



## Obesity and Hypertension among Christian Religious Subgroups: Pentecostal vs. Orthodox

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### Authors' contributions

This work was carried out in collaboration between all authors. Authors NA and WKBAO developed the concept and designed the study. Authors NA, WKBAO, AWM, PPMD, BBA, VES and JA administered the questionnaire, analyzed and interpreted the data. Authors NA, PPMD, BBA, VES and JA drafted the manuscript. Authors NA, WKBAO, AWM, PPMD and BBA revised the manuscript for intellectual content. All authors read and approved the final manuscript.

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### ABSTRACT

**Aims:** The aim of this study was to determine the impact of religious practices and diet doctrines on obesity and hypertension among Pentecostal and orthodox Christians in the Tamale metropolis.

**Study Design:** This study was a cross sectional study.

**Place and Duration of Study:** This study was conducted between January and June 2014, at the

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Tamale metropolis, Ghana.

**Methodology:** Three hundred (300) Ghanaian subjects (50.3% Pentecostal participants from the Perez Chapel International and the Church of Pentecost and 49.7% Orthodox participants from the Presbyterian Church and Bethel Methodist Church), 18-72 years of age were recruited for this study. Anthropometric measurements including height, weight, waist and hip circumference as well as blood pressure were measured for each of the study participants.

**Results:** The male participants were taller, heavier with higher mean WHR as well as higher mean SBP as compared to the female participants. The females however, had broader hips as compared to the male participants. The males were more likely to fully comply with the religious prescription on fasting (52.6% vs. 40.7%;  $p = 0.0397$ ) and diet (30.8% vs. 20.4%;  $p = 0.0375$ ) as compared to the female. The prevalence of obesity among the population in this study ranged from 17% to 28% depending on the criteria used in the weight classification (i.e. BMI, WHR and WC) and the prevalence of hypertension was 15.0% with no significant difference between both genders.

**Conclusion:** This study highlights the significant increase in the prevalence of obesity and hypertension among both males and female populations, with obesity being more prevalent among females. Compliance to religious doctrines on fasting and or diet does not have an impact on the prevalence of obesity and hypertension from this study.

*Keywords: Obesity; hypertension; pentecostal; orthodox.*

## 1. INTRODUCTION

Religion is not only a defining force in the developed society, it also play important roles in the developing society [1]. At least, 90% of human beings believe in God, with about 30-42% attending church weekly [1,2]. The impact of religious beliefs about political and family issues has been expanded to its relationship with health [3,4], body weight [5,6], and eating disorders [7-10]. The relation between religion and body weight attitude have not been examined thoroughly, partly because of the lack of adequate information on the extent of obesity among religious groups. Excessive body fat accumulation to the extent that it may affect health can predispose the individuals to hypertension, dyslipidaemia, type 2 diabetes, coronary artery disease, cardiovascular attack (stroke), osteoarthritis as well as cancer [11]. Religion could therefore be connected to obesity and hypertension in several ways.

There are several hypotheses as to why religion may be related to body weight and hypertension, but the evidence is not clear as to whether there is an empirical relationship. Some religious groups include complex systems of doctrine, values, and experiences that define their members in relation to the larger society [12]. The various religious doctrines (i.e. social enclave) may affect the level of obesity and hypertension among their members in relation to the mainstream society's norms [13,14]. This also depends on the level of adherence to the

religious doctrine via deity's acceptance, service, kindness to others and fasting [15,16].

Orthodox Christian holy books recommend a total of 180–200 days of fasting per year, during which the faithful are advised to avoid olive oil, meat, fish, milk and dairy products every Wednesday and Friday throughout the year [15]. The Adventist Church for example, proscribes the use of tobacco and alcohol and the consumption of biblically unclean foods, such as pork and shellfish and in addition, recommends consumption of fruits, vegetables, wholegrain cereals, legumes and nuts, and avoidance of meats, heavy desserts, condiments and stimulant drinks [17]. While religious fasts are partaken primarily for spiritual purposes, they also have the potential to greatly affect one's physical health [18]. There have been reports of a decrease in BMI and improvements in the serum lipid profile of Greek Orthodox fasters at the end of the fasting seasons, but serum lipid values reversed somewhat during their non-fasting periods [15].

In Ghana, Christians form about 71.2% of the total population [19]. Most of the Christian denominations proscribe consumption of certain foods and alcohol whiles encouraging regular intermittent fasting and prayer to enhance spiritual growth of their members. However, very few studies have focused on the impact of Christian religious dietary restrictions and fasting requirements on obesity and hypertension among the Christian community in Ghana. This study therefore was aimed at assessing the

impact of religious dietary restrictions and intermittent fasting requirements on the prevalence of obesity and hypertension among orthodox and Pentecostal Christian adults.

## 2. METHODOLOGY

### 2.1 Study Participants

This study is a cross sectional study which was conducted between January and June 2014. The subjects of this study were from an adult population in the Tamale metropolis of the northern region of Ghana. Three hundred (300) Christians worshipping at the Church of Pentecost, the Perez chapel, the Bethel Methodist Church and the Presbyterian Church of Ghana were recruited for the study. The participation of the respondents was voluntary and informed verbal consent was obtained from each of them. Subjects with known chronic conditions and subjects who did not belong to the religious groups involved were excluded from this study.

### 2.2 Data Collection

Data was collected in various churches on Sundays, with the aid of special ushers in the churches. Data collected from the respondents ranged from anthropometric measurements, socio-demographic information to Blood pressure readings after a brief presentation on how religious doctrines could raise or reduce the impact on obesity and hypertension.

#### 2.2.1 Anthropometric measurements and blood pressure readings

Obesity was assessed using four parameters; weight (kg), height (m<sup>2</sup>), waist circumference (WC/cm) and hip circumference (HC/cm). Weight was taken to the nearest 0.1 kilograms using a bathroom scale while measurement of height was done with a stadiometer. The waist and hip circumference was measured in centimeters using a tape measure and the blood pressure with the digital and manual sphygmomanometer and stethoscope. Three indicators were deduced; the Body mass Index (BMI) which was calculated from  $\text{weight in kg}/\text{height}^2(\text{m}^2)$ , the Waist-to-hip ratio (WHR), and the systolic to diastolic blood pressure readings to indicate whether the person is normal or hypertensive.

Waist circumference was measured to the widest girth to the nearest 0.1 cm. Hip circumference

was also measured at the level of the greater trochanter to the nearest 0.1 cm. WHR was calculated by dividing waist circumference by the hip circumference. Blood pressure was measured using the left arm while the participant is in the sitting position using a sphygmomanometer using the auscultation method. All measurements were taken twice per person as well as a confirmatory check using a digital BP apparatus and the average was taken as final. Respondents were given a 5 minutes period of rest, before and after the first blood pressure reading.

#### 2.2.2 Definition of terms

BMI (kg/m<sup>2</sup>) was categorized, using the current World Health Organization (WHO) definitions. BMI of <18.5 kg/m<sup>2</sup>, 18.5-24.9 kg/m<sup>2</sup>, 25-29.9 kg/m<sup>2</sup> and  $\geq 30$  kg/m<sup>2</sup> were used to define underweight, normal, overweight and obese respectively. Waist circumference (WC) was defined for both males and females with WC <94, 94- 101.9 and  $\geq 102$  cm defined as normal, overweight and obese respectively for males, and <80, 80-87.9, and  $\geq 88$  cm defined as normal, overweight and obese respectively for females. WHR was also defined for both males and females with WHR <0.90, 0.90-0.99 and  $\geq 1.0$  defined as normal, overweight and obese respectively for males and <0.80, 0.80-0.84, and  $\geq 0.85$  defined as normal, overweight and underweight respectively for females. Hypertension was defined as systolic blood pressure,  $\geq 140$  mmHg and/ or diastolic blood pressure  $\geq 90$  mmHg.

Exercise was defined as any activity causing light perspiration or a slight to moderate increase in breathing or heart rate for at least 30 minutes. Alcohol intake was defined as the intake of at least one bottle of an alcoholic beverage per week. Regarding smoking, individuals were classified as smokers based on whether the respondent is in the habit of smoking at least one cigarette a day.

### 2.3 Statistical Analysis

Data was analyzed using Microsoft Excel 2010 and Graph Pad Prism version 5.0. Means and standard deviations were obtained for relevant variables. For comparison of categorical variables, the Chi-square test was used while for continuous variables, the unpaired t-test was employed. A p-value <0.05 was considered significant.

### 3. RESULTS AND DISCUSSION

#### 3.1 Results

##### 3.1.1 General characteristic of the studied population

Three hundred (300) participants were recruited for this study even though 289 were estimated from the sample size calculation. Of this 300, 151(50.3%) participants were of Pentecostal denomination whilst 149(49.7%) participants were orthodox Christians. The Pentecostal participants were drawn from the Perez Chapel International (24) as well as the Church of Pentecost (127). The Orthodox participants were from the Presbyterian Church (114) and Bethel Methodist Church (35). Of these participants, the male population represents 133(44.3%) whilst the female represent 167(55.7%).

As shown in Table 1, the mean age of the studied participants was 34.53±12.3 years and the mean age of the male was not significantly different from that of their female counterparts (p = 0.2506). More than 40% each of the studied participants were married (47.3%) and single (42.0%). The mean duration of marriage from this study was 7.4±11.04 years (Table 1). Majority of the studied participants have attained at least basic

education, whereas a small proportion smoke cigarettes (1.0%) and consumed alcoholic beverages (15.3%). Close to half of the participants are engaged in active exercise (44.7%). When the studied participants were stratified based on gender, a higher proportion of the males were married, had attained tertiary education and consumed alcoholic beverages whereas a higher proportion of the females were divorced and had attained basic education as shown in Table 1.

##### 3.1.2 Compliance with religious prescription based on gender

From Table 2, about 45% each of the participants either partially (43.0%) or fully (46.0%) comply with the religious prescription on fasting. About half of the studied participants (52.3%) do not comply with the religious prescription on diet, 22.7% partially comply and 25.0% fully comply with diet prescription (Table 2). Majority (70.7%) of the participants perceived their body image as about the right weight. When the studied participants were classified based on gender, the males were more likely to fully comply with the religious prescription on fasting (52.6%; p = 0.0397) and diet (30.8%; p = 0.0375) as compared to their female counterparts (40.7% and 20.4% for fasting and diet respectively) (Table 2).

**Table 1. General characteristic of the studied participants stratified by gender**

Variable	Total (n=300)	Male (n=133)	Female (n=167)	P value
Age	34.53±12.3	35.44±12.8	33.8±11.9	0.2506
<b>Religious denomination</b>				
Pentecostal	151(50.3%)	60(45.1%)	91(54.5%)	0.1065
Orthodox	149(49.7%)	73(54.9%)	76(45.5%)	0.1065
<b>Marital status</b>				
Separated	6(2.0%)	2(1.5%)	4(2.4%)	0.5838
Married	142(47.3%)	75(56.4%)	67(40.1%)	0.0050
Single	126(42.0%)	50(37.6%)	76(45.5%)	0.1676
Widowed	8(2.7%)	4(3.0%)	4(2.4%)	0.7437
Divorced	18(6.0%)	2(1.5%)	16(9.6%)	0.0034
Duration of marriage	7.4±11.04	6.9±11.05	7.7±11.04	0.5254
<b>Education</b>				
No	16(5.3%)	5(3.8%)	11(6.6%)	0.2789
Basic	32(10.3%)	7(5.3%)	25(15.0%)	0.0068
Secondary	96(32.0%)	40(30.1%)	56(33.5%)	0.5236
Tertiary	156(52.0%)	81(60.9%)	75(44.9%)	0.0059
<b>Smoking</b>				
Yes	2(1.0%)	2(1.5%)	0(0.0%)	0.1118
<b>Alcohol</b>				
Yes	46(15.3%)	27(20.3%)	19(11.4%)	0.0331
<b>Exercise</b>				
Yes	134(44.7%)	67(50.4%)	67(40.1%)	0.0759

*Categorical data are presented as proportion and compared using chi-square whilst continuous data are presented as Mean ± SD and compared using unpaired t-test*

**3.1.3 Mean anthropometric parameters of the studied participants stratified based on gender**

The mean weight, BMI, WHR, SBP as well as DBP from this study were 66.63±15.7 kg, 26.11±6.3 kg m<sup>-2</sup>, 0.85±0.1, 127.5±17.1 mmHg and 82.62±13.0 respectively (Table 3). Classifying the studied population based on gender, the male participants were taller (p< 0.0001), heavier (p = 0.0041) with higher mean WHR (p< 0.0001) as well as higher mean SBP (p = 0.0067) as compared to the female participants. The females however, have broader hip circumference (p = 0.0002) as compared to the male participants (Table 3).

**3.1.4 The distribution of underweight, normal weight, overweight and obese using BMI among the studied participants classified by gender**

As shown in Fig. 1, the prevalence of the studied participants who were underweight, normal

weight, overweight as well as obese were 11.7%, 37.7%, 32.3% and 18.3% respectively using BMI as the indicator. Whereas higher proportion of the male (43.6%) participants were of normal weight as compared to the females (32.9%), the females (37.7%) were significantly (p = 0.0253) overweight as compared to the males (25.6%) (Fig. 1).

**3.1.5 The distribution of normal weight, overweight and obese using WHR using WC as the indicators among the study participants classified by gender**

Using WHR as the indicator of body weight, the proportion of the participants who were normal weight, overweight and obese were 49.0%, 34.0% and 17.0% respectively. However, when WC was used as the indicator, 58.7%, 15.3% and 28.0% of the participants were of normal weight, overweight and obese respectively (Fig. 2). Notwithstanding which of the two indicators was used, majority of the females were obese as compared to the males (Fig. 2).

**Table 2. Distribution of the rate of compliance with religious prescription on diet and fasting classified by gender**

Variable	Total (n=300)	Male (n=133)	Female (n=167)	P value
<b>Compliance with RD on fasting</b>				
Not at all	33(11.0%)	15(11.3%)	18(10.8%)	0.8907
Partially	129(43.0%)	48(36.1%)	81(48.5%)	0.0310
Fully	138(46.0%)	70(52.6%)	68(40.7%)	0.0397
<b>Compliance With RD On diet</b>				
Not at all	157(52.3%)	63(47.4%)	94(56.3%)	0.1244
Partially	68(22.7%)	29(21.8%)	39(23.3%)	0.8706
Fully	75(25.0%)	41(30.8%)	34(20.4%)	0.0375
<b>Perceived body image</b>				
Very underweight	3(1.0%)	1(0.8%)	2(1.2%)	0.6999
Somewhat underweight	31(10.3%)	8(6.0%)	23(13.8%)	0.0283
About right weight	212(70.7%)	99(74.4%)	113(67.7%)	0.2006
Somewhat obese	53(17.7%)	25(18.8%)	28(16.8%)	0.6469
Very obese	1(0.3%)	0(0.0%)	1(0.6%)	0.3714

*Categorical data are presented as proportion and compared using chi-square*

**Table 3. Distribution of the mean anthropometric parameters of the studied participants stratified based on gender**

Variable	Total (n=300)	Male (n=133)	Female (n=167)	P value
Height (m)	1.60±0.1	1.65±0.1	1.568±0.1	< 0.0001
Weight (Kg)	66.63±15.7	69.53±18.8	64.32±12.3	0.0041
BMI (kg/m <sup>2</sup> )	26.11±6.3	25.89±7.2	26.3±5.6	0.5781
WC (cm)	82.56±16.5	82.57±16.4	82.56±16.7	0.9940
HC (cm)	98.16±19.6	93.53±16.6	101.9±21.1	0.0002
WHR	0.85±0.1	0.89±0.1	0.82±0.1	< 0.0001
SBP (mmHg)	127.5±17.1	130.5±17.1	125.2±16.7	0.0067
DBP (mmHg)	82.62±13.0	83.26±13.8	82.12±12.3	0.4531

*Continuous data are presented as Mean ± SD and compared using unpaired t-test*

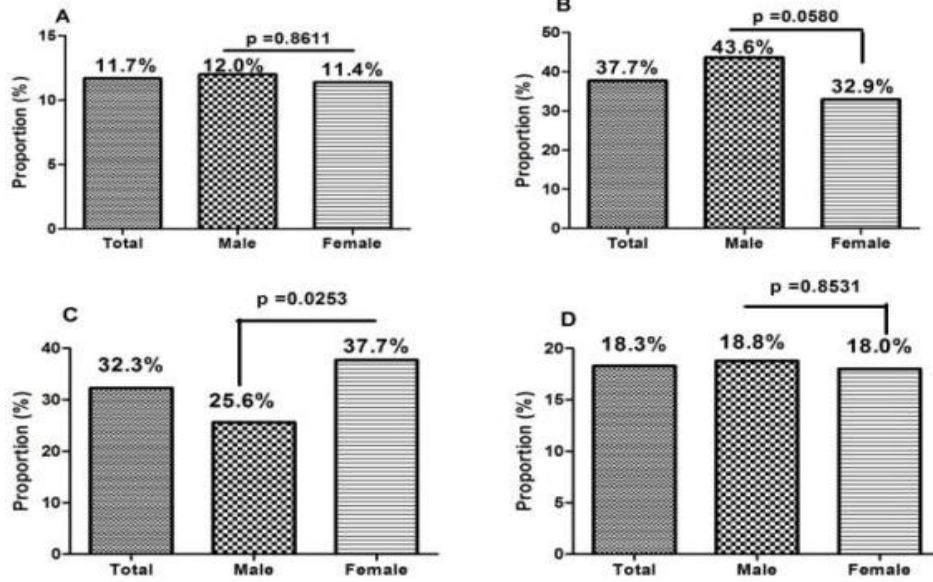


Fig. 1. The distribution of underweight (A), normal weight (B), overweight (C) and obese (D) using BMI among the studied participants classified by gender

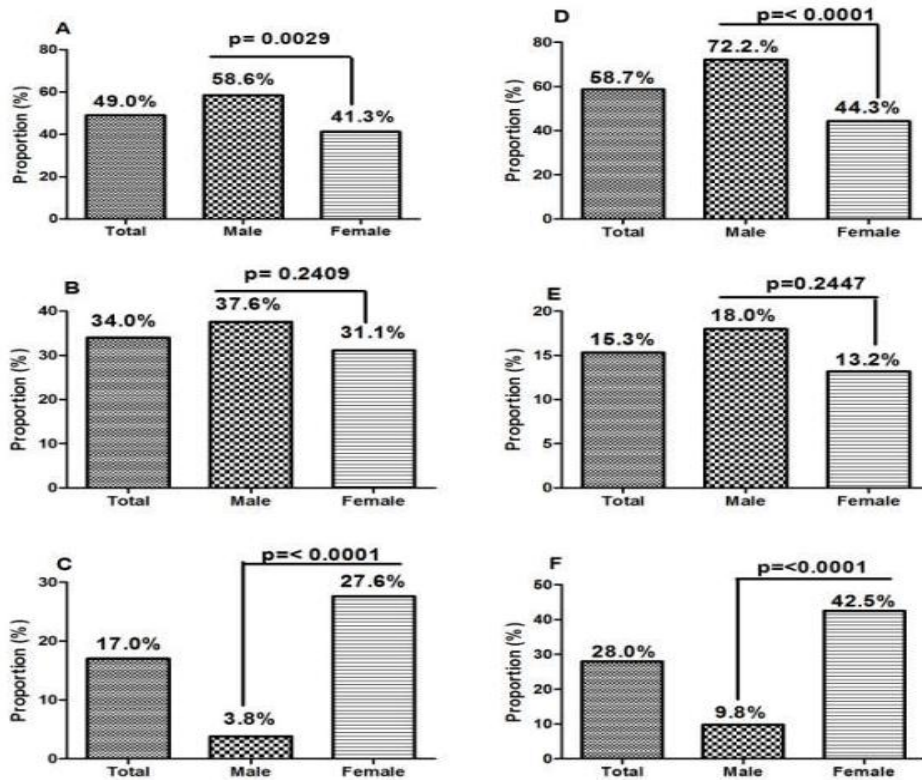


Fig. 2. The distribution of normal weight (A), overweight (B) and obese (C) using WHR and normal weight (D), overweight (E) and obese (F) using WC as the indicator among the studied participants classified by gender

**3.1.6 The prevalence of hypertension among the studied participants classified by gender**

From this study, the prevalence of hypertension was 15.0%. Among the male participants, the prevalence of hypertension (15.9%) was not significantly different ( $p = 0.7325$ ) from that of the females (14.4%) (Fig. 3).

**3.1.7 General characteristic of the studied participants based on religious believe**

As shown in Table 4, the mean age of the Pentecostal population was similar to the age of the Orthodox participants. A significantly higher proportion of the Pentecostal population was married (53.0%) and had attained secondary education (39.1%) as compared to the Orthodox participants (41.6% and 24.8% respectively). However, a significantly higher proportion of the Orthodox population was single (48.3%), had attained tertiary education (61.1%) and consumed alcoholic beverages (26.8%) (Table 4).

**3.1.8 Compliance with religious prescription on diet and fasting classified by religious believe**

From this study, significantly higher proportion of the Orthodox participants do not comply with the religious prescription on fasting (16.1%) and diet (62.4%) as compared to the Pentecostal population (6.0% and 42.4% respectively). Generally, a significantly higher proportion of the

Pentecostal participants was either partially or fully complying with the religious prescription on fasting and diet as compared to the Orthodox participants (Table 5).

**3.1.9 The mean anthropometric parameters of the studied participants stratified based on religious believe**

There were generally no significant differences in the mean values of the anthropometric parameters when the two religious groups were compared using unpaired *t*-test. The prevalence of hypertension was also not significantly different ( $p = 0.2379$ ) when the Pentecostal population (12.6%) was compared to the Orthodox population (17.2%) (Table 6).

**3.1.10 Underweight, normal weight, overweight and obese using BMI among the studied participants classified by religious believe**

Using BMI, the prevalence of underweight, normal weight, overweight and obesity among the Pentecostal population (12.6%, 37.1%, 31.8% and 18.5% respectively) were not significantly different ( $p = 0.6188, 0.8345, 0.8389$  and  $0.9247$  respectively) from the Orthodox population (10.7%, 38.3%, 32.9% and 18.1% respectively) (Fig. 4). When WHR and WC were used as indicators, there were no significant differences in the prevalence of the various weight classifications based on the religious belief (Fig. 5).

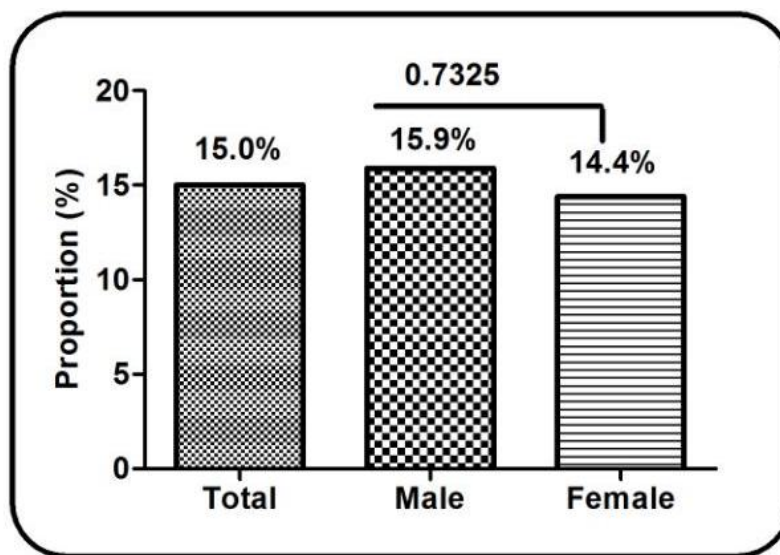


Fig. 3. The prevalence of hypertension among the studied participants classified by gender

**Table 4. General characteristic of the studied population classified based on religious believe**

Variable	Pentecostal (n=151)	Orthodox (n=149)	P value
<b>Age</b>	34.02±11.22	35.04±13.36	0.4741
<b>Marital Status</b>			
Separated	5(3.3%)	10(0.7%)	0.1024
Married	80(53%)	62(41.6%)	0.0486
Single	54(35.7%)	72(48.3%)	0.0275
Widowed	3(2%)	5(3.4%)	0.4618
Divorced	9(6%)	9(6.0%)	0.9767
<b>Education</b>			
No	8(5.3%)	8(5.4%)	0.9781
Basic	19(12.6%)	13(8.7%)	0.2791
Secondary	59(39.1%)	37(24.8%)	0.0082
Tertiary	65(43.0%)	91(61.1%)	0.0018
<b>Smoking</b>			
Yes	0(0.0%)	2(1.3%)	0.1532
<b>Alcohol</b>			
Yes	6(4.0%)	40(26.8%)	< 0.0001
<b>Exercise</b>			
Yes	64(42.4%)	70(47%)	0.4234

*Categorical data are presented as proportion and compared using chi-square whilst continuous data are presented as Mean ± SD and compared using unpaired t-test*

**Table 5. Distribution of the rate of compliance with religious prescription on diet and fasting classified by religious believe**

Variable	Pentecostal (n=151)	Orthodox (n=149)	P value
<b>compliance with RD on fasting</b>			
Not at all	9(6.0%)	24(16.1%)	0.0050
Partially	63(41.7%)	66(44.3%)	0.6526
Fully	79(52.3%)	59(39.6%)	0.0271
<b>compliance with RD on diet</b>			
Not at all	64(42.4%)	93(62.4%)	0.0005
Partially	42(27.8%)	27(18.1%)	0.0461
Fully	45(29.8%)	29(19.5%)	0.0378
<b>perceived body image</b>			
Very underweight	0(0.0%)	3(2.0%)	0.0797
Somewhat underweight	21(13.9%)	10(6.7%)	0.0406
About right weight	102(67.5%)	110(73.8%)	0.2326
Somewhat overweight	27(17.9%)	26(17.5%)	0.9220
Very overweight	1(0.7%)	0(0.0%)	0.3197

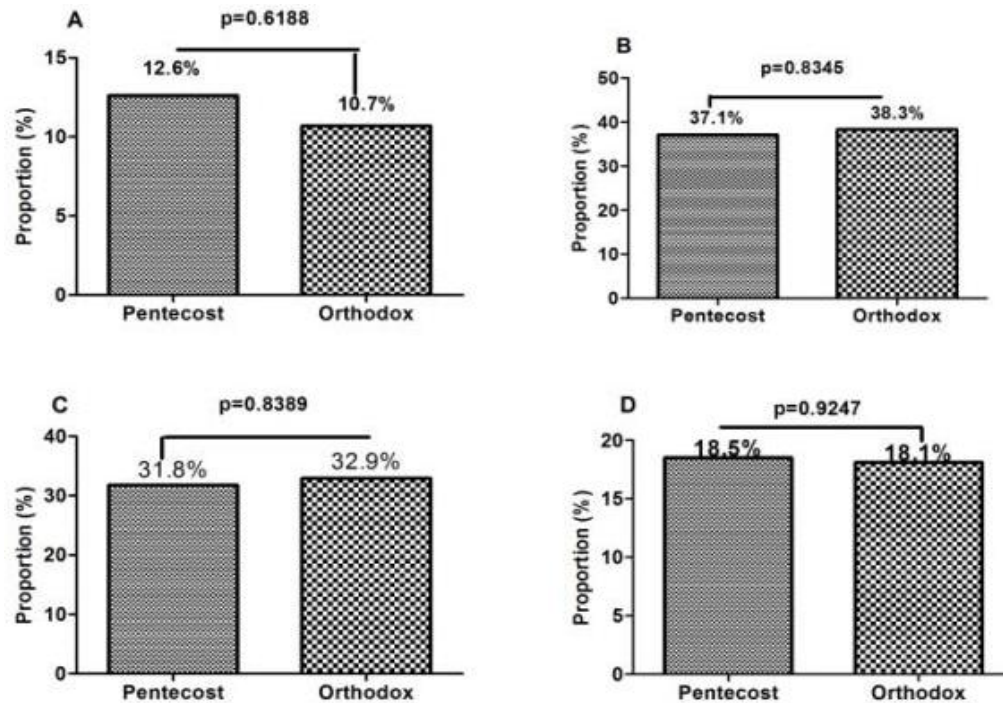
*Categorical data are presented as proportion and compared using chi-square*

**Table 6. Distribution of the mean anthropometric parameters of the studied participants stratified based on religious believe**

Variable	Pentecostal (n=151)	Orthodox (n=149)	P value
Height (m)	1.61±0.1	1.60±0.09	0.3543
Weight (Kg)	67.15±18.5	66.1±12.28	0.5642
BMI (kg m <sup>-2</sup> )	26.33±7.4	25.89±5.1	0.5434
WC (cm)	80.77±17.6	84.38±15.2	0.0577
HC (cm)	96±22.6	100.3±15.8	0.0550
WHR	0.85±0.1	0.84±0.1	0.3445
SBP (mmHg)	126±16.5	129.1±17.5	0.1107
DBP (mmHg)	84.7±11.4	80.52±14.2	0.0053
Hypertension	19(12.6%)	26(17.2%)	0.2379

*Categorical data are presented as proportion and compared using chi-square whilst continuous data are presented as Mean ± SD and compared using unpaired t-test*





**Fig. 4. The distribution of underweight (A), normal weight (B), overweight (C) and obese (D) using BMI among the studied participants classified by religious believe**

**3.1.11 Prevalence of various body weight classifications stratified by age**

Generally as shown in Table 7, the prevalence of obesity significantly increase with age irrespective of the criteria that was used in the classification. The prevalence of those with normal body weight however, reduced as the participants aged (Table 7).

**3.1.12 Prevalence of obesity (based on BMI, WHR AND WC) and hypertension stratified by rate of compliance**

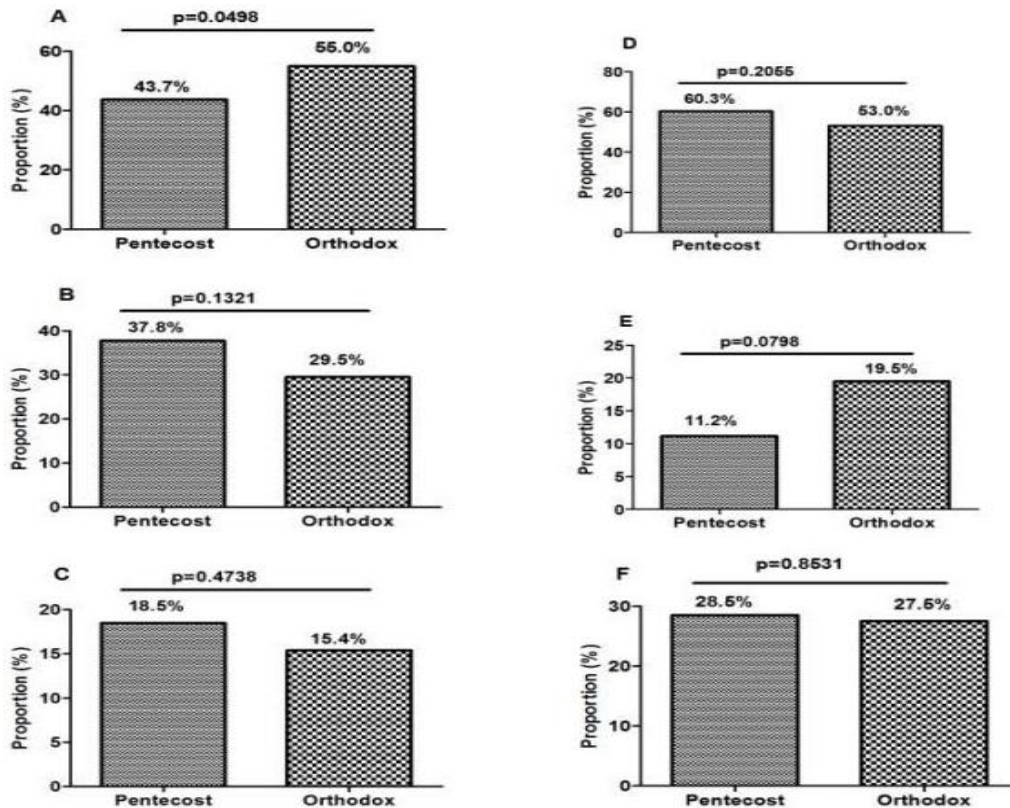
Generally, the rate of self-reported compliance to religious doctrines on fasting and diet seem not to have had an impact on the prevalence of obesity and hypertension among the study participants (Table 8).

**3.2 Discussion**

Obesity is a condition associated with several life-threatening diseases such as hypertension [20,21]. It remains a public health issue, despite warnings from the World Health Organization of an escalating epidemic of obesity, with worldwide prevalence having more than doubled between 1980 and 2008 [22]. In this study, the mean BMI

was 26.11±6.3 kg/m<sup>2</sup>. This figure is comparable to that (25.72±5.79) reported from a population of penteco-charismatic church members in Kumasi by [23]. The prevalence of obesity among the population in this study ranged from 17% to 28% depending on the criteria used in the weight classification i.e. BMI, WHR and WC. It was also found out from this study that the prevalence of obesity generally increased with age up to about 64 years. This is consistent with results of other studies which also reported that obesity increases with age up to about 65 years old [23,24].

When BMI was used as the criteria for weight classification, the prevalence of obesity was found to be 18.3%, more than three times the national prevalence of 5.5% and twelve times the northern regional prevalence of 1.5% as reported by [25]. The difference in the prevalence of obesity could be as a result of the rapid urbanization over the period during which the two studies were conducted. Increased prevalence in obesity is attributable to urbanization with associated acculturation plagued with changes in diet and physical activity [26]. Besides, the effect of globalization coupled with speedy economic transition over the years, has resulted in the high intake of foods saturated with fats and salts [27].



**Fig. 5. The distribution of normal weight (A), overweight (B) and obese (C) using WHR and normal weight (D), overweight (E) and obese (F) using WC as the indicators among the studied participants classified by religious believe**

In contrast however, the prevalence of obesity as found in this study was lower than the 20.37% reported from a population of penteco-charismatic Christians in Kumasi by [23]. This difference in prevalence could be as a result of the variations in diet and lifestyle of the two study populations. As the second largest city in Ghana, Kumasi is generally socio-economically more advanced than Tamale. This advancement comes with easy access to high energy foods and less strenuous jobs resulting in many people having a positive energy balance and hence becoming more obese. Additionally, while the main dish (made from maize and millet) of the population in Tamale has moderate amounts of carbohydrates, that of the population in Kumasi, fufu (made from cassava and yam), has higher quantities of carbohydrates. This difference in diet of the two study populations, could also explain the higher prevalence of obesity in the study population in Kumasi than in Tamale.

This study also revealed a higher prevalence of obesity in females than in males when the

classification was done based on WHR (female, 27.6% vs male, 3.8%) and WC (female, 42.5% vs male, 9.8%). Higher prevalence of obesity in females than in males has been observed from several studies around the world. [23,24,28,29]. Higher prevalence of obesity in female than in male may be as a result of biological changes associated with female hormones and childbirth [30]. Besides more Ghanaian males tend to be involved in more physically active jobs than females, and hence burn more calories as compared to females. Furthermore, Ghanaians generally associate fatness with beauty in women, more women therefore work hard to put on weight in order to appear beautiful [24]. This study also showed that a significantly greater proportion of males had attained higher education and were more likely to comply with religious doctrines on fasting and diet. Higher education and religious compliance with diet and fasting have been found to be associated with decreased prevalence of obesity [15,31,32]. Thus a higher prevalence of obesity in females.

**Table 7. The prevalence of various body weight classifications stratified by age**

Variable	≤24(n=70)	25-34(n=106)	35-44(n=62)	45-54(n=38)	55-64(n=15)	≥65(n= 9)	P value
<b>BMI classes</b>							
Underweight	11(15.7%)	18(17.0%)	2(3.2%)	1(2.6%)	2(13.3%)	1(11.1%)	0.0322
Normal	46(65.7%)	43(40.6%)	13(21.0%)	9(23.7%)	0(0.0%)	2(22.2%)	< 0.0001
Overweight	11(15.7%)	32(30.2%)	29(46.8%)	17(44.7%)	5(33.3%)	3(33.3%)	0.0016
Obese	2(2.9%)	13(12.2%)	18(29.0%)	11(29.0%)	8(53.3%)	3(33.3%)	< 0.0001
<b>WHR</b>							
Normal	47(67.1)	60(56.6%)	24(38.7%)	13(34.2%)	2(13.3%)	1(11.1%)	< 0.0001
Overweight	15(21.4%)	40(37.7%)	19(30.6%)	16(42.1%)	7(46.7%)	5(55.6%)	0.0135
Obese	8(11.4%)	6(5.7%)	19(30.6%)	9(23.7%)	6(4.0%)	3(33.3%)	< 0.0001
<b>WC Classes</b>							
Normal	61(87.1%)	70(66%)	15(24.2%)	17(44.8%)	4(26.7%)	3(33.3%)	< 0.0001
Overweight	3(4.3%)	19(17.9%)	17(27.4%)	7(18.4%)	0(0.0%)	0(0.0%)	0.3845
Obese	6(8.6%)	17(16.1%)	30(48.4%)	14(36.8%)	11(73.3%)	6(66.6%)	< 0.0001

**Table 8. The prevalence of obesity (based on BMI, WHR and WC) and hypertension stratified by rate of compliance**

Variable	Religious compliance on fasting		
	Not at all (n=33)	Partially (n=129)	Fully (n=138)
BMI(km m <sup>-2</sup> )	2(6.1%)	33(25.6%)	20(14.5%)
WHR	5(15.2%)	23(17.8%)	23(16.7%)
WC (cm)	8(24.2%)	51(39.5%)	25(18.1%)
Hypertension	5(15.2%)	22(17.1%)	18(13.0%)
Variable	Religious compliance on diet		
	(n=157)	(n=69)	(n=74)
BMI(km m <sup>-2</sup> )	27(17.2%)	11(15.9%)	17(23.0%)
WHR	26(16.6%)	14(20.3%)	11(14.9%)
WC (cm)	48(30.6%)	16(23.2%)	20(27.0%)
Hypertension	24(15.3%)	10(14.5%)	11(14.9%)
Variable	Religious compliance on both diet and fasting		
	(n=31)	(n=48)	(n=57)
BMI(km m <sup>-2</sup> )	2(6.5%)	9(18.8%)	13(22.8%)
WHR	5(16.1%)	11(22.9%)	10(17.5%)
WC	8(25.8%)	14(29.2%)	5(8.8%)
Hypertension	5(16.1%)	8(16.7%)	5(8.8%)

Categorical data are presented as proportion

Various studies in Accra and Kumasi have pegged the prevalence of hypertension at 28.3% and 28.7% respectively [24,33,34]. In this study however, the prevalence of hypertension was found to be 15.0%, which is much lower than those reported by the studies from Kumasi and Accra. A direct relation has been found to exist between obesity and hypertension [35,36], and therefore, the difference could be as a result of higher prevalence of obesity in the study populations in Accra and Kumasi as compared to their counterparts in Tamale which results from higher socio-economic status leading to differences in diet and level of physical activities as explained earlier.

This study sought to compare the prevalence of obesity and hypertension between members

of the Pentecostal and orthodox population. From the study, even though more Pentecostals comply with their religious beliefs on diet and fasting than the orthodox Christians and more orthodox Christians consume alcohol and have attained tertiary education than their Pentecostal counterparts, there was no significant difference in the prevalence of obesity and hypertension between the two groups (obesity; Pentecostal, 18.5% vs orthodox, 18.1% and hypertension; Pentecostal, 12.6% vs orthodox 17.2%). Despite reports of an inverse impact of religious compliance to fasting, diet and higher level of education on obesity and hypertension [15,31,32] as well as a direct association between alcohol and obesity and subsequently hypertension [25,37,38], this appears to have had no impact on the

differences in prevalence of obesity and hypertension between the two groups. The reason for this is unclear from this study and may require further studies.

Generally, the rate of self-reported compliance to religious doctrines on fasting and diet seem not to have an impact on the prevalence of obesity and hypertension among the study participants. The reason for the observed results is unclear from this study and may warrant further investigations. However, it may partly be attributed to the self-reported data on fasting and diet as well as the time of the study. The study was conducted at a time where normal fasting periods were over and participants may have reverted to their normal eating habits leading to changes in BMI and hence less impact of the fasting and diet compliance on the prevalence of obesity.

#### 4. CONCLUSION

This study highlights the high prevalence of obesity and hypertension among both male and female Christian populations, with obesity being more prevalent among females. Also, self-reported compliance to religious doctrines on fasting and or diet, does not have an impact on the prevalence of obesity and hypertension. Further studies is recommended to ascertain the reason for this.

#### CONSENT

A verbal consent was sought from each participant before being included in the study. Subjects who did not give their consent were excluded from the study.

#### ETHICAL APPROVAL

Ethical clearance was sought from the Committee on Human Research, Publication and Ethics of the School of Medicine and Health Science and the Tamale Teaching Hospital, Tamale.

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#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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