



ANTHROPOMETRIC INDICES ASSOCIATED WITH DISPARITIES IN MEAN BLOOD PRESSURE BETWEEN TWO ETHNIC GROUPS IN GWAGWALADA, NIGERIA

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ABSTRACT: Background: Several studies have demonstrated the association between the development of hypertension and elevated indices of overweight and obesity. The Fulani people are considered to have genetic origin comprising West African, North Africa, and Arabian descent while the Gbagyi people are of the Benue-Congo linguistic family indigenous to the Nigerian FCT. Whereas the Fulani are generally slender the Gbagyi people often have more sturdy appearances phenotypically. **Methods:** In this cross-sectional study, we investigated two phenotypically distinct ethnic groups resident in Northcentral Nigeria to ascertain associations between their blood pressures and anthropometric indices. **Results:** Hypertension was detected in 24.7% of the combined study populations. The prevalence rates for were 23.2 versus 26.3% for the Fulani and Gbagyi ethnic groups with those differences being statistically insignificant ($p=0.498$) However there were significant differences in the SBP of 122.15 versus 126.1 mmHg and DBP of 77.21 versus 83.16mmHg between the Fulani and Gbagyi groups respectively. Similarly, there were observed significant differences in the anthropometric measurements in the weight, Body Mass Index, Waist Circumference and Waist to Hip Ratio between the two groups. **Conclusion:** This study lends support to the association between higher anthropometric indices and mean systolic and diastolic blood pressures in the general population. The Fulani people had lower systolic and diastolic blood pressures, associated with lighter body weight, lower body mass index, smaller, waist circumference, and lower waist to hip ratios compared to the Gbagyis

KEYWORDS: Anthropometrics, Indices, blood pressure, Mean, Fulani, Gbagyi



INTRODUCTION

Several studies have demonstrated the association between the development of hypertension and elevated indices of overweight and obesity. The Fulani people are considered to have genetic origin comprising West African, North Africa, and Arabian descent while the Gbagyi people are of the Benue-Congo linguistic family indigenous to the Nigerian FCT. Whereas the Fulani is generally slender the Gbagyi people often have more sturdy appearances phenotypically.

Fulani herdsmen are traditionally nomadic, pastoralist traders who own herds of cattle goats, and sheep originally from the desert and semi-desert lands, they are the largest nomadic ethnic group in the world [1]. The herdsmen are also found in over 26 countries within the African continent with a population of about 15.3 million in Nigeria. These herdsmen constitute the major breeders of cattle, the main source of meat; the most available and affordable source of animal proteins consumed by Nigerians [2] The herdsmen were known to move from one village to another and across many states before settling for a while and returned back still trekking, each return trip may last for several months and is their routine way of life. Studies on hypertension in Sub-Saharan Africa hardly focused on the Fulani/Peul who are a diverse group [3] An estimated population of 7 to 8 million nomadic Fulani (indigenous Mbororo) and 16 million settled Fulani (Fulbe).[4] The Fulani are transitioning from traditional to transitory and modern lifestyles, their access to healthcare is limited by barriers of language, location, and culture [5] As a result, they disproportionately experience poorer health than most mainstream ethnic groups [6] Existing health data on Fulani populations is not much.

The Gbagyi tribe is predominantly found in central Nigeria with a population of about 15 million. They occupy the federal capital territory, Niger, Kaduna, Nassarawa, and Kogi state. Their major occupation is farming, although they are also hunters and are also involved in making traditional art and craft products such as pottery, woodwork like mortar and pestle. There is a paucity of studies on the prevalence of hypertension in the Gbagyi tribe and at the time of this research, just one piece of literature was found on hypertension prevalence in Gbagyi ethnic group. Hypertension remains a leading cause of morbidity and mortality worldwide. Risk factors for the development of essential or primary hypertension include increasing age, family history, genetic polymorphisms involving adduction, nitric oxide synthase, angiotensinogen, and several others. Whereas hypertension occurs globally there exists racial and geographic variations in frequency plausibly related to a combination of factors including several genetic, environmental, physical, and even emotional factors. Notable among ethnic groups are African Americans, Bantu speaking indigenous Africans. Community-based studies have consistently revealed higher blood pressure levels in blacks than other ethnic groups [7].

Black Americans of African origin have been demonstrated to have higher blood pressure levels than whites. There are stark ethnic group differences in the experiences of hypertension and its related sequelae such as coronary heart disease (CHD), stroke, and other manifestations of cardiovascular disease (CVD) [8],[9]. According to the World Health Organization (WHO), the prevalence of hypertension is highest in the African Region at 46% of adults aged 25 years and above while the lowest was found in the American region [10]



The incidence of hypertension and cardiovascular mortality has been increasing in sub-Saharan Africa over the past few decades [11] and is expected to nearly double by the year 2030 [12]. A systematic review of articles published on hypertension between 2000 and 2013 in sub-Saharan Africa, reported a pooled hypertension prevalence of 30% in adults and a range from 14.7 to 69.9% [11]. About 28.7% prevalence was reported in Ghana and 16.9% in Cameroon, 10.35% in Ethiopia. [13]

In Nigeria, the prevalence of hypertension has been on the increase affecting a significant number of highly productive populations. A review of prevalence among adults from 1990 to 2009 showed a combined prevalence of 22% and range from a minimum of 12.4% to a maximum of 34.8% [33]. It was estimated that there were about 20.8 million cases of hypertension in Nigeria among people aged at least 20 years, with a prevalence of 28.0% and a projected increase to 39.1 million cases with a prevalence of 30.8% by 2030 [14]. A recent community-based study of rural and semi-urban populations in Enugu, Nigeria put the prevalence of hypertension in Nigeria at 32.8% [15][16] and an 18.5% prevalence of hypertensive burden in Edo State of Nigeria [17]. The prevalence of hypertension amongst Fulani in a rural community in Ilorin east and Moro local government of Nigeria was found to be 17.3% [13]. Another study found that the prevalence of hypertension in the Gbagyi tribe was 25.9% which is the lowest of the 17 ethnic groups studied and that of Fulani was found to be 54.6% [18]. A study on Fulani in Cameroon found the prevalence of hypertension to be 31.1% [6]

Effect of age and sex on blood pressure

Blood pressure is known to rise with age in both males and females. Age probably represents an accumulation of environmental influences and the effects of genetically programmed senescence in body systems [19]. Some populations have now been identified whose mean blood pressure does not rise with age [15]. These communities are for the most part primitive societies with calorie and often salt intakes at subsistence level. Until age 45 years, a higher percentage of men than women have hypertension; from age 45 to 64 years, the percentages are nearly equal between men and women. After 64 years of age, a more percentage of women have a high blood pressure than men [20]

SEX: At the beginning of life there is not much evidence to show the difference in blood pressure between the sexes, but, at adolescence, men appear to have higher average blood pressure limits and usually it is most evident in young and middle-aged adults, Later in life the difference narrows and the pattern may even be reversed [7]. Post-menopausal changes in women may be the contributory factor for this change. Studies are in progress to evaluate whether estrogen supplementation protects against the late relative rise of blood pressure in women [7]. A study on the epidemiology of hypertension in Fulani in Cameroon found that the prevalence of hypertension was 36.5% in men and 28.7% in women. Younger women were more likely to have a normal blood pressure than younger men, while older women aged > 60 years were more likely to have elevated blood pressure than men of the same age group.

Studies in Nigeria and sub-Saharan Africa have mainly involved specific geographical areas or have focused on subgroups of the population [21] [22]. Surveys from Nigeria report prevalence estimates ranging from 20.2 to 36.6%, but all have involved participants with different age ranges [23][24]



Anthropometrics and ethnicity

Anthropometrics are the most worldwide applicable, inexpensive, and safe method available to assess the size, proportions, and composition of the human body [25]

Anthropometric indices can be compared to reference standards in order to assess growth and body dimensions, past or present nutritional status, and the future risk of health outcomes. The 2006/07 New Zealand Health Survey includes three common anthropometric measurements: **height, weight and waist circumference, hip circumference**. Height and weight measurements are used to calculate body mass index (BMI), others are waist-hip circumference, waist-hip ratio, and waist-height ratio. There are four categories of BMI: $<18.5\text{kg/m}^2$, $18.5\text{-}24.9\text{kg/m}^2$, $25.0\text{-}29.9\text{kg/m}^2$ and $\geq 30.0\text{kg/m}^2$ identified as underweight, normal weight, overweight and obesity respectively. The waist circumference is measured at the level of the umbilicus and the hip circumference at the level of the greater trochanter.

Aim and objective; To determine the anthropometric indices that are associated with disparities in mean blood pressure between two ethnic groups living in Gwagwalada.

METHODS

Study area

The study was carried out in the Gwagwalada area council of the Federal Capital Territory Abuja, Nigeria. Gwagwalada is one of the 6 local Government Area Councils of the Federal Capital Territory with a population of 158,618 as, at the 2006 population census, it had a surface area of $1,043\text{km}^2$ and a density of $385.4/\text{km}^2$. Its coordinates are latitude $80\ 56\ 29''$ north and longitude $70\ 5\ 31'$ east. Its headquarters is about a 25minutes drive from Nnamdi Azikiwe International Airport and 45 minutes from the city center, it is along the Abuja-Lokoja expressway it is easily accessible to other bordering area councils such as Kuje, Kwali, Abaji, Abuja municipal and Suleja in Niger state. Gwagwalada has 10 wards, which include Dobi, Gwagwalada center, Gwako, Ibwa, Ikwa, Kutunku, Paiko, Staff quarter, Iungan maje, and Zuba. Public utilities such as water supply, electricity are available in the Gwagwalada area council. It also has the presence of important FCT and federal institutions such as the University of Abuja, University of Abuja Teaching Hospital, Immigrations and Pension board, Sharia court, FCT school of nursing. The climate is tropical with the summer having a good deal of rainfall while the winter has very little. The annual rainfall is about 1389mm, the wet season extends from the month of May to October, while the dry season spans from November, December, January, and February. The coolest month is December and the warmest month is March. January is the driest month, while September is the wettest month.

The major inhabitants of Gwagwalada are the Gbagyi tribe, Bassa tribe, and Fulani tribe, other ethnic groups such as the Igbo's, Hausa's, Yoruba's, and other minority groups are also found in gwagwalada. The Bassa people are mostly fishermen, the majority of Gbagyi people are farmers or craft men, and the women are known for carrying heavy loads on their back while the Fulani people are mostly herdsmen found in small isolated settlements across many villages in the local government. There are usually communal clashes between gbagyi farmers and Fulani herdsmen.



Study population

The study population was adults aged 18 years and above of the Fulani and Gbagyi ethnic group of the Gwagwalada area council.

Study design

This study was a descriptive cross-sectional study.

Sample size

The total sample size for the 2 groups = 388 participants. A minimum sample size was determined as follows using the formula Leslie Kish [14]

$$n = z^2pq/d^2$$

However, the formula of the sample size for the comparison of the group is;

$$n = \frac{2(Z\alpha + Z\beta)^2 \pi(1-\pi)}{d^2}$$

Where:

n is the minimum sample size

z α is the standard normal deviate taken as 1.96

Z β = standard normal deviate taken as 1.28

Π = mean of two proportions P1 and P2

P1 is the estimated proportion (prevalence) of hypertension in the population. An

estimate of 17.3% (0.17) was chosen based on the study on the prevalence of hypertension among Fulani in Ilorin Nigeria [13]

$$P2 = P1 + d = 17.3 + 15 = 32.3\%$$

d is the degree of accuracy. For this study, it was set at 15% (0.15).

$$\pi = (P1 + P2) / 2 = (17.3 + 32.3) / 2 = 24.8\% = 0.248$$

$$1 - \pi = 1 - 0.248 = 0.752$$

$$n = \frac{2(1.96 + 1.28)^2 \times 0.248 \times 0.752}{0.15^2}$$

Therefore, n = 174

To compensate for non-responses, adjustment was made to the sample size. The adjusted sample size (n_s) was calculated using n_s = n/r.



r is the anticipated response rate. A response rate of 90% (0.9) was anticipated

$n = 174 / 0.9 = 193.3 = 194$ for each group.

Sampling technique

A multistage sampling method was used.

- Stage one was the selection of the central ward from the ten wards in Gwagwalada Area Council using a simple random sampling method by way of balloting without replacement.
- Stage two was the selection of Paikon kore and Anguwan Gwari from the various communities in the central ward of Gwagwalada area council by way of balloting without replacement.
- Stage three was the selection of respondents from the selected communities by a simple random sampling technique. Half of the sample size (194) was selected from Paikon kore while the other half (194) was selected from Anguwan Gwari

Both communities are remote, situated about 5 kilometers from the metropolis. They have similar characteristics in terms of poor infrastructural development and no social amenities such as electricity, pipe-borne water, they have just one primary school each with about 5 classrooms. Habitants of Paikon kore were Fulani nomads while habitants of Anguwan Gwari were mostly Gbagyi farmers.

Inclusion criteria

Respondents aged 18 years and above, male and female of Fulani and Gbagyi ethnic group, gave consent to participate in the study.

Exclusion criteria

Adults who are not Fulani or Gbagyi

Those who did not give consent

Pregnant women

Persons who are too ill to participate

Those who were severely deformed.

Data collection instrument and materials

The questionnaire, Mercury sphygmomanometer, Stadiometer, Meter tape, Weighing scale.

- I. **Questionnaire;** The questionnaire was divided into several parts which include, Sociodemographic characteristics of the subject such as age, gender, ethnicity, religion, occupation, level of education, and marital status. Questions on the history of raised blood pressure, awareness, control, and treatment of high blood pressure. Measurements of subject's blood pressure and anthropometrics



II. Blood pressure; The blood pressure of the subjects was measured by an auscultatory method using an Accosson(R) mercury sphygmomanometer with an appropriately sized cuff and a 3M Littmann(R) stethoscope. Subjects sat for about five minutes before readings of blood pressure, blood pressure was taken on either arm at the level of the heart. Two readings were obtained, and the average was calculated and recorded.

III. Anthropometrics; Height, Weight, Body Mass Index, Waist circumference, and Hip circumference. The height of the participants was measured in meters with a Stadiometer. The weight of the participants was measured with a weighing balance in kilograms. The waist circumference was measured with a meter tape at the level of the umbilicus, and hip circumference at the level of the greater trochanter in centimeters. The waist-hip ratio was deduced. The body mass index (BMI) was calculated using the standard formula

$$\text{BMI} = \text{Weight (kg)} / \text{Height(m)}^2$$

Data collection technique

A combination of structured interviewer-administered questionnaires and clinical measurements were used for data collection. The benefits of the study and assurance of their confidentiality, voluntary participation, and freedom to withdraw at any point of feeling inconvenient with the study. Questionnaires were administered by interviewers who translated the questions to the Hausa language, they were also trained regarding the appropriate technique of interview, measurement of blood pressure, the inclusion and exclusion criteria of the participants.

Ethical Consideration

Ethical clearance for the study was obtained from the University of Abuja Teaching Hospital Health Research Ethics Committee. Permission was obtained from the chief or head of the various communities and informed consent was obtained from each individual before enrolling them in the study.

Data analysis

Data collected were analyzed using the Statistical Package for Social Sciences (SPSS Version 19.0). Results were presented using frequency tables and charts. Qualitative variables were expressed using proportions and Pearson's chi-square was used to analyze demographic variables and to compare between groups. Quantitative variables were analyzed using Student t-test for differences in means of anthropometrics and blood pressure between groups. All analysis was done at the 5% level of significance with $P < 0.05$ considered statistically significant.

Limitation of the study

The blood pressure of subjects was taken at different times of the day which may affect the reading obtained.

No blood samples were analyzed for trans fatty acids and lipids



RESULTS

Demographic characteristics

We studied a total of 398 individuals with equal numbers of Fulani and Gbagyi people, aged between 18 and 85 (mean 32.9, SD 11.1) years as the study population. There was no difference in the mean ages of the two groups, 34.08 versus 31.8 years for Fulani and Gbagyi groups respectively ($p=0.07$). However, the male gender was in a clear majority for the whole of the study population and for the different groups Male: Female =2:1 (Table 1)

Prevalence of hypertension

There were more hypertensive patients among the Gbagyi people than the Fulani group, 26.3% versus 23.2% for the Gbagyi and Fulani respectively, but that difference was not statistically significant ($p=0.48$).

There were significant differences between the mean SBP of the groups (122.15 ± 18.79 versus 126 ± 15.29 mmHg for the Fulani and Gbagyi people respectively $p=0.012$). For the DBP the pattern was similar to that of the SBP with the Fulani people having a lower mean value than the Gbagyi 77.21 ± 13.29 versus 83.16 ± 12.02 mmHg for Fulani and Gbagyi respectively ($p<0.001$)

Anthropometric indices

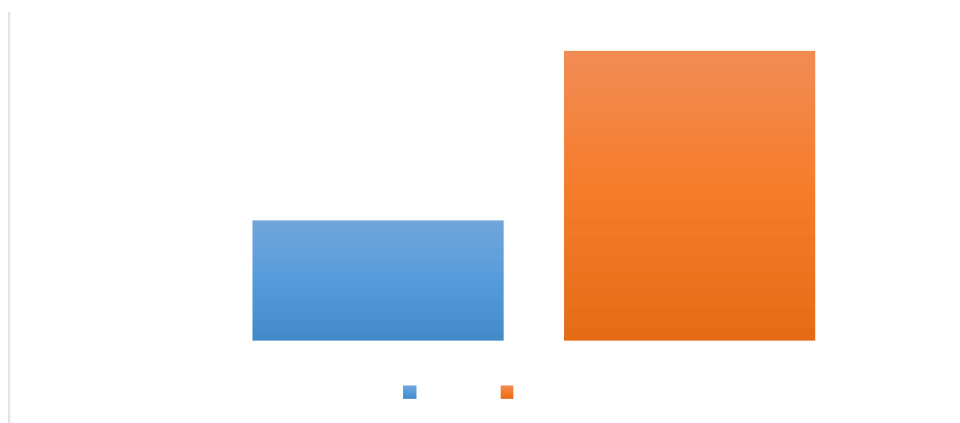
The mean heights of the general study population, the Fulani and Gbagyi groups were similar ($p=0.8$), but the Gbagyi were heavier in weight, had wider waist circumferences than the Fulani people (p values of <0.001). However, there was no statistical difference between the groups with respect to their waist to hip ratios 0.85 versus 0.86 for Fulani and Gbagyi respectively ($p=0.077$).

Table 1. Demographic characteristics of the study population

Characteristic	Fulani	Gbagyi	Combined	P-value
<i>Age (years)</i>				
Less than 25	47 (24.2)	58 (29.9)	105 (27.1)	6.480
0.372				
25-34	60 (30.9)	63 (32.5)	123 (31.7)	
35-44	38 (19.6)	39 (20.1)	77 (19.8)	
45-54	32 (16.5)	27 (13.9)	59 (15.2)	
55-64	7 (3.6)	4 (2.1)	11 (2.80)	
65-74	9 (4.6)	3 (1.5)	12 (3.10)	
75 +	1 (0.5)	0 (0)	1 (0.30)	
<i>Mean (\pmSD) years</i>	34.08 \pm 13.11	31.88 \pm 10.70	32.98 \pm 11.9	1.808
0.071				
<i>Gender</i>				
Male	129 (66.5)	131 (67.5)	260 (67)	0.047
0.829				
Female	65 (33.5)	63 (32.5)	128 (33)	

Occupation

Farmer	12 (6.20)	38 (19.6)	50 (12.9)	124.86
<0.001				
Nomad	93 (47.9)	1 (0.5)	94 (24.2)	
Others*	89 (38.1)	155 (61.9)	244 (50)	

**Figure 1.****Table 2. Mean anthropometric and blood pressure in Fulani and Gbagyi ethnic groups**

Variable	Fulani Mean (\pm SD)	Gbagyi Mean (\pm SD)	Total Mean (\pm SD)	T-test	p-value
Height (m)	1.67 \pm 0.095	1.67 \pm 0.089	1.67 \pm 0.091	0.2	0.842
Weight (kg)	57.34 \pm 11.75	66.10 \pm 11.01	61.72 \pm 12.19	-7.581	<0.001
BMI (kg/m ²)	20.58 \pm 3.56	23.89 \pm 4.06	22.24 \pm 4.16	-8.553	<0.001
WC (cm)	75.28 \pm 10.80	81.87 \pm 10.40	78.57 \pm 11.09	-6.115	<0.001
HC (cm)	87.85 \pm 9.54	94.48 \pm 9.40	91.17 \pm 10.02	-6.894	<0.001
Waist hip ratio	0.856 \pm 0.053	0.867 \pm 0.072	0.861 \pm 0.063	-1.775	0.077
Systolic BP	122.15 \pm 18.79	126 \pm 15.29	124.34 \pm 17.25	-2.51	0.012
Diastolic BP	77.21 \pm 13.29	83.16 \pm 12.02	80 \pm 13.00	-4.624	<0.001

BMI= body mass index, WC= waist circumference, HC= hip circumference



DISCUSSION

This study was conducted on 388 participants of Fulani and Gbagyi ethnic groups aged 18 years and above in Gwagwalada area council of Federal Capital Territory Abuja using a structured and interviewer-administered questionnaire. The purpose of this study was to compare the blood pressure pattern and anthropometrics pattern between Fulani and Gbagyi. Socio-demographic factors, anthropometrics, Systolic Blood Pressure, and Diastolic Blood Pressure (SBD and DBP) were the variables compared.

Socio-Demographic Characteristics

The mean age of the participants was 33years, the mean age for the Fulani ethnic group was 34.1 years and that of the Gbagyi was 31.9years, these values are low compared to results from other studies in Ilorin where the average age of 39 years was reported [13]. 31.7% of participants were within the age bracket of 25-34years which is close to a study in Ilorin in which the majority of the participants were within the age group of 18-30years [13]. Overall there were more males 67% than females in the study; this is inconsistent with results from a study in Cameroon [6], in which the majority of the subjects were females. The pattern observed in this study can be explained by a cultural barrier of Fulani and Gbagyi in Nigeria that restricts exposure of women. A high number of the participants were Muslims (79.7%). The majority of Fulani participants were nomads while the Gbagyi were farmers similar to other literature that stated that the major occupation of Fulani is cattle herding and Gbagyi is farming [1]. The majority of participants of the Fulani ethnic group had no formal education (69.6%) similar to studies in Ilorin with 86.7% of Fulani participants with no formal education [13]. Most of the Gbagyi had a secondary level of education (43.3%). The majority of the participants were married (63.4%), this was similar to finding in other works in Cameroon [6]. The monthly income for most participants in this study was less than N20000(\$128), which is lower than found in a study in Ilorin [13] in which the majority of participants had income between N40,000(\$128)-N50,000(\$148).

Prevalence Of Hypertension

The overall prevalence of hypertension in this study was 24.7%, this is slightly less than the global prevalence of hypertension of 26% and a prevalence of 28% in Nigeria. It has also differed from the finding in Edo state where a prevalence of 18.5% was obtained [17] and another study that got a prevalence of 32.8% across west Africa [26].

The prevalence rate of hypertension in Fulani was 23.2%, which was higher than the result obtained in a study in Ilorin [13], where the prevalence of hypertension was 17.3% among Fulani while the prevalence in the Gbagyi ethnic group was 26.3% which is similar to findings in another study in northern Nigeria that placed the prevalence at 25.9% [18]. The difference in the prevalence of hypertension between Fulani and Gbagyi was not statistically significant ($P=0.480$), thus no ethnic disparity in the prevalence of hypertension between the two ethnic groups and this may be attributed to the fact that despite their genetic difference, they experience similar environmental factors and lifestyle that influence hypertension occurrence



Anthropometric and Blood Pressure Pattern in Fulani And Gbagyi

The anthropometric parameters compared include height, weight body mass index, Waist Circumference (WC), Hip Circumference (HC), and Waist Hip Ratio (WHR). The blood pressures compared include systolic and diastolic pressure.

The mean height for this study population was 1.67meters, there was no statistically significant difference in height between the Fulani and Gbagyi ethnic groups ($P=0.842$). The mean weight of the study population was 61.7kg, the mean weight for Fulani was 57.34kg and Gbagyi was 66.1kg this difference was statistically significant ($P<0.001$). The literature reviewed compared only body mass index, waist circumference, hip circumference, and waist-hip ratio. No literature reviewed compared height and weight between ethnic groups. The mean body mass index was $22.24\text{kg}/\text{m}^2$ which is consistent with the finding by clement et al [6] who got a mean body mass index of $19.5\text{kg}/\text{m}^2$. There was a statistically significant difference in the body mass index ($p<0.001$) observed in Fulani and Gbagyi with a mean BMI of $20.58\text{kg}/\text{m}^2$ and $23.89\text{kg}/\text{m}^2$ respectively. Majority of those who are underweight ($\text{BMI}<18.5$) are Fulani with a proportion of 34% compared to 6.7% in Gbagyi who are underweight. There was a small difference in the proportion of those that are normal weight ($\text{BMI } 18.5\text{-}24.9$) with 57.7% of Fulani and 61.9% of Gbagyi. A higher proportion of Gbagyi was overweight 24.7% while overweight Fulani was 6.2%. 6.7% of Gbagyi were obese compared to 2.1% of Fulani who is obese. The difference in BMI may be attributed to the genetic make-up of both ethnic groups, the type of occupational physical activities, and dietary pattern. From the results obtained on the dietary pattern, no statistically significant difference was noted. However, there was a statistically significant difference in the pattern of occupational physical activity in both ethnic groups. The Fulani are mostly nomadic and always trek long distances with their cattle in search of green pasture to feed their cattle thus burning calories and preventing weight gain. Most studies compared BMI between males and females or between hypertensive and normotensives. No literature reviewed compared BMI between Fulani and Gbagyi. However, in a study among Fulani in Cameroon [6], the proportion of underweight was 46.5% which is higher than the findings (34%) in this study. Studies among Fulani in Cameroon [6] found the proportion of Fulani with Normal weight to be 46.5%, overweight is 5.8% and obese is 2.2% similar to finding in this study. The higher prevalence of overweight and obesity among Gbagyi can be attributed to the fact that they engage in less occupational physical activity and a more sedentary lifestyle, they are mostly farmers and are only active during the wet season and less active during the dry season compared to Fulanis who are active all through the year.

The mean waist circumference in this study was 78.57cm. The waist circumference for the Fulani population was 75.28cm which is similar to findings from other finds which were 75.10 cm among Fulanis in Cameroon[6]. The mean waist circumference of the Gbagyi population was 81.87cm which is far higher than those of Fulani's, although the difference noted was statistically significant. No previous study among Gbagyi was found at the time of this study. A positive correlation was observed between WC and SBP and DBP. The mean hip circumference (HC) for the sample population was 91.17cm. The mean value for the Fulani participants was 87.85cm and for the Gbagyi participants was 94.48cm. The difference noted was statistically significant ($P<0.001$). These show that the Gbagyi ethnic group has more central obesity (higher waist circumference and hip circumference) and is at risk of metabolic disease.



The waist-hip ratio (WHR) for the total sampled population was 0.861. The WHR for the Fulani was 0.856 and for the Gbagyi 0.867. The difference observed was not statistically significant ($P=0.007$). The mean value of WHR is less than 1.0 for male which places them at a higher risk of metabolic disease. Out of five previous studies that reported on WHR in men [8][27][17][28][29], three of the studies [17][28][29] reported lower findings, compared to the findings of this study, one study in the united states [27] reported the same and another study in the united kingdom [8] reported higher ratios in African descent men compared to white men. No similar studies have been conducted in these groups at the time of this study.

The mean systolic blood pressure and diastolic blood pressure in the sampled population were 124mmHg and 80mmHg respectively. The mean Systolic Blood Pressure and Diastolic Blood Pressure for the Fulani population were 122mmHg and 77.21mmHg, this is similar to findings from previous studies which reported 127.9mmHg SBP and 80.4mmHg DBP in Cameroon [6]. SBP and DBP increased with age as they are positively correlated similarly to findings in other works in Cameroon [6]. The mean SBP and DBP among Gbagyi was 126mmHg and 83.16mmHg. There was no previous study that reported on the mean blood pressure in these ethnic groups which was available at the time of reporting these results. The difference in SBP and DBP noted in both ethnic groups was statistically significant. The Gbagyi had a higher SBP and DBP. In a Birmingham Factory study, the mean systolic BP was lower in blacks than in white populations [30] [31]. For diastolic BP, all the studies reported higher mean values in black than in white groups, except one study in England [32].

CONCLUSION

This study lends support to the association between higher anthropometric indices and mean systolic and diastolic blood pressures in the general population. The Fulani people had lower systolic and diastolic blood pressures, associated with lighter body weight, lower body mass index, smaller waist circumference, and lower waist to hip ratios. Genetic studies may

RECOMMENDATIONS

There is a need to create more awareness in the general populations, especially in the rural communities, on hypertension, its risk factors, symptoms, and complications through health education and promotion and the need to visit health care centers regularly for blood pressure monitoring.

Outreaches to communities should be carried out by health workers in order to identify hypertension early and prevent its complications.

Acknowledgment

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Conflict of interest

We declare that there is no conflict of interest in this study.

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