for the study will be obtained from the Medunsa Campus Research and Ethics Committee (MCREC) of the University of Limpopo, the Botswana Ministry of Health and the Kgalagadi District Council. Subjects will be informed that their identity will be concealed. The information obtained through this study will serve for purposes of this study only, as outlined in the protocol. Refusal to participate in the study will not be used against the individual concerned. Should the individual decide to quit while the study is in progress, s/he will be free to do so and no questions will be asked.

9. IMPLEMENTATION:

The proposed Schedule:

1. Ethical Clearance: Sep 2008 to Oct 2008
2. Logistics and Training of Team: End of Nov 2008

3. Data collection: Dec 2008 - Jan 2008

4. Analysis: Feb 2008

5. Submission: Mar 2009

Budget:

	Items	Quantity/ Number	Status	Unit Price/ Allowances(Pula)	Total(Pula)
Logistics	Electronics BP machines	5	Available	N/A	N/A
	batteries	40		10	400
	Tape meters	15		20	300
	Electronic Bathroom scale	5		200	1000
	Wood stick	5		50	250
	Plain papers	10 rimes		30	300
	Printer cartridges	2		500	1000
	Diet SHOWCARD	5	Available	N/A	N/A
Team	Health auxiliaries	5	Available in Kang Clinic	115 X 3	1745
	Volunteers	5		115 X 3	1745
Statistician: For data analysis					2000
Total					6950

The study will be entirely financed by the researcher.

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APPENDIX 2: QUESTIONNAIRE

Participant Identification Number

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STEPS Instrument

Survey information

Location and Date		Response	
1	District code	24	I1
2	Interviewer Identification		I2
3	Date of completion of the instrument		I3
		dd mm year	

Participant Identification Number			
Consent, Interview Language and Name		Response	Code
4	Consent has been read out to participant. <i>A motho yo o arabang o tthaloseditswe ka botlalo ka patlisiso e a bo a dumalana</i>	Yes--- 1 No -----2 If NO, read consent	I4
5	Consent has been obtained (verbal or written). <i>A o dumetse (ka molomo kana ka mokwalo)</i>	Yes ---1 No--- 2 If NO, end	I5
6	Interview Language (English or Setswana) <i>Go dirisitswe (Sekgowa, Setswana)</i>	English----- 1 Setswana---- 2	I6
7	Time of interview (24 hour clock)		I7
		Hrs min	
8	Identity (<i>Omang</i>) or Passport number		I8

Step 1**Demographic Information**

CORE: Demographic Information		
Questions	Response	Code
9	Sex (<i>Record Male / Female as observed</i>)	C1
	Male -----1 Female-- 2	
10	What is your date of birth? <i>Letsatsi la gago la matsalo ke leng?</i>	C2
	<div style="text-align: center;"> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> </div> <div style="text-align: center;"> dd mm yyyy </div> <p><i>Don't Know 77 777 7777</i></p> <p><i>If known, go to C4</i></p>	
11	How old are you? <i>O ngwaga di kae?</i>	C3
	Years <input type="text"/> <input type="text"/>	

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Step 1	Behavioural Measurements
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CORE: Tobacco Use

Now I am going to ask you some questions about various health behaviours. This includes things like smoking, drinking alcohol, eating fruits and vegetables and physical activity. Let's start with tobacco.

Jaanong ke tlaa go botsa dipotso tse di itebagangtseng ie tsa botsogo, jaaka go goga, go nwa bojalwa, go ja mero go le maungo, le go itshidila. A re simolole ka motsoko.

Questions		Response	Code
12	Do you currently smoke any tobacco product or use any smokeless tobacco such as <i>snuff</i> ? <i>A o goga motsoko kana peipi?</i>	Yes ----1 No-----2 <i>If No, go to T5</i>	T1
13	If Yes , do you currently use tobacco products daily ? <i>Fa o dumetse, gore o a goga, A o goga tsatsi le tsatsi?</i>	Yes ----1 No-----2 <i>If No, go to T5</i>	T2
14	Do you remember how long ago it was? <i>A o ga kekgelwa gore go lobaka le le kae o goga?</i> (RECORD ONLY 1, NOT ALL 3) Don't remember 777	In Years <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <i>If Known, go to T4a</i> OR in Months <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <i>If Known, go to T4a</i> OR in Weeks <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>	T3
15	On average, how many of the following do you smoke each day? <i>Tiriso ya motsoko mo letsatsing?</i> (RECORD FOR EACH TYPE) Don't remember 777	Manufactured cigarettes <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> Hand-rolled cigarettes <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> Other <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <i>If other, go to T4 other</i> Other (please specify): <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>	T4a T4b T4c T 4 other

16	<p>How long ago did you stop using tobacco products daily?</p> <p><i>Fa oneo goga tsatsi le letsatsi, o emisitse go goga tsatsi le letsatsi leng?</i></p> <p><i>(RECORD ONLY 1, NOT ALL 3)</i></p> <p>Don't remember 777</p>	<p>Years ago</p> <p> _ _ _ </p> <hr/> <p>OR</p> <p>Months ago _ _ </p> <hr/> <p>OR</p> <p>Weeks ago _ _ </p>	T5

CORE: Alcohol Consumption

The next questions ask about the consumption of alcohol.

Jaanong ke tsile go go botsa ka tiriso ya nnotagi.

Questions	Response	Code
<p>17</p> <p>Have you consumed alcohol (such as beer, wine, spirits, chibuku, khari) within the past 12 months?</p> <p><i>Ao kile wa nwa nnotogi mo kgweding tse lesome le bobedi tsemi fetileng (biri, mofine, chibuku khadi)?</i></p>	<p>Yes ----1</p> <p>No-----2 <i>If No, go to D1</i></p>	<p>A1</p>
<p>18</p> <p>In the past 12 months, how frequently have you had at least one drink?</p> <p><i>Mo lobakeng lwa dikgweditsemi lesome le bobedi ke makgwetho ale kae o nole gangwe fela?</i></p>	<p>Daily -----1</p> <p>5-6 days per week -----2</p> <p>1-4 days per week -----3</p> <p>1-3 days per month -----4</p> <p>Less than once a month ----5</p>	<p>A2</p>
<p>19</p> <p>When you drink alcohol, on average, how many drinks do you have during one day?</p> <p><i>Fa o lebile o nwa ga kae mo letsatsing?</i></p>	<p>Number <input type="text"/></p> <p>Don't know 77</p>	<p>A3</p>
<p>20</p> <p>During each of the past 7 days, how many standard drinks of any alcoholic drink did you have each day?</p> <p><i>Mo malatsing a supa aa fetilang o nele ga kae, mehuta ya dino ee faroleganaeng?</i></p> <p>(RECORD FOR EACH DAY)</p> <p>Don't Know 77</p>	<p>Monday <input type="text"/></p>	<p>A4a</p>
	<p>Tuesday <input type="text"/></p>	<p>A4b</p>
	<p>Wednesday <input type="text"/></p>	<p>A4c</p>
	<p>Thursday <input type="text"/></p>	<p>A4d</p>
	<p>Friday <input type="text"/></p>	<p>A4e</p>
	<p>Saturday <input type="text"/></p>	<p>A4f</p>
	<p>Sunday <input type="text"/></p>	<p>A4g</p>

CORE: Diet

The next questions ask about the fruits and vegetables that you usually eat.

Potso tse di latelang ketse di itebagantseng le merogo le maungo ao a ajang mo letsatsing. O arabe o itebagantse le gore o jang mo bekeng mo ngwageng ee fetileng.

Questions		Response	Code
21	In a typical week, on how many days do you eat fruit ? <i>Mo bekeng o ja maungo ga kae?</i>	Number of days _ _ Don't Know 77	D1
22	In a typical week, on how many days do you eat vegetables ? <i>Mo bekeng o ja merogo ga kae?</i>	Number of days _ _ Don't Know 77	D2

CORE: Physical Activity

Next I am going to ask you about the time you spend doing different types of physical activity in a typical week. Please answer these questions even if you do not consider yourself to be a physically active person. Think first about the time you spend doing work. Think of work as the things that you have to do such as paid or unpaid work, household chores, harvesting food/crops, and hunting for food, seeking employment.

Tsedi latelang dipotso ke tsa itshidilo, gore o itshidila ga kae mo bekeng. Tsweetswe araba fela lefa ose motho yo o itshidilang. O akanye nele ka gore o bereka lobaka lolo kae. Go bereka ekatswa ele tiro nngwe le le ngwe; ee dwelweng, ee sa dweleng, o bala kana o kwala, o itshidila kwa masimo, o tsoma kana o bapala dijo, go batla mmereko le tsone tsamo lwapeng tota.

Questions	Response	Code
<p>23 Does your work involve vigorous-intensity activity that causes large increases in breathing or heart rate like [carrying or lifting heavy loads, digging or construction work] for at least 10 minutes continuously?</p> <p><i>A tiro ya gago ke ee tseneletseng ee tlhokang tiriso ya maatla a mantsi ee leng gore o eketsa go itaya ga pelo lego hema jaaka [go kuka dilo tse di bokete, go epa, tiro ya kago] e bile oe bereka go feta metsotso ee lesome?</i></p>	<p>Yes ----1</p> <p>No-----2 If No, go to P 3</p>	P1
<p>24 In a typical week, on how many days do you do vigorous intensity activities as part of your work?</p> <p><i>Mo bekeng ke malatsi ale kae ao dirang tiro ee tseneletseng ee batlang tiriso ya maatla a mantsi, mme ele tsela eo berekang ka yone fela?</i></p>	<p>Number of days <input type="text"/></p>	P2
<p>25 Does your work involve moderate-intensity activity that causes small increases in breathing or heart rate such as brisk walking [or carrying light loads] for at least 10 minutes continuously?</p> <p><i>A tiro ya gago ke ee fa gare ee sa tlhokeng tiriso ya maatla aa tseletseng jaaka go tsamaya le go kuka dilo tsedi seng bokete thata, go feta metsotso ee lesome. Tiro ee eng gore go itaya ga pelo le go hema gago kwa go dimo thata?</i></p>	<p>Yes ----1</p> <p>No-----2</p>	P3
<p>26 In a typical week, on how many days do you do moderate intensity activities as part of your work?</p> <p><i>Mo bekeng ke malatsi ale kae a eleng gore tiro e o e dirang ke ee fag are ee sa tsenelelang thata?</i></p>	<p>Number of days <input type="text"/></p>	P4

Travel to and from places

The next questions exclude the physical activities at work that you have already mentioned.

Now I would like to ask you about the usual way you travel to and from places. For example to work, for shopping, for hunting, to cattle post, to place of worship...

Dipotso tse di latelang gadi amane le ditiro tseo di dirang kwa mmerekong tseo setseng o dibuile. Jaanong ke batla go itse gore o dirasa eng goya kwa mafelong aa faleroganyeng; go ya kwa tirong, go ya dishopong, go ya ko morakeng, go ya dikerekeng le gone go eta tota.

27	<p>Do you walk or use a bicycle (<i>pedal cycle</i>) for at least 10 minutes continuously to get to and from places?</p> <p><i>Go ya kwa mafelong aa farologaneng a oa tsamaya kona o dirasa baesekele metsotso ee lesome?</i></p>	<p>Yes ----1</p> <p>No-----2</p>	P5
28	<p>In a typical week, on how many days do you walk or bicycle for at least 10 minutes continuously to get to and from places?</p> <p><i>Mo bekeng ke malatsi ale kae a eleng gore oa tsamaya kana palama baesekele go ya kwa mefelong aa farologanyeng go feta metsotso ee lesome?</i></p>	<p>Number of days <input type="text"/></p>	P6

Recreational activities

The next questions exclude the work and transport activities that you have already mentioned.

Now I would like to ask you about sports, fitness and recreational activities (leisure).

Dipotso tse di latelang gadi tsenye sepe se retseng re buile ka sone. Jaanong ke batla go itse ka dilo tsa metshameko, tsa itshidilo le tsa itloso bodutu ka go farologana.

29	<p>Do you do any vigorous-intensity sports, fitness or recreational (<i>leisure</i>) activities that cause large increases in breathing or heart rate like [<i>running or football,</i>] for at least 10 minutes continuously?</p> <p><i>Ao etle o diri tse di tseheletseng tse di oketsang go itaya ga pelo le go hema jaaka kgwele ya dinao le go taboga odi dira metsotso ee fetang lesome kana go feta?</i></p>	<p>Yes ----1</p> <p>No-----2 <i>If No, go to P 9</i></p>	P7
30	<p>In a typical week, on how many days do you do vigorous intensity sports, fitness or recreational (<i>leisure</i>) activities?</p> <p><i>Mo bekeng ke malatsi ale kae a eleng gore o dira tiro tse di tseheletseng tsa metshameko, itshidilo le tsa itloso bodutu ka go farologana?</i></p>	<p>Number of days <input type="text"/></p>	P8

31	<p>Do you do any moderate-intensity sports, fitness or recreational (<i>leisure</i>) activities that cause a small increase in breathing or heart rate such as brisk walking for at least 10 minutes continuously?</p> <p><i>Ao dira itshidilo ee fa gare ya go hema le go itaya mo ga pelo go seng kwa godimo jaaka go tsamaya, kgwele ya dinao le go thuma o di dira metsotso ee lesome?</i></p>	<p>Yes ----1</p> <p>No-----2</p>	P9
32	<p>In a typical week, on how many days do you do moderate-intensity sports, fitness or recreational (<i>leisure</i>) activities?</p> <p><i>Mo bekeng itshidilo ee fa gare e, oe dira ga kae? Metshameko letsa itloso bodutu kagoo farologana)</i></p>	<p>Number of days <input type="text"/></p>	P10

Expanded: History of Raised Blood pressure and Diabetes			
Questions	Response	Code	
33	When was your blood pressure last measured by a health professional? <i>La bofelo o tlhatlhobelwa madi a matona ko ba botsogo ke leng?</i>	Within past 12 months -----1 1-5 years ago -----2 Not within past 5 years-----3	H1
34	During the past 12 months have you been told by a doctor or other health worker that you have raised blood pressure or hypertension? <i>A mo kgweding tse lesome le bobedi tsemi fetileng ao kile wa bolelwa fa madi a gago a tsholetsegile kana wa bolelwa fa o lo motho wa madi a matona ke ba botsogo?</i>	Yes-----1 No-----2	H2
35	Have you had your blood sugar measured in the last 12 months? <i>A o kile wa tlhatlhobelwa sukiri mo kgweding tse lesome le bobedi tse di fetileng</i>	Yes-----1 No-----2	H3
36	During the past 12 months, have you ever been told by a doctor or other health worker that you have diabetes? <i>Mo dikgweding tse di lesome le bobedi tsemi fetileng a o kile wa bolelwa ke bangwe ba botsogo ka na ngaka gore ona le bolwetse jwa sukiri?</i>	Yes-----1 No-----2	H4
37	During the last 2 weeks, did you take oral drug (medication) or injection (like Insulin)? <i>A o kilewa nwa dipilisi tsemi tsewang ka legano mo bekeng tse pedi tsemi fetileng</i>	Yes-----1 No-----2	H5
38	Special prescribed diet <i>A o kgethetswe dijo dingwe</i>	Yes-----1 No-----2	H6
39	Advice or treatment to lose weight <i>Ao gabolotswe kana omo kalafing go fokotsa mmele</i>	Yes-----1 No-----2	H7
40	Advice or treatment to stop smoking <i>Ao gabolotswe kana omo kalafing go emisa motsoko</i>	Yes-----1 No-----2	H8
41	Advice to start or do more exercise <i>Ao gabolotswe go simolola go itshidila kana gatwe</i>	Yes-----1 No-----2	H9

	<i>o dire itshidilo ee tseheletseng</i>		
42	Are you currently taking any herbal or traditional remedy for your diabetes? <i>Oa tsaya kalofi ya sukiri mogo ba setso</i>	Yes-----1 No-----2	H10

Participant Identification Number

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Step 2	Physical Measurements
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CORE: Height and Weight			
Questions		Response	Code
43	Interviewer ID	<input type="text"/>	M1
44	Device IDs for height and weight	Height <input type="text"/>	M2a
		Weight <input type="text"/>	M2b
45	Height	In Centimetres (cm) <input type="text"/>	M3
46	<i>Weight</i> <i>If too large for scale, code 666.6</i>	In Kilograms (kg) <input type="text"/>	M4
47	(For women) Are you pregnant? <i>(Basadi) A o imile?</i>	Yes 1	M5
		No 2 <i>If Yes, go to M 8</i>	
CORE: Waist			
48	Device ID for waist	<input type="text"/>	M6
49	Waist circumference	In Centimetres (cm) <input type="text"/>	M7
CORE: Blood Pressure			
50	Interviewer ID	<input type="text"/>	M8
51	Device ID for blood pressure	<input type="text"/>	M9
52	Cuff size used	Small 1	M10
		Medium 2	
		Large 3	
53	Reading 1	88 ^s ystolic (mmHg) <input type="text"/>	M11a

		Diastolic (mmHg) <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>	M11b
54	Reading 2	Systolic (mmHg) <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>	M12a
		Diastolic (mmHg) <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>	M12b
55	Reading 3	Systolic (mmHg) <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>	M13a
		Diastolic (mmHg) <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>	M13b
56	<p>During the past two weeks, have you been treated for raised blood pressure with drugs (medication) prescribed by a doctor or other health worker?</p> <p><i>Mo bekeng tse pedi tse di fetileng, a o kile wa alafelwa madi a matona ke ngaka kana mooki ka dipilisi?</i></p>	<p>Yes-----1</p> <p>No-----2</p>	M14

Expanded: Hip Circumference and Heart Rate			
Questions		Response	Code
57	Hip circumference	In Centimetres (cm) <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>	M15
Heart Rate			
58	Reading 1	Beats per minute <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>	M16a
59	Reading 2	Beats per minute <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>	M16b
60	Reading 3	Beats per minute <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>	M16c

APPENDIX 3: CONSENT FORM

UNIVERSITY OF LIMPOPO (Medunsa Campus) CONSENT FORM

Statement concerning participation in a Research Project.

Mafoko a a lebaganeng batsaya karolo mo tshekatshekong

Name of / Study (*Leina la patlisisong/ tshekatshekong*)

**Risk factors associated with high blood pressure in the adult population of Kang (Kgalagadi
..North, Botswana).....**

Dilo tsemi ka bayang motho mo boraing jo bo amanang le bolwetse jwa madi a matona mo

I have read the information on or heard the aims and objectives of the proposed study and was provided the opportunity to ask questions and given adequate time to rethink the issue. The aim and objectives of the study are sufficiently clear to me. I have not been pressurized to participate in any way.

Ke badile ka botlalo ka tshekatsheko/pitisiso e e tla dirwang, kafiwa sebaka sa go botsa dipotso le nako ya go ikakanya. Ke tloganya maitlano le maikaelelo a pakisiso e, mme ga ke a patelediwa go tsaya karolo.

I understand that participation in this Clinical Study is completely voluntary and that I may withdraw from it at any time and without supplying reasons. This will have no influence on the regular treatment that holds for my condition neither will it influence the care that I receive from my regular doctor.

Ke tloganya gore go tsaya karolo mo patlisiso / tshekatsheko e ke boithaopi jwa me, mme ke kgona go ikogela morago kana go gana go tswelala le patlisisong/ tshekatshekong e ke sa tlamege go ntsha mabaka. Ke thaloganya gore se se ka seke se ame ka gope go bona kalafi le thuso ya bongaka jwa me.

I know that this Study has been approved by the Research, Ethics and Publications Committee of Faculty of Medicine, University of Limpopo (Medunsa Campus) / Dr George Mukhari Hospital. I am fully aware that the results of this results of this Trial / Study / Project* will be used for scientific purposes and may be published. I agree to this, provided my privacy is guaranteed.

Ke tloganya fa patlisisong/ tshekatshekong e e letleletswe ke ba Research, Ethics and Publications Committee of Faculty of Medicine, University of Limpopo (Medunsa Campus). Ke thalonyanya gape gore maduo a patlisiso / tshekatsheko e a tsile go dirisiwa a bo a ka anamisiwa mo ditsheka tshekong tsa boranyane. Ke dumalana le tse tsotlhe, fe la fa sephiri sa me se ka sireletsega.

I hereby give consent to participate in this Study.

Ka jalo kefa tetla ya go tsenelela patlisiso / tshekatsheko e.

.....

Name of patient/volunteer

Signature of patient

Leina la Moithaopi

Monwana wa moithaopi

.....

Place (*Lefelo*)

Date (*Letsatsi*)

Witness (*Mosupi*)

Statement by the Researcher

I provided verbal and/or written* information regarding this Trial / Study / Project*

I agree to answer any future questions concerning the Trial / Study / Project* as best as I am able.

I will adhere to the approved protocol.

DR STEPHANE TSHITENGE

.....

Name of Researcher

Signature

Date

Place

APPENDIX 4: CLEARANCE CERTIFICATE MREC

UNIVERSITY OF LIMPOPO

Medunsa Campus



MEDUNSA RESEARCH & ETHICS COMMITTEE

CLEARANCE CERTIFICATE

MEETING: 07/2008

PROJECT NUMBER: MREC/M/173/2008: PG.

PROJECT :

Title: Risk factors associated with high blood pressure in the adult population of Kang (Kgalagadi North, Botswana)
Researcher: Dr S. Tshitenge
Supervisor: Dr L.H. Mabuza
Department: Family Medicine & Primary Health Care
School: Medicine
Degree: M Med (Family Medicine)

P O Medunsa
Medunsa
0204
SOUTH AFRICA

Tel: 012 - 521 4000
Fax: 012 - 560 0086

DECISION OF THE COMMITTEE:

MREC approved the project.

DATE: 11 September 2008


PROF. G.A. OGUNBANJO
CHAIRPERSON MREC



Note:

- i) Should any departure be contemplated from the research procedure as approved, the researcher(s) must re-submit the protocol to the committee.
- ii) The budget for the research will be considered separately from the protocol. PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES.

APPENDIX 5: CLEARANCE LETTER BOTSWANA MINISTRY OF HEALTH

Telephone: (267) 3632000
FAX (267) 353100
TELEGRAMS: RABONGAKA
TELEX: 2818 CARE BD



MINISTRY OF HEALTH
PRIVATE BAG 0038
GABORONE

REPUBLIC OF BOTSWANA

REFERENCE No: PPME: PS 13/18/1 Vol III (50) 15 October, 2008

Dr. S. Tshitenge
P.O. Box 60
Kang

Dear Dr. Tshitenge



Permit: ' Risk Factors Associated with High Blood Pressure in the Adult Population of Kang (Kgalagadi North, Botswana).'

Your application for a research permit for the above stated research protocol refers. We note that you have satisfactorily revised the protocol as per our suggestions.

Permission is therefore granted to conduct the above mentioned study. This approval is valid for a period of one year effective October 15, 2008.

This permit does not however give you permission to collect data from the selected facilities without approval from the management. Consent from the identified individuals should be obtained at all times.

The research should be conducted as outlined in the approved proposal. Any changes to the approved proposal must be submitted to the Health Research Unit and Development Division in the Ministry of Health for consideration and approval.

Furthermore, you are requested to submit at least one hard copy and an electronic copy of the report to the Health Research Division, Ministry of Health within 3 months of completion of the study. Approval is for academic fulfilment only. Copies should be submitted to all other relevant authorities.

Yours sincerely



P. Khulumani
For/Permanent Secretary



APPENDIX 6: CLEARANCE LETTER KGALAGADI DISTRICT COUNCIL

KGALAGADI DISTRICT COUNCIL



HUKUNTSI SUB DISTRICT

Private Bag 12

Tel: (0267) 6510286/249

Fax: (0267) 6510244

**HUKUNTSI
BOTSWANA**

REF: Us 12910

24th October 2008

Dr Stephane Tshitenge
P.O. BOX 60
Kang

U.f.s: Primary Health Care Manager

Dear Sir,

**RE: REQUEST FOR PERMISSION TO CONDUCT A RESEARCH –
YOURSELF**

This responds to your letter dated 20th October 2008 regarding the above mentioned matter.

You are informed that you have been granted the permission to conduct your research. More importantly you are expected to provide our office with a copy of your research after completion.

Wishing you all the best in your research.

Thank you.

Yours faithfully,

D. Kalantle

SENIOR ASSISTANT COUNCIL SECRETARY