ANTHROPOMETRIC AND REPRODUCTIVE CHARACTERISTICS OF GIRLS AND WOMEN IN KUMANA CHIEFDOM, KAURU LOCAL GOVERNMENT AREA OF KADUNA STATE, NIGERIA

BY

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Anthropometric and Reproductive Characteristics of Girls and Women in Kumana Chiefdom, Kauru Local Government Area of Kaduna State, Nigeria

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DECLARATION

I, Murdakai TANKO, declare that the work in the thesis entitled **"Anthropometric and Reproductive Characteristics of Girls and Women in Kumana Chiefdom, Kauru Local Government Area of Kaduna State, Nigeria"**was duly performed by me in the Department of Human Anatomy, Faculty of Medicine, Ahmadu Bello University, Zaria, Nigeria, under the supervision of Prof. S.S. Adebisi, Dr. B. Danborno and Prof. S.A. Ojo. The information derived and used for literature review has been duly acknowledged in the text and the list of references provided. No part of the thesis was previously presented for another degree or diploma at any University.

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CERTIFICATION

The thesis titled **"Anthropometric and Reproductive Characteristics of Girls and Women in Kumana Chiefdom, Kauru Local Government Area of Kaduna State, Nigeria"** by Murdakai TANKO meets the regulation governing the award of the degree of Doctor of Philosophy (Ph.D) of Ahmadu Bello University, Zaria, Nigeria, and is approved for its contribution to knowledge and literacy presentation.

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DEDICATION

This work is dedicated to God Almighty

My wife, Rifkatu Irimiya

My children, Sussana, Levi, Zipporah, Shalom and Rapha

My late father, Yunusa Adamu

My mother, Hauwa Adamu

My Brothers and Sisters

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ABSTRACT

Growth after birth may be characterized by five stages of life, which include infancy, childhood, juvenile, adolescence and adulthood. Puberty is the process of change that occur in the body of girls, in which the body matures into adulthood. It is associated with the development of sexual characteristics as the most notable morphological changes. Menarche as a very important reproductive phenomenal changes in the life of a female was first introduced by Kish in 1910 and is defined as the first menstruation that occur in the female taking into account as the age of her puberty and maturation. Another important aspect in the reproductive life of the female that ends with some degree of suddenness is menopause. Anthropometric data are very important and have direct relationship with medical conditions of the individual. The aim of this study was to investigate the relationship between the anthropometric and reproductive characteristics of girls and women in Kumana Chiefdom, Kauru Local Government Area, Kaduna State, Nigeria. The subjects for this study were girls and women that were not pregnant and both physically and mentally fit. The girls (n = 415) were randomly drawn from the nine secondary schools and the women (n = 623) were randomly drawn from villages in the eight districts of Kumana Chiefdom, Kauru Local Government Area, Kaduna State, Nigeria. The data of this study were obtained through questionnaire from the girls and the women, while the body composition, blood pressure, some demographic and anthropometric variables were obtained through measurements following the appropriate standard protocol. The result obtained showed that mean of the hip circumference for the women and girls were 92.94 ± 8.81 cm and 86.60 ± 7.30 cm respectively. The mean waist circumference for the women and girls were 80.59 ± 9.25 cm and 75.62 ± 4.20 cm respectively. The mean of the neck circumference of the women and girls were observed to be 31.43 ± 2.61 cm and 30.27 ± 1.92 cm respectively. The mean height of the women and girls were found to be 154.84 ± 6.12 cm and 151.33 ± 5.86 cm respectively. The mean of hand lengths of the women and girls were 17.91 ± 1.29 cm and 17.53 ± 0.92 cm respectively. The 2d-4d ratio of the women and girls are 0.94 ± 0.04 cm and 0.97 ± 0.06 cm respectively. The means of palm lengths of the women and girls were found to be 10.27 ± 0.74 cm and 10.02 ± 0.65 cm respectively. The means of foot lengths of the women and girls were seen to be 23.35 ± 1.37 cm and 22.88 ± 1.45 cm respectively. The means of forearm lengths of the women and girls were found to be 24.83 ± 1.44 cm and 22.94 ± 1.05 cm respectively. The means of bone mass of the women and girls were

2.02 ± 0.02 cm and 2.16 ± 0.16 cm respectively. The mean values of muscle mass of the women and girls are 38.33 ± 5.91 m^2 and 39.86 ± 2.37 m^2 respectively. The means of total body water percentage of the women and girls were 53.21 ± 8.65 % and 51.05 ± 5.00 % respectively. The mean values of the body mass index of the women and girls are 23.73 ± 3.71 kg/m^2 and 19.77 ± 2.79 kg/m^2 respectively. The mean values of the systolic blood pressure of the women and girls were 127.86 ± 19.06 and 117.95 ± 11.16 respectively. The mean values of the diastolic blood pressure of the women and girls were 81.02 ± 11.12 and 70.76 ± 9.54 respectively. The means of weight of the women and girls were 57.06 ± 9.35 kg and 45.43 ± 7.83 kg respectively. The mean menarcheal age of the women was found to be 15.58 ± 1.57 years and the mean menopausal age of the women was observed to be 47.17 ± 5.06 years. The menarcheal age of girls whose parents had attended tertiary education was observed to be lower than for the girls whose parents had attended only primary education. The menopausal age of the women was higher for the women with tertiary education, first order of birth and house wives. Girls born in the rainy season had higher menarcheal age than those born in the dry season, while women born in the rainy season were observed to have lower menarcheal age higher menopausal age was observed in women born in the rainy season than those born in the dry season, while the number of children born by a women did not have any effect on the woman's menopausal age. Women who had tertiary education and those born in the rainy season were seen to have higher menopausal age. Left-handed girls and women were observed to have higher menarcheal age than the right-handed. The result of this study showed that, higher percentage of the women were premenopausal, only 10.11% were menopausal. Many of the women were observed not to have ever had miscarriage, few of them reported to experience menstrual pain and only 24.4% of them reported not to be menstruating, indicating that many of them have the ability to become pregnant. It was observed that the women had good perception to menopause and knowledge of menopause by these women was obtained more through teachings in the church. There was positive relationship height and hand length, palm length, forearm length, foot length, menarche and the correlation were statistically significant at $p = 0.05$, but the correlation between height and little finger was observed not to be statistically significant. The correlation of age at first menses with height and hand circumference were statistically significant at $p < 0.01$, and statistically significant with weight at $p < 0.05$. The correlation between menopause and age at marriage, age at first pregnancy, at first birth, at last birth were statistically significant at $p < 0.01$, with age at first menses statistically significant at $p < 0.05$.

The correlation between menopause and body mass index, weight, hip circumference, digit ratio, waist circumference, neck circumference, birth order were statistically significant at $p < 0.05$ but with hand circumference, statistically significant at $p < 0.01$). The correlation between body mass index (BMI) and body circumferences was positive and significant at $p < 0.05$, strong positive was seen with neck and arm circumferences. It was observed that, height could only be estimated using weight and body mass index. In conclusion, it was found that the reproductive characteristics of girls and women in this study population correlated with most of the anthropometric measurements. The menarcheal and menopausal ages of the subjects were within the normal values, which indicated that the socio-economic level in this region was not below standard.

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LIST OF ABBREVIATIONS

AC: Arm circumference

ANOVA: Analysis of variance

AFM: Age at first menses

ANM: Age at natural menopause

AMHR2:Antimullerian hormone type 2 receptor

BMI: Bone Mass index

BP: Blood pressure

BMP15: Bone morphogenetic protein 15

BO: Birth order

BUS: Business

CC: Calf circumference

Cm: Centimeter

CVD: Cardiovascular disease

DBNP: Date before next period

DGR: Digit ratio

FM: Farmer

FSH: Follicle-stimulating hormone

GnRH: Gonadotropin- releasing hormone

GWAS: Genomic-wide association studies

HC: Hip circumference

HOD: Head of department

HRT: Hormone replacement therapy

HT: Height

H/W: House wife

KG: Kilogram

KG/M²: Kilogram per meter square

LGA: Local Government Area

LH: Luteinizing hormone

LT: Length

MM: Muscle mass

NC: Neck circumference

NHANES: National Health and Nutrition Examination Survey

PRT: Physique rating

SD: Standard deviation

STD: Student

TBW%: Total body water percentage

WC: Waist circumference

WD: Widow

WHO: World Health Organisation

WHR: Waist hip ratio

WT: Weight

UK: United Kingdom

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background of the Study

The pattern of human growth after birth may be characterized by five stages, which include infancy, childhood, juvenile, adolescence and adulthood, (Bogin and HollySmith, 1996). These stages are the life cycle of the individual that are defined by biological characteristics of which growth and sexual maturation are the two biological characteristics (Bogin and HollySmith, 1996). Menarche is the most important measure and indicator of onset of sexual maturation in a female, (Wronka and Pawlinska-Chmara, 2005; Gokhale, 2015; Song *et al.,* 2015) and the most significant milestone in the woman's life (Zegeye *et al.,* 2009). The term menarche was first introduced by Kish in 1910 (Biswas and Kapoor, 2004). The reproductive life of the female is affected by sexual maturation (Dakshayani *et al.,* 2007). Menarcheal age varies from population to population and is a sensitive indicator of various characteristics of the female population (Chumlea *et al.,* 2003; Ikaraoha *et al.,* 2005; Zegeye *et al.,* 2009). This is because it is affected by multitude of factors that include; socioeconomic status, physical activity, nutritional status, literacy level, hereditary, food habits, environment, climate, altitude, occupation, genetic causes and neuro-endocrine disorders (Thomas *et al.,* 2001; Ofuya, 2008; Zegeye *et al.,* 2009; Pramanik *et al.,* 2015). Karapanou and Papadimitriou (2010) in their study indicated that age at menarche is strongly correlated with body size parameters (Pramanik *et al.,* 2015). Socio-economic status has often been evaluated by measuring such features as population size, number of children in the family and education of the parents (Padez, 2003; Wronka and Pawlinska-Chmara, 2005; Kaplowitz, 2006). The age at menarche shows the effectiveness of the female reproductive hormones, luteinizing hormone (LH) and the follicle- stimulating hormone (FSH) (Ofuya, 2008). Studies suggested that menarche tends to appear earlier in life as the sanitary, nutritional and economic conditions of a society improve, (Kaplowitz, 2006) and for most females menarche occur between the age of 10 and 16 years, (Thomas *et al.,* 2001; Zegeye *et al.*, 2009), but it also shows remarkable range of variation, (Thomas *et al.*, 2001) and recent menarche is associated with highly irregular cycles (Frisch, 2002). There is declining trend in age at menarche in developed countries over decades highly attributed to excessive weight gain, but study conducted by Ayele and Berhan (2013) observed that the menarcheal age was higher than that reported from the developed countries.

Anthropometric data are very important and have direct relationship with the medical conditions of individuals (Adebisi, 2008; Danborno and Oyibo, 2008). Some certain factors contribute to more rapid decline in ovarian function and understanding them is important. While at birth there are approximately 700,000 follicles in the woman's ovaries, the number reduces markedly and by the time of last menstrual period of the woman only few follicles remain (Hunter and Rendall, 2007; Rance, 2009). Degeneration of non-growing ovarian follicles continually accelerates from time of births to menopause (Rance, 2009). Menopause is taken to be the permanent cessation of menstruation characterized by the depletion of ovarian, follicles diagnosed after 12 months of amenorrhea, is the transition from the reproductive to the non-reproductive stage of women's lives (Garrido-Latorre *et al.,* 1996; Utian, 2004; Biswas and Kapoor, 2004; Kriplani and Banerjee, 2005; Cassou *et al.,* 2007; Hunter and Rendall, 2007; Hong *et al.,* 2007), it is also referred to a non facultative and irreversible cessation of fertility (Peccei, 2001) and can always be considered an adaptation which is always morphologically, physiologically and developmentally constrained by an organism's phylogenetic heritage (Peccei, 2001). Menopausal transition is also associated with highly irregular cycles (O'connor *et al.,* 2001; Weiss, 2001; Williams, 2006; Mackey, 2009). The phase of reproductive ageing include menopause and the endocrinology of menopause transition represents a complex interplay of actions at all levels of the hypothalamic-pituitary-ovarian axis (Santaro, 2005; Morrison *et al.*, 2006).

Female fecundity decreases with increasing age, the process of reproductive aging varies considerably among women and some women remain highly fertile until the fifth decades of their life while some faces loss of natural fertility in their mid thirties, (Broekmans *et al.,* 2009). Menopause occurs on average between the ages of 50 and 51years (Kuhle, 2007; Hunter and Rendall, 2007; Achie *et al.,* 2011). The physical experience of it, is similar across temporal and spatial boundaries (Utz, 2011). Age at natural menopause may be a marker of health and ageing in which a better understanding of the determinants of its onset is therefore important (Cassou *et al.*, 2007), menopause produce a wide range of effects on a woman behavior and psyche resulting in unpleasant symptoms (Sidhu, *et al.,* 2005). The frequency and severity of symptoms associated with menopause differ within and between populations (Avis *et al.,* 2001; Sievert *et al.,* 2006), not every woman reports hot flashes and night sweats during menopause (Obermeyer, 2000; Sievert *et al.,* 2006). Late menopause has been linked to an increased risk of breast cancer (Hardy *et al.,* 2008), while early menopause is associated with increased risk of osteoporosis (Kritz-Silverstein and Barrett-Connor, 1993; Recker *et al.,* 2000; Hardy *et al.,* 2008). Several studies conducted have linked left-handedness, women with down's syndrome, increasing body mass index, depression, menstrual cycle length, parity, and smoking to early natural menopause (Harlow and Signorello, 2000; Whalley *et al.,* 2004; Ayatollahi *et al.,* 2005; Willis *et al.,* 2011) and late natural menopause is found to be associated with early menarche, use of oral contraceptives, marriage, higher level of education and higher socio-economic status (Mohammad *et al.,* 2004; Cassou *et al.,* 2007; Achie *et al.,* 2011), while factors as ethnicity, place of residence, marital status, family income, occupation and working condition still remain unclear (Cassou *et al.,* 2007).

The risks of coronary heart disease, osteoporosis and osteoporotic fracture are increased in postmenopausal women due to the decrease of estrogen (Murabito *et al.,* 2005). Therefore, it is probable that the mortality rate of early menopausal women is higher than that of normal menopausal women (Hong *et al.,* 2007). The need to access and determine the general body composition becomes very pertinent. Diagnosis of many medical and physical disorders is another important aspect of anthropometric data in that identifying factors associated with age at menopause is important (Dvornyk *et al.,* 2006). The perception and attitude of women towards these important reproductive changes in the female body is poor, thus the need for the women to be well informed about these changes is very important (Adewuyi and Akinade, 2010).

1.2 Statement of Research Problem

Anthropometric studies as well as comparative data between menarche and menopause is rarely available, or even unavailable and inaccessible on the girls and women in this study population. Variations and similarities that exist between anthropometric variables and some reproductive characteristics of the girls and women from this study population are unavailable. The need to study the attitude, perception and knowledge of the girls and women to the reproductive characteristics became imperative.

1.3 Significance of the study

The result of this study can be compared with the existing data from other parts of the country and would also provide a reference value for menarcheal age and menopausal age among the Nigerian girls and women. The result of this study may provide a reference value among Nigerian girls and women in the rural areas.

1.4 Justification of study

Anthropometric data of other minority ethnic groups are available, but none exist in this study region. Reproductive characteristics of women can be used to determine longevity of the women in this region. The perception and attitudes of females towards some reproductive characteristics would help in preparing them towards any unwanted eventualities and the need of a baseline data for the study population necessitate the reasons why this study need to be conducted.

1.5 Aim and objective of the study

1.5.1 Aim of the study

The aim of the study was to investigate the relationships between the anthropometric and reproductive characteristics of girls and women in Kumana Chiefdom, Kauru Local Government Area of Kaduna State, Nigeria.

1.5.2 Objectives of the study

The objectives of the study were to:-

i. describe the anthropometric characteristics of girls and women in Kumana Chiefdom.
ii. determine the pattern of reproductive characteristics of girls using mean menarcheal age.
iii. investigate the relationships between some anthropometric traits (Body mass index) and some reproductive characteristics, such as menarcheal and menopausal ages.
iv. determine the perception and attitude of the girls and women toward their reproductive changes
v. investigate relationships between (2D:4D) digit ratio, menarcheal and menopausal age in girls and women from Kumana Chiefdom.
vi. investigate the relationship between some anthropometric variables and height of the girls and women in Kumana Chiefdom
vii. determine the relationship of the reproductive characteristics and their determinants

1.6 Hypotheses of the study

I. There was no association between anthropometric trait and reproductive characteristics

II. The mean menarcheal age of girls and women from Kumana chiefdom is higher than the mean menarcheal age reported in studies conducted by other researchers

III. Season of birth and reproductive characteristics are strongly associated

IV. There was good perception and attitude by the women in Kumana Chiefdom to menarche and menopause

1.7 Limitations of the study

i. There was difficulty in getting permission from Principals of the Secondary Schools in which this study was conducted.

ii. There was difficulty in getting full cooperation from the women and inability of event recall of their reproductive history as well as the women inability to properly fill the research questionnaires.

iii. There was also mobility problem due to lack of good roads.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Puberty in Girls

Puberty is the process of change that occurs in the body of girls in which the body matures into adult hood. Puberty and adolescence are often used synonymous to refer to the developmental transition from childhood to adulthood, even though they are not the same (Sisk and Zehr, 2005). Puberty is the period during which the individual becomes capable of reproducing, while adolescence is the period between childhood and adulthood, encompassing not only reproductive maturation but also cognitive, emotional and social maturation (Sisk and Zehr, 2005). A biological hallmark of puberty is the elevated secretion of gonadal steroid hormones which produce the signs of reproductive maturation such as the development of breast or the appearance of facial hair. A biological hallmark of adolescence is the remarkable remodeling of cortical and limbic circuit which leads to acquisition of adult cognition, decision making strategies and social behaviours. Puberty and adolescence are intricately linked because the brain is the target organ for steroid hormones (Sisk and Zehr, 2005).

Some factors are responsible for the occurrence of puberty, prominent among these factors are genetic and environmental factors that are responsible for the timing of puberty in girls (Ge *et al.,* 2007). The average age at which puberty begins may also be affected by race as well, the African-American girls are found to have the earliest onset of puberty and the Asian girls having the latest onset of puberty (Mustanski *et al.,* 2004; Dunger *et al.,* 2005). Direct genetic effect have been found to account for at least 46% of the variations of timing of puberty in well-nourished populations, this genetic association is strongest between mothers and daughters (Commings *et al.*, 2002; Mustanski *et al*., 2004). Body fat or body composition may also play an important role in regulating the onset of puberty (Thomas, *et al.,* 2001). Puberty is associated with the development of sex characteristics which is the most notable morphological changes in the girl (Parent, *et al.,* 2003; Kail and Cavanaugh, 2010). There is early or late puberty, early puberty is term precocious puberty and the one that starts later than usual is known as delayed puberty. Some medical conditions in the girl may worsen or become apparent at puberty. It has been observed that childhood obesity may be related to early puberty (Davison, *et al.,* 2003). Nodding syndrome is a neurological disorder that affect children and adolescents in parts of East Africa (Winkler *et al*., 2008; Dowell *et al*., 2013) patients with the nodding syndrome have extreme short stature and delayed development of secondary sexual characteristics which causes delay in the onset of the Puberty (Piloya-Were *et al.,* 2014).

Some patients have also been observed to have delayed development of secondary sexual characteristics and very low height as compared to normal children. These types of patients are said to have Nakalanga syndrome, which is similar to the Nodding syndrome (Piloya-Were *et al*., 2014). Puberty only describes the physical changes to sexual maturation not psychosocial and cultural maturation that is described by adolescent (Gluckman and Hanson, 2006; Chukwujekwu *et al.,* 2014). The first sign of puberty in girls is a firm, tender lump under the center of the areola of one or both breast and the second is the pubic hair visible first along the labia. Perineal skin keratinizes under the influence of estrogen increasing its resistance to infection. At the completion of puberty uterine body to cervix ratio increases from 1:1 to 2:1 or 3:1.

2.2 Infertility

Infertility refers to an inability of couples to conceive after having regular unprotected sex for at least a year (Larsen, 2005). It is also referred to be the biological inability of an individual to contribute to the conception or to a female who cannot carry pregnancy to full term (Sule, *et al*., 2008). About 30% of infertility is due to females, 30% to male problems and 30% to combined male and female problems, while 10% is due to no recognisable cause. Infertility can lead to distress and depression as well as discrimination (Cui, 2010). To reduce the burden of this neglected disability an accurate profile of the prevalence is very important but this is very difficult because of the scarcity of population based studies (Sule *et al.*, 2008). The inability to have children affects both men and women (Cui, 2010). The clinical definition of infertility used by the World Health Organization (WHO) is a disease of the reproductive system that defined the failure to achieve a clinical pregnancy after 12 months or more of regular unprotected sexual intercourse or women of reproductive age at risk of becoming pregnant but do not become pregnant after having unprotected intercourse for more than two years (Mascarenhas *et al.*, 2012).

Fertility indicates the actual number of children born by a woman alive (Oyefara, 2011). There are two types of infertility, these are primary infertility and secondary infertility. Primary infertility is the absence of a live birth for women who desire a child and have been in a union for at least five years while secondary infertility is the absence of live birth for women who desire a child and have been in a union for at least five years after their last live birth without using any contraceptive (Mascarenhas *et al.*, 2012). There are causes to the infertility of women, these causes of infertility include tubal, uterine and ovarian factors, coital difficulties, and infections are other causes of infertility (Sule *et al*., 2008). High infertility has effect on the overall fertility and the rate of population growth (WHO, 2004), and the reproductive health of country ensures demographic prosperity (Douglas *et al.*, 2014)

The average fertility rate of a rural woman without any formal education was found to be 6.0 children while her counterpart with their education has 3.9 children, this indicate that education of women has inverse relationship with their fertility rate (Akpotu, 2008; Oyefera, 2011). Mothers who had their first birth before the age of 20 years are more likely to have significantly higher number of children ever born compared with mothers who had their first birth by age 20 years and above (Oyefara, 2011). According to WHO in 1989 said that early child-bearing shortens the period between generations extends the reproductive lifespan and tends to be associated with high population growth and that those who start having children early have more children at shorter interval than those who embark latter on parenthood (WHO, 1989). Studies have found that rural fertility is higher than urban fertility (Oyefara, 2011).

2.3 Menstrual Cycle Characteristics

Menstrual history of women can have very important implications for the woman’s health outcomes (Kuindzhi *et al.*, 2006; Williams, 2006). There is wide spread assumption of the existence of little variations in individual menstrual cycle length in most of the woman's reproductive years, this is according to earlier work done by Treloar *et al* in 1967. There is high variation in menstrual cycle length between individuals and within the individual, seasonal variations in menstrual cycle irregularity also exist and there are also variations between populations (Vitzthum, 2001; Creinin *et al*., 2004; Williams, 2006). The normal range for ovulatory cycle is between 21 and 35 days, most periods last between 3 to 7 days and the duration of the menstrual flow ranges from 2 to 7 days. Aribo *et al* (2015) in their work found that the duration of menstrual flow for most girls in both private and public schools was 4-5 days per cycle. Few years after menarche, irregular and longer cycles are common (Adams, 2002; Diaz *et al*., 2006; Fraser *et al*., 2007).

Menopausal transition is associated with highly irregular cycles (O'Connor *et al*., 2001; Weiss, 2001; Santoro, 2004; Williams, 2006). Knowledge of the length and variations of the menstrual cycle becomes necessary for patient education and identification of deviations from normal (Diaz *et al*., 2006; Zegeye *et al*., 2009). The most frequent disorders are polymenorrhea, olygomenorrhea and dysmenorrheal (Fraser *et al*., 2007; Singh *et al*., 2008; Rigon *et al*., 2012). Menstrual abnormalities are more common among younger girls which become less frequent as they grow older (Chang *et al*., 2009; Rigon *et al*., 2010; Rigon *et al*., 2012; Dambhare *et al.*, 2012; Victor *et al.*, 2015). According to a study conducted in Moscow, 18% of teenage girls have irregular menstrual cycle during the second year of menstruation and the girls take longer time to establish regular menstrual cycle (Douglas *et al.*, 2014) and that some girls were discovered to have increased risk of experiencing reproductive problems in future.

The interest in menstrual cycle has increase because it is found that estrogen may be involve in several health outcomes (Chavez-Machregor *et al*., 2005) irregular cycles have been implicated strongly with an increase risk of development of endometrial cancer (Solimann *et al*., 2005; Williams, 2006), non-insulin dependent diabetes mellitus (Solomon *et al*., 2001) and even rheumatoid arthritis (Williams, 2006). It is important to remember that prolonged menstruation intervals and heavy menstrual bleeding is giving serious attention most especially when these conditions are associated with anovulation or oligo-ovulation, hirsutism, cushing's disease, thyroid dysfunction, premature ovarian failure, strong physical exercise, eating disorders and congenital adrenal hyperplasia which are all examples of endocrine dysfunctions that can cause oligomenorrhea (Rigon *et al*., 2012). However, age was found in some studies not be associated with menstrual cycle length or irregularity, even though this may be because of the limited age range (Williams, 2006).

Menstrual cycle data can be used as direct measurement of hormones, because complex female ovarian cycle is determined by the release of these hormones (Williams, 2006). Menstrual cycle is divided into two phases as follicular and luteal phases with ovulation in between these two phases, luteinizing hormones (LH) and follicle-stimulating hormones (FSH) released from the pituitary gland. Seasonality of menstrual characteristics could be an interesting source of human cycle variation (Williams, 2006).

2.4 Adiposity

Anthropometry is the study of the measurement of human body in terms of the dimensions of bone, muscle and adipose tissue also (Adebisi, 2008). Measures of subcutaneous adipose tissue are important because, individuals with large values are at risk of hypertension, adult-onset diabetes mellitus, cardiovascular disease, gallstones, arthritis, some forms of cancer and other diseases, postmenopausal women have increased prevalence of comorbidities including obesity (Toth *et al.,* 2000: Chittawatanarat *et al.,* 2011) associated with these health outcomes. Obesity is associated with multiple adverse health outcomes (Hsu *et al.*, 2006; Reynolds *et al.*, 2007; Tanner *et al.*, 2012; Wells, 2012). Obesity can be defined as a level of body weight and adiposity that is sufficiently excessive to damage health and seen by an increased risk of various chronic diseases (Danei *et al.*, 2009). Before the 20th century obesity was rare (Haslam and James, 2005) until 1997 when the WHO formally recognized it to be a global epidemic (Haslam, 2007) and reported that 65% of the World's population live in countries where overweight and obesity kills more people than underweight.

World health organisation defines people as overweight if their Body mass index is between 25 and 30, obese greater than 30, and considers it to be of major risk factors for a number of chronic diseases (Haslam and James, 2005; Saka *et al.,* 2014). Adiposity is a continuous trait much like other life-history traits which is indicated by genetic evidence (Elks *et al.,* 2010). Recent studies have suggested that individuals with normal body weight as defined by body mass index (BMI) might still be at risk of metabolic syndrome, insulin resistance and increased mortality if they have a high body fat content

(Musa *et al.,* 2012) even people with normal body mass index (BMI) but enlarged waist circumference (WC) have a higher rate of cardiovascular events and death. Obesity relied on the subjective interpretation of physical appearance and the absolute body weight and the use of weight alone in estimating adiposity is inappropriate because it fails to consider the fact that body-weight is proportional to height (Romero-Corral *et al* ., 2010).

Body mass index is one of the most commonly used anthropometric measures to assess total body adiposity, which is a tool for the clinical assessment of obesity (Pouliot *et al* ., 1994). However, there are limitations in the use of body mass index in the assessment of adiposity in clinical practice, particularly among adults with Body mass index equal or less than 30 Kg/m^2 (Okorodudu *et al.,* 2010) this is because body mass index calculation does not distinguish between lean and fat mass, therefore individuals with normal weight but excess body fat may not be diagnosed as overweight or obese and adults with high levels of lean body mass may be misclassified as overweight or obese. The Body mass index that used to diagnose overweight or obese are assumed to be independent of age, sex, ethnicity and race (Okorodudu *et al.,* 2010). The measurement of height and weight (and hence of body mass index) is the easiest technique to use in epidemiological studies, when assessing body composition (Okorodudu *et al.,* 2010).

Simple measurements of body weight and body mass index do not yield good assessments of either the body composition or distribution of body fat, other tools are available to better assess the distribution of adiposity. Waist circumference has been shown to be a simple, inexpensive and effective way in assessing central obesity (WHO, 2004) and having high association with cardiovascular risk and mortality (Pouliot *et al.*, 1994). Waist circumference measurements have not been well adopted in clinical practice. Panel of experts have found eight different measurement locations documented for waist circumference as follows;

i. Half way between the lowest rib and the iliac crest (mid-point)

ii. Point of minimal circumference

iii. Immediately above the iliac crest

iv. Umbilicus

v. 2.5 cm above the umbilicus

vi. 1 cm above the umbilicus

vii. At the lowest rib

viii. Point of largest circumference around the waist (Ross *et al.,* 2008)

These waist circumference measurement sites do not provide the same estimate (Wang *et al.,* 2003; Bigaard *et al.,* 2005; Ross *et al.,* 2008; Mason and Katzmarzyk, 2009; Bosy-Westphal *et al.,* 2010) and most of these sites do not appear to be influenced by age or BMI (Ross *et al.,* 2008). The WHO, 2004, recommends the use of the mid-point waist circumference measurement. Another important consideration in establishing a standard site for WC is the predictability of CVD, morbidity and mortality associated with each measurement site. The WC cut points and their corresponding body mass index have been established to be $\geq$ 25kg/m^2 or $\geq$ 30kg/m^2, 80cm to 88cm for women and 94cm to 102cm for men respectively (Willis *et al.,* 2007). Waist circumference has been used to identify overweight and obesity, and also observed to have good correlation with age, weight, hip circumference, waist hip ratio, body mass index and positively with changes in systolic and diastolic blood pressure (Ben-Noun *et al.,* 2001; Ben-Noun *et al.*, 2004)

Hip circumference (HC) measurement is used to calculate waist hip ratio (WHR) which has been a subject of debate as a useful tool for the assessment of body composition (Snijder *et al.,* 2004) some also argue that ratio does not provide information on whether the WC is large or the HC is narrow and some also argue that HC adds value to the measurement of WC, because wider hips provide protection against CVD, however HC does not appear to be a significant predictor of all causes of mortality (Snijder *et al.,* 2004; Esmaillzadeh *et al.,* 2006; Mason and Katzmarzyk, 2010).

Neck circumference (NC) is another anthropometric measure that may also provide additional information for cardiovascular disease (Li *et al.,* 2010; Adamu, *et al.,* 2013; Preis, *et al.,* 2013). Several studies have shown that neck circumference measurement has been found to correlate with WC, WHR and BMI as well as metabolic syndrome risk factors (Ben-Noun and Laor, 2003; Ben-Noun and Laor. 2006; Onat *et al.,* 2009; Kawaguchi *et al.,* 2011). Neck circumference also provides risk assessment for obstructive sleep apnea independent of obesity (Preis *et al.,* 2010). Neck circumference has been found also be positively related to BMI, WC, HC and WHR, and stronger effect on the incidence of type 2 diabetes (Fink *et al.,* 2006; Barzi *et al.,* 2010; Zen *et al.,* 2012; Preis *et al.,* 2013)

2.5 Menarche

Menarche is a biological term that was first introduced in 1910 by Kisch. This biological phenomenon gets impression in women’s body pointing out an important stage of the women's reproductive life cycle (Alam *et al.*, 2015), and is her first periodical regular blood flow. This phenomenon also indicates the functional development of the female reproductive system (Biswar and Kapoor, 2004; Goon *et al.*, 2010; Talwar *et al.*, 2012). The first menstruation is taken into account as the age of puberty or maturity and it is from this stage that females are biologically capable to conceive (Ayatollahi *et al.*, 2002; Biswar and Kapoor, 2004). Menarche is one of the major indices of female fertility, making it very important to properly investigate it in a population (Kazeem *et al.*, 2005; Pejhan *et al.*, 2011; Hossain, *et al.*, 2013). Menstruation is an important and much valued event in the reproductive life of most women (Kazeem *et al.*, 2005; Pejhan *et al.*, 2011). The first scientific record on age at menarche was 158 years ago (Ong *et al.*, 2006; Adesina and Peterside, 2013). For most females, menarche occurs between the age of 10 and 16 years, but with range of variations (Thomas *et al.*, 2001; Zegeye *et al.*, 2009; Momoh and Okonkwo, 2009). The existence of "critical-fat theory" is supported by some investigators to be of importance for menarche to occur, while some studies do not support this theory, and they indicate that menarche may be related to relative distribution of the fat than the total amount of the body fat (Bhadra *et al.*, 2013).

Mean age of menarche varies from population to population and is known to be a sensitive indicator of various characteristics of population (Chumlea *et al.*, 2003; Chodick *et al.*, 2005; Wronka and Pawlinska-Chmara, 2005; Kaplowitz, 2006; Ofuya, 2007; Zegeye *et al.*, 2009). Aribo *et al.* (2015) found that there is difference in the menarcheal age of students in private schools compared with those in public schools. Information, sources and knowledge about menarche by girls is also important and has been found to be derived from mothers, which may be due to the close relationship between the girls and their mothers more so that, menarche is highly feminine affairs (Aribo, *et al.,* 2015). However, it was observed that the first period is usually traumatic (Bharatwaj, 2014).

Age at menarche reflects many health aspects of a population, including timing of sexual maturation (Zegeye *et al.,* 2009; Banik, 2011; Mumby, *et al.*, 2011), Biswar and Kapoor (2004) in their investigations found that the age at menarche of Saharia women varies from 12 to 15 years, with mean age of menarche to be 13.5 ± 0.84 (Biswar and Kapoor, 2004). Jack *et al* (2005) carried a study in Maiduguri, North-east zone of Nigeria and found the age at menarche to be 13.6 years, while Ikaraoha *et al* (2005) in their study found the mean age at menarche of girls in Rivers State of Nigeria to be 13.89 years. A cross sectional study conducted by Pejhan *et al.* (2011) in Iran found that most girls menstruated in the age range of 11-13 years old, with the mean menarche of 21.4 ± 1.4 years, which is lower compared with countries like Bangladash (15.8), Congo (13.83), Ghana (13.98), Tanzania (15.21) and Senegal (16.1), according to their studies they found the mean menarche of the Iranian girls to be similar to countries like America (12.8), Greece (12) and Italy (12.2) (Thomas *et al.,* 2001; Hwang *et al.*, 2003; Park *et al.,* 2006; Pejhan *et al.,* 2011) while the average of menarche in Russian group was found to be 12.6 years (Douglas *et al.*, 2014). There is currently a trend for girls to reach menarche significantly earlier than in previous generations across all racial and ethnic groups (Chodick *et al.,* 2005; McDowell *et al.,* 2007; Gillette *et al.,* 2012). Anderson *et al* (2003) conducted studies in US and they discovered that mean menarcheal age in American girls had decreased from 12.75 to 12.54 in a 20 year time span, which proved the decreasing trend of menarcheal age (Anderson and Must, 2005).

2.5.1 Factors influencing age at Menarche

There are considerable variations in weight, height and body mass index (BMI) of adolescent girls that attained menarche (Adesina, *et al.,* 2012). Studies have shown that girls who attained menarche have significantly higher weight, height and body mass index than girls of their age group who have not attained menarche (Hesketh *et al.*, 2002; Williams and Dickon, 2002; Lee *et al.,* 2007; Mane *et al.,* 2012). High BMI (obesity) in childhood has been linked to early puberty and menarche (Nicolas *et al.*, 2010; Aribo *et al.,* 2015; Alam *et al.,* 2015), but Osayande, *et al* (2014) in their study have earlier found no significant different in age at menarche between the normal, overweight and obese. Several studies have been done by many investigators on the influence of body structure on the menarche age, even though some researchers disagree on the role of these factors where they considered a bit of body fat to be necessary in the female adolescents and a minimum weight is required for starting the menstruation (Khakbazan *et al.,* 2005; Lassek and Gaulin, 2007; Gharravi *et al.,* 2008).

Body mass index has been found to be most relevant factor in determining the onset of menarche (Lee *et al.,* 2007; Onyiriuka and Egbagbe, 2013). With the increasing BMI the menarche occurrence rate also increased, giving the indication that physical condition of the girl was very appropriate for the first menstruation (Onland-Moret *et al.,* 2005; Pierce and Leon, 2005; Akbar *et al.,* 2013). Studies have shown that girls who attend menarche early have shorter height in adulthood, indicating a correlation between menarche and height, and that taller girls experience menarche earlier than shorter girls (Akbar *et al.,* 2013).

The cause of menarche is also linked to the frequency of the gonadotropin-releasing hormones (GnRH), which is pulse generated in the hypothalamus (Thomas *et al.*, 2001; Bayat *et al.*, 2012; Parker *et al.*, 2014). Childhood malnutrition can delay the onset of menstruation, although this does not prevent it from occurring. Better nutrition and improved socio-economic status are among the factors that lead to lower age of menarche (Karapanou and Papadimitriou, 2010). Factors like geographical location, cultural factors, attitudes and beliefs are also important in determining the timing of menstruation (Akbar, 2013). Study conducted in Australia girls from lower socio-economic status, shows a high mean menarcheal age of 13.99 years, compared to those girls with high socio-economic status, having an age of 9.61 years, meaning that girls of higher socio-economic class have lower age of menarche (Arteria and Hennerbeg, 2000). A study also conducted in Cape Town, South Africa found that girls of higher socio-economic status had an earlier age at menarche of 12.61 years and 13.30 years for girls in the lower socio-economic status (Akbar, 2013). The same study was conducted by Adedavoh *et al (*1989) in Ghana, who found that the mean age of menarche was 13.98 years, with a significant difference in the socio-economic class of their parents. Fawole *et al* (2002) found the mean age of menarche school girls in Nigeria to be 13.82 years, with significant difference in terms of social class. Both of them found a higher age at menarche for girls from low socio-economic status and a lower age for girls from high socio-economic group where they discovered that girls from higher socio-economic class had a better weight, height and BMI.

A study was conducted in Sokoto State which is in the far North West Zone of Nigeria and has the most depressing socio-economic and health indicators where about 77% of the population lives below poverty line and only 22% of the females aged 15 years are literate (Tunau *et al.,* 2012). It was found that the mean age of menarche for all the girls was 15.26 years in Sokoto State, significantly higher than the current age of menarche of 13.82 – 14.80 years (Tunau *et al.,* 2012). This age is higher than the 14.50 years reported in Nigeria more than 50 years ago, and even higher than the 14.51 years of those living in the slums and rural areas of Mozambique (Padez, 2003). The study conducted by Tunau *et al* (2012) found out that there was no significant difference in the age at menarche between the rural and urban school girls in Sokoto, even though the girls were from similar socio-economic status.

2.5.2 Health implications of early and late menarche

The age at which females reach sexual maturity, as evidenced by menarche is a critical determining factor of future reproductive success and overall health (Chodick *et al.*, 2005; McDowell *et al.,* 2007; Gillette *et al.*, 2012). Early menarche are risk factors for breast cancer and is associated with increased BMI indicating overweight and obesity, insulin resistance, total metabolic syndrome components and hence, increased cardiovascular risk (Feng *et al.,* 2008; Mumby *et al.,* 2011). Early menarche is also at risk to exhibit elevated blood pressure, risk factors of breast cancer and glucose intolerance compared to girls that start menstruation at later age (Remsberg *et al* ., 2005). Late age at menarche was found to be associated with almost three times long cycles and doubling the incidence of irregular cycles (Rowland *et al.*, 2002) and there is a report that indicate the existence of association between early age at menarche and increased risk for cardiovascular disease (Dreyfus *et al.*, 2015).

Girls that start menstruation at early age have slightly higher bone mineral density of the lumbar spine and femoral neck in older age (Gerdhem and Obrant, 2004). Early menarche leads to early sexual intercourse and is a risk factor for adolescent depression (Kaltiala-Heino *et al.,* 2003). Late menarche is associated with osteoporosis and increased risk of fractures (Bharathi, 2015). A study carried out by Gebremariam *et al* (2015) in Makelle City of Uganda found the menarcheal age of the girls to be delayed compared to Europe. The bone densities seemed to be at higher rate in women who attained menarche at an ideal age than compared to early menarche and late serum level of estrogen, race, body mass index (BMI), family history of osteoporosis, hysterectomy, early bone fracture, late menarche and early menopause (Xu *et al.,* 2014). Age at menarche is also influenced by the family composition, like the absence of a biological father, presence of half-brothers and step-brothers in which these seem to be associated with early menarche, while menarcheal age according to study conducted by Mpora *et al* (2014) was found not to be affected by the number of brothers in the family, so also they observed the menarche not to be affected by birth order.

The role of dietary patterns in determining age at menarche is not well understood in low- income countries, the age at menarche of girls in the slums is relatively high (Khopkar *et al.,* 2015). The onset of menarche was observed to be positively influenced by higher weight, body mass index and mid-arm circumference (Osemwenkha *et al.,* 2014) but an earlier study observed the menarche not to be significantly correlated with weight and height but was observed to be significantly correlated with 2D:4D ratio and low socio-economic status with delayed menarche (Ghosh *et al.,* 2012). Exercise and mother's age were observed in a study by Afshariani *et al* (2015) to be significantly associated with age at menarche, but no significant association was observed between age at menarche and parents educational levels. At the same time, they indicated that female athletes who begin training at younger age often have delayed menarche. The age at menarche is clinically valuable, since it forms a basis for diagnosing delayed puberty, pathologic and hormonal disorders, and it appears that the level of development is inversely related to the age of first menstruation which is higher in underdeveloped regions (Bayat *et al.*, 2012). Girls undergoing early menarche have a shorter final adult height when compared to late menarche group (Pramanik *et al.*, 2015).

2.6 Menopause

This is the aspect of the woman's life that shows her life experience, her reproductive life ends with some degree of suddenness in which her reproductive function completely ceases with arrest of ovulation. Menopause marks a dramatic change in the endocrine and reproductive status of women (Kevenaar *et al.*, 2007) and the end of womanhood. This is because the woman at this stage of her life would no longer be able to conceive. The definition of menopause is, according to that of the WHO 1981, the permanent cessation of menstruation (Gold, 2000; Al-Sejari, 2005) for a period 12 consecutive months, resulting from loss of ovarian activity that is not influenced by either drugs or surgical procedures. Two types of menopause are identified (Igbo and Ako, 2008; Adewuyi and Akinade, 2010) as premature and natural menopause. A natural menopause is when the menstrual flow has ceased for a complete twelve months, and the premature menopause is when it is induced by drugs or surgical operations of the ovaries (Kaczmarek, 2007). The biology of menopause has not changed according to Ellison (2001), but the cultural norms associated with it have undergone some radical transformation during the latter half of the 20th century (Bell, 2006; Nkwo and Onah, 2008; Utz, 2011). This is because it is now considered an unpleasant marker of age that requires medical attention, instead of a natural developmental transition of the woman's midlife (Meyer, 2003; Utz, 2011).

Studies in the past have shown that physical experience of this reproductive phenomenon is similar across temporal and spatial boundaries (Ellison, 2001). However, woman's life experience of the menopause varies depending on her personal characteristics as well as her social, cultural and historical perspective in which her life dwells in her midlife (Gold, 2000; Fu *et al.*, 2003; Utz, 2011) Ascertaining average age at natural menopause remains a topic of general interest, so is the influence of biological and social factors as well as the intra- and inter-cultural differences. It has been suggested that there is close relationship between mothers' and daughters' menopausal age (Peccei, 2001). The age at which natural menopause occur worldwide is between 45 and 55 years (Thomas *et al.*, 2001) and in Nigeria is between the age of 40 and 51 years (Achie *et al.*, 2011). Frequency and severity of symptoms associated with menopause such as night sweats and hot flashes differ within and between populations (Obermeyer, 2000; Avis *et al.*, 2001; Sievert *et al.*, 2006).

Williams (1957) hypothesized that for longevity to evolve, mechanisms should exist that increase the proportion of late versus early births and many organisms, age at attainment of sexual maturity appear to be positively correlated (Congdon and Richard, 1993) suggesting that menopause is adaptive (Armin and Daryl, 2009). Some authors suggest that age at natural menopause may be a marker of health and ageing (Sowers, 2000; Cassou *et al.*, 2007), and a better understanding of the factors or determinant of its onset may, therefore, have clinical and epidemiologic implications (Jacobsen *et al.,* 2003; Cassou *et al.,* 2007). Thus, the effective management of menopause is necessary so as to improve the quality of life of these women which may need simple hormone treatment (Nkwo, 2009).

2.6.1 Factors associated with early and late menopause

i) Cigarette smoking: This is one of the strongest risk factor for early menopause (Harlow and Signorello, 2000; Fuh *et al.,* 2003). Women who smoke are likely to have natural menopause one year earlier than those women who do not smoke, this is because of some compounds present in tobacco are found to be toxic to the ovarian germ cells and may also cause an effect on the estrogens making the hormone less active (Harlow and Signorello, 2000) that is to say that tobacco smoke might have specific anti-antrogen effect on the uterus. There is also the possibility of tobacco smoke having an effect on the hypothalamic-pituitary function and thereby delaying the surge of LH level (Harlow and Signorello, 2000). It is observed and suggested that ex-smokers experience menopause at an age more comparable to those that never smokes than even those who are current smokers (Harlow and Signorello, 2000). .

ii) Reproductive factors: Investigation on the effect of use of oral contraceptives, age at menarche, menstrual cycle length and parity on the age at natural menopause (ANP) have been conducted. Early menarche was found to be associated with early menopause, but not all studies share this concept (Harlow and Signollero, 2000; Nicolas *et al.,* 2010; Ubirani *et al.,* 2010). Shorter cycle lengths can decrease the age at natural menopause (Harlow and Signorello, 2000).

iii) Pregnancies and use of oral contraceptives are known to interrupt ovulations, and many studies have found nulliparous women to be at risk of early menopause while increasing parity is observed to be associated with late menopause. Women that have never been under any oral contraceptives have early onset of menopause (Harlow and Signorello, 2000).

iv) Depression; There is a period when estrogen level is expected to decline, this occur between the age of 35 and 45 years in the woman's life, which is during the late premenopausal years and coincide with the highest prevalence of major depression in women (Harlow and Signorello, 2000). Emotional factors have been shown to influence the pituitary-ovarian axis at the level of the hypothalamus (Rivier *et al.,* 1986).

v) Anthropometry; Thinner women are also known to reach menopause earlier (Recker *et al.*, 2000; Murkey *et al.*, 2011). Education, marital status and urban-rural living condition play important role in determining the age at natural menopause (Harlow and Signorello, 2000). Smoking, childhood or adolescent malnutrition and geographical location are also some factors that have effect on the onset of age at natural menopause (Harlow and Signorello, 2000). Handedness has been of great interest on early onset of age at natural menopause. Some studies have linked left-handedness in premature onset of menopause due the influence of autoimmune and reproductive disorders on hormone receptors and the oocytes (Rabinowe *et al.,* 1989). Leidy, (1990) conducted a study on some Mexican women and found that left-handed women have an early onset menopause than the right-handed women. However, a study conducted by Pavia *et al* (1994) found no association of handedness on menopause.

vi) Genetic and Neuronal; During foetal life, primordial follicle pool is formed, containing 6 to 7 million oocytes in 20 weeks foetus, after which the oocyte begins to dramatically decrease until there are approximately between 300,000 to 400,000 oocytes remaining in the new born baby (Forabosco *et al.*,1991), and the pituitary/hypothalamic responsiveness that influence the ovarian hormones. There is recruitment of the primordial follicles into growing follicles throughout life, during the reproductive years growth of these follicles into antral stage and subsequent loss of follicles as a result of atresia, leading to gradual decrease of the original follicles pool, resulting into menopause (McGee and Hsuch, 2000; Dixit *et al.,* 2006; Jack-Ide *et al.*, 2014).

Genes encoding proteins belonging to the TGFβ super family are found to be involved in primordial follicles recruitment and are considered to be genes for the timing of menopause (Durlinger *et al.,* 2002; Laissure et al., 2006; Voorhius *et al.,* 2011). Interactions between both rs200255 and rs11170547 in the AMHR2 gene and parity in determining age at menopause were found to exist, and there is also an association between rs6521896 in the BMP15 gene and age at menopause (Kevenaar *et al.,* 2007; Voorhius *et al.,* 2011). Voorhius *et al.,* (2011) suggest that women with the G/G genotype are possibly more fertile and have a later menopause compared with A/G and A/A genotype women and they also found that there is an association between genetic variants of AMHR2 and an unexplained infertility. Common variant allele frequencies of the AMHR2 gene polymorphisms were found to be lower in fertile women (Pettersson *et al.,* 2009; Rigon *et al.,* 2010).

The heritability of menopausal age has been estimated to be between 30% and 85% (Towne *et al.,* 2005; Murabito *et al.,* 2005) because studies by various scholars have found that menopausal age is genetically complex in origin and polymorphism in genes involved in estrogen metabolism have been associated with age at menopause (Gorai *et al.,* 2003; Hefler *et al.,* 2005; Kok *et al.,* 2005). Genetic loci for many traits, including menopause have been identified successfully using genomic-wide association studies (GWAS), in which four loci associated with normal age at menopause variation is identified to be located on chromosomes 19, 20, 6 and 5 (He *et al.,* 2009; Stolk *et al.,* 2009).

vii) Occupational, marital and socio-economic status and use of contraceptives, quality of life of women have significant influence on age at menopause (Maclennan *et al.,* 2004; Bhavnani and Strikler, 2005; Nkwo, 2009). Studies conducted by Hardy *et al* (2000) found no relationship between socio-economic status and age at menopause. Later menopause was associated with job strain where it was highest for those women with passive jobs and the mean age higher for women who were exposed to shift work than for those that are not so exposed. Women who were exposed to 48 hours per week or more at work have lower menopause than for other women and no association was found to exit with physical work constraints, standing during work, noise or even difficult schedules and menopause (Okasha *et al.,* 2001; Padez and Rocha, 2003;

Cassou *et al.,* 2007). No association was also observed between menopause and social or marital status in a study conducted by Cassou and his colleagues.

Women who reported repetitive work may have been in better healthy condition, having already put up with the working condition for a longer time and the effect on age at menopause of difficult schedules could be due to conflict between night work and circadian rhythms (Cassou *et al.,* 2007). The use of contraceptives is another factor that has been given some consideration, where it is found to delay the onset natural menopause (Garrido-Latorre *et al.,* 1996) but other studies like that of Harlow and Signorello (2000) observed that women with no history of oral contraceptives have earlier onset of age at menopause, while Brambilla and McKinlay (1989) had observed no relationship between the use of contraceptives and onset of natural menopause.

viii) Other factors like parity, breast-feeding, number of pregnancies and births have been studied and findings showed some differences in the number of pregnancies and births, where it was observed that there was a linear trend between women that had never have pregnancy or births and those with even a child. It was discovered that nulliparous women experience menopause by 2.6 years earlier (Garrido-Latorre *et al.,* 1996), while women that had ever breast-fed have average age for menopause 2.1 years later than those women who have never breastfed. On the other hand there was marked differences by number of children who were breast-fed (Garrido-Latorre *et al.,* 1996).

2.6.2 Concept and Attitude of women towards menopause

The experience of menopause by women differs, no two women experience menopause at the same time (Karim *et al.,* 2013). Most women do not know about symptoms and health hazards of menopause. Some of them don't even want to be treated of the menopausal symptoms and few of them express desire to receive education about it (Mazhar and Erum, 2003; Leon *et al.,* 2005; Kowalcek, *et al.,* 2005; Malik, 2008; Noroozi, *et al.,* 2013).

Perception and experience of menopause by women is found not to be universal and wide variations occur due to ethnic origin (Karim *et al.*, 2013). Many women have positive attitude towards menopause and they believed that it is a normal phase of life where they view it to be a good experience (Pan *et al.,* 2002; Biri *et al.,* 2005; Loutfy *et al.,* 2006; Bairy *et al.,* 2009; Delavar and Hajiahmadi, 2011). Studies conducted by Karim *et al.* (2013) discovered that women in developing countries face menopause better than the women in the western countries and that majority of the women lacked good knowledge of it. Menopause is associated with natural progressive alterations in the hormonal production and is not an illness (Jahanfar *et al.,* 2006; Ramakuela *et al.*, 2012), and the symptoms being an indication of the woman getting old, as such some women do not see it to be an overwhelming challenge. Some women commonly view menopause as freedom from monthly bleeding, and feeling of being complete women (Jahanfar *et al.,* 2006; Ramakuela *et al.,* 2012), while some women see it as point of not having a child. Culture also play a role in the way women cope with menopausal symptoms (Thomas, 2005; Ande *et al.*, 2011) and lack of knowledge of menopause causes negative perception toward it (Adewuyi and Akinade, 2010), leading to negative or neutral attitude (Castelo-Branco *et al.*, 2005).

Menopause has a comprehensive effect on all body systems (Nastri *et al.*, 2013). Experience of the symptoms vary from mild, moderate and severe, although some women do not even experience any symptoms (Bauld and Brown, 2009; Ayranci *et al.*, 2010). The severity of menopausal symptoms depends upon biological, cultural, social and psychological processes (Dillaway, 2005; Thomas, 2005; Nappi and Nijlland, 2008). Both educated and uneducated women are discovered to be aware of menopause and its implication (Ozumba *et al.*, 2004; Baig and Karim, 2006; Nusrat *et al.*, 2008; Dhia and Sadik, 2009; Mustafa and Sabir, 2012).

Several studies compared menopause knowledge and attitudes along racial lines correlated with hormone replacement therapy (HRT) use among black women and found that the black women were less likely to use HRT than the white women. Underestimation of menopause and its related risk factors such as cardiovascular disease and cancer was mostly discovered among blacks and English-speaking Caribbean women (Thomas, 2005). It was also discovered that awareness and use of hormone replacement therapy (HRT) are generally low among populations from different Asian countries (Huang, 2010; Hvas *et al.*, 2003).

Awareness of risk factors of menopause is critical to the knowledge and attitude of women to menopause (Ayers *et al.*, 2012). The unsympathetic nature of men are also barriers to the women not to seek any treatment for the symptoms of the menopause (Thomas, 2005). Menopause is symptomatic, many of the women see the symptoms as normal and that it is something all women go through, and is expected to be over even without treatment (Thomas, 2005).

2.6.3 Health implications of early and late Menopause

Menopause and its effect on quality of life for women remain incomplete and controversial according to Ayatollahi *et al.,* (2005). It may have an indirect effect on the bone metabolism of the woman. The nutritional status of an individual is an indication of his standard of living, which is very important in public health (Rebato *et al.,* 2001) and the calories needed by an individual each day vary depending on lifestyle of the individual such that estimated average requirements for women is a daily calorie intake of 1940, and for men is 2550 (Rebato *et al.*, 2001). Several illnesses have been associated with either early or late onset of age at natural menopause, for example, it has been implicated with increased risk of osteoporosis and cardiovascular disease (Kritz-Silverstein and Barrett-Conner, 1993; Egwaile *et al.,* 2012). Total free fat mass is significant in the determination of bone mass in both premenopausal women to be 22-49, and of post-menopausal women to be between 50-79 Genton *et al.,* (2011).

During menopause ovaries stop producing eggs and less estrogen and progesterone are produce. Studies have shown that nulliparous and use of oral contraceptives brings about early onset of age at natural menopause which is implicated in the risk for breast cancer but, women who experience later natural menopause have higher rates of breast cancer than does with early natural menopause (Henderson *et al.,* 2008) and also a marker for ageing (Cassou *et al.,* 2007). Effective management of menopause is necessary so as to improve the quality of the women which may need simple hormone treatment (Nkwo, 2009). The earlier the menopause occurs the greater the risk to the heart and bones. However, prolonged estrogen exposure carries risks particularly to higher breast and ovarian cancer rates. Generally, the later the menopause occurs the better the woman's health (Murkey *et al.*, 2011).

The risk of ovarian cancer is particularly strong if menarche is early, and if the body had no breaks from estrogen exposure due to pregnancy and breast-feeding, such that ladies that begin menstruation before the age of 12 years have cumulative risks (Murkey *et al.*, 2011). Menopause is accompanied with some emotional and social crisis that contribute to serious health problems like osteoporosis, and the most important nutritional factor in the prevention of it is by adequate intake of calcium and Vitamin D (Matkovic *et al*., 1990).

2.7 Stature

Stature is the height of the person in the upright posture. Stature is an important element often used to identify an individual (Pandhare *et al.,* 2013; Ebeye *et al.,* 2015), this become very necessary when only some part of the human body remain as a result of disasters like, bomb blast, stampede, terrorist attacks, fatal accidents and wars (Ruff, 2000; Duyar *et al.,* 2006; Krishan and Sharma, 2007; Anitie, 2007; Kanchan *et al.*, 2010; Ebeye *et al.,* 2012; Agnihotri *et al.,* 2013). Correlation between the height and some anthropometric parameters like hand length, finger length (Habib and Kamal, 2010) , foot length (Vijaykumar *et al.,* 2013), palm length (Kaur *et al.,* 2013b), foot breadth and fore arm length have been established, however, variations occur in different populations of these anthropometric parameters (Ozden *et al.,* 2005; Sanli *et al.,* 2005; Patel *et al.,* 2007; Danborno and Elukpo, 2008; Kumar *et al.,* 2008; Danborno, 2009; Ilayperuma *et al.,* 2009; Rastogi 2009; Jitender *et al.,* 2010;; Chikhakar *et al.,* 2010; Chittawatanarat *et al.,* 2012; Pradeep and Abhiladha, 2012; Patel *et al.,* 2012; Mansur *et al.,* 2012; Agrawal, *et al.,* 2013; Ibegbu *et al.,* 2013, 2014; Iyoti *et al.,* 2013; Pandhare *et al.,* 2013; Vijaykumar *et al.,* 2013; Jitendra *et al.,* 2014; Satosh, *et al.,* 2014). This correlation has been observed in Nigerian children (Ibegbu *et al.,* 2013), however, there are some studies conducted that show no positive relationship between finger length ratios and height (Ibegbu *et al.,* 2012), in contrast to Suseelamma *et al* (2014), where a relationship was observed between finger length and the height.

The determination of stature is a very important step in the identification of disarticulated body that would have occurred in a fatal accidents or disasters (Khanapurkar and Radke, 2012; Ibegbu *et al.,* 2012; Matheswaran and Vallabhajosyula, 2014). Some of these anthropometric parameters are very important in adjusting drug dosages, in many cases as alternatives where height of an individual could not be accurately measured and to predict body weight and foot length (Ebite *et al.,* 2008; Bidmos, 2009; Ibegbu *et al.,* 2013). The significant of stature in forensic medicine and forensic anthropology, where the hand and foot dimension play major roles in the determination of sex and age (Amireheybani *et al.,* 2000; Amireheybani *et al.,* 2001; Jasuja *et al.,* 2004; Jasuja and Singh, 2004; Oommen *et al.,* 2005; Fessler *et al.,* 2005; Damirel *et al.,* 2014).

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Materials

The anthropometric equipment that were used in this study were; the Stadiometer, Measuring tape, skin-fold and Vernier calipers, Digital BP Apparatus and the Inner Scan Body composition Monitor.

3.1.1 Height and Weight Measurements:

Stadiometer was used to measure height and weight, where the subjects were made to stand on the stadiometer, with the weight evenly distributed on both feet and without shoes. The heels of the feet were placed together with both heels touching the base of vertical board of the stadiometer (NHANES, 1998). The feet pointed slightly outward at 60 degrees angle, with the subject putting on light clothes. The weight was measured to the nearest 0.1 kg and the height was measured from the sole of the feet to the vertex of the head, and recorded to the nearest 0.1 cm.

3.1.2 Measurement of Blood Pressure:

The blood pressure was measured using (OMRON) M2 Basic Automatic Blood Pressure Monitor according to (Pickering, 1996; Wagner *et al.*, 2012; Egwaile *et al.*, 2016). The subjects were told to sit comfortably with their back supported, upper arm bared without constrictive clothing, legs uncrossed and the feet resting on a firm surface (Williams *et al.*,2009).

Plate I: Vernier caliper for the measurement of digit length

Plate II: Holdan manual skinfold caliper and measuring tape for the measurement of thickness of the skin, and body circumferences

Plate III: Stadiometer for the measurement of weight and height

Plate IV: Inner scan body composition monitor for reading of body composition

Plate V: M2 Basic Automatic Blood Pressure Monitor, for reading of blood pressure

3.1.3 Use of Measuring Tape

The measuring tape was used to measure the arm circumference, forearm circumference, foot circumference, hand circumference, neck circumference, waist circumference, hip circumference, calf circumference, arm length, forearm length, foot length, hand length, palm length, finger length, calf length (Snijder *et al.*, 2004).

I. **Arm circumference (cm):** The measuring tape was wrapped around the arm at a point halfway between the shoulder and the elbow, the tape rested on the skin surface but not pulled tight enough so as not to compress the skin and the reading from zero point of the measuring tape was recorded to the nearest 0.1 cm

II. **Forearm circumference (cm):** The measuring tape was wrapped around the forearm at a point about ¼ (one fourth) distal to the elbow and the reading from zero point of the measuring tape was recorded to the nearest 0.1 cm

III. **Foot circumference (cm):** The measuring tape was wrapped round the foot at the highest point of the foot about 2/3 from the tip of the big toe and reading recorded to the nearest 0.1 cm

IV. **Hand circumference (cm):** The measuring tape was wrapped the fist hand and the reading was recorded to the nearest 0.1 cm

V. **Neck circumference (cm):** The measuring tape was wrapped round the neck at a point on the Adam's apple and the reading recorded to the nearest 0.1 cm

VI. **Waist circumference (cm):** The subject was made to stand erect and the tape was wrapped round at a point immediately above the iliac crest (Ross *et al.*, 2008; NHANES, 1998). The subjects were told to make a minimal respiration and the measurement of the waist circumference was taken to the nearest 0.1 cm

VII. **Hip circumference (cm):** The subject was told to stand erect with the feet together and weight evenly distributed on both feet and the measuring tape wrapped around the maximum extension of the buttocks, the measurement was read loudly by the research assistant and was recorded to the nearest 0.1 cm

VIII. **Calf circumference (cm):** The measuring tape was wrapped round the leg at the point of highest protrusion of the calf and the measuring taken to the nearest 0.1 cm

IX. **Forearm length (cm):** The measuring tape was placed on the flexed forearm, measurement was taken at a point about ¼ (one fourth) distal to the elbow and recorded to the nearest 0.1 cm

X. **Foot length (cm):** The measuring tape was placed at the posterior most point of the heel to the tip of the big toe and the measurement recorded to the nearest 0.1 cm

XI. **Hand length (cm):** The measuring tape was placed on the palmer surface of the hand from the wrist to tip of the middle finger and recorded to the nearest 0.1 cm

XII. **Palm length (cm):** The measuring tape was placed on the palmer surface of the hand from the wrist to the most proximal crease of the middle finger and the measurement was recorded to the nearest 0.1 cm

XIII. **Calf length (cm):** The measuring tape was placed at the back of the knee, mid-point of the popliteal fossa to about the middle of the leg, which is the high of the highest posterior protrusion of fleshy part of the calf muscles. The reading on the measuring tape was recorded to nearest 0.1 cm

XIV. **Finger length (cm):** Vernier caliper was used for the measurement of the digits from the most proximal crease of the digits to the tip of the first, second, third, fourth and fifth digits in the right hand and the measurement was recorded to the nearest 0.1 mm and converted to centimeters.

XV. **Skinfolds:** The measurement was done using (Holtain UK) skinfold calipers taken at the right side of the body to the nearest 0.1 mm according to the recommendations of the international biological programme (Weiner and Lourie, 1969). The skin was grasped 2.0 cm above the point and gently with the thumb and forefinger, the caliper was applied on the site and the actual measurement was read from the caliper about 3 seconds after tension was released. The skinfold measured were the waist, abdominal, arm (biceps), forearm and the back of hand, two measurements were performed on each and the mean was used for the analyses.

XVI. **Body composition:** Body composition monitor was used to analysed the body composition by using a simple principle. The body fat %, total body water %, muscle mass, bone mass, visceral fat rating, basal metabolic rate, metabolic age and physique rating were obtained using the monitor.

3.2 Methods

3.2.1 Study area

The study was conducted in Kumana Chiefdom. (Fig. 2) is one of the three Chiefdoms in Kauru Local Government Area of Kaduna State, Nigeria (Fig. 1). The Chiefdom is bounded to the West by Kajuru Local Government, to the South- West by Zangon Katap Local Government, to the East by Lere Local Government, to the South Tsam Chiefdom and to the North by Kauru Chiefdom. There are about twelve minor ethnic (tribes) groups in this Chiefdom and Nine Junior/Senior Secondary Schools of both boys and girls. The tribes in this Chiefdom are Surubu, Ruruma, Rumaiya, Kaibi, Rishiwa, Kuzamani, Binawa, Kono, Kiwollo, Dingi, Kinugu and Kitimi (Fig. 1).

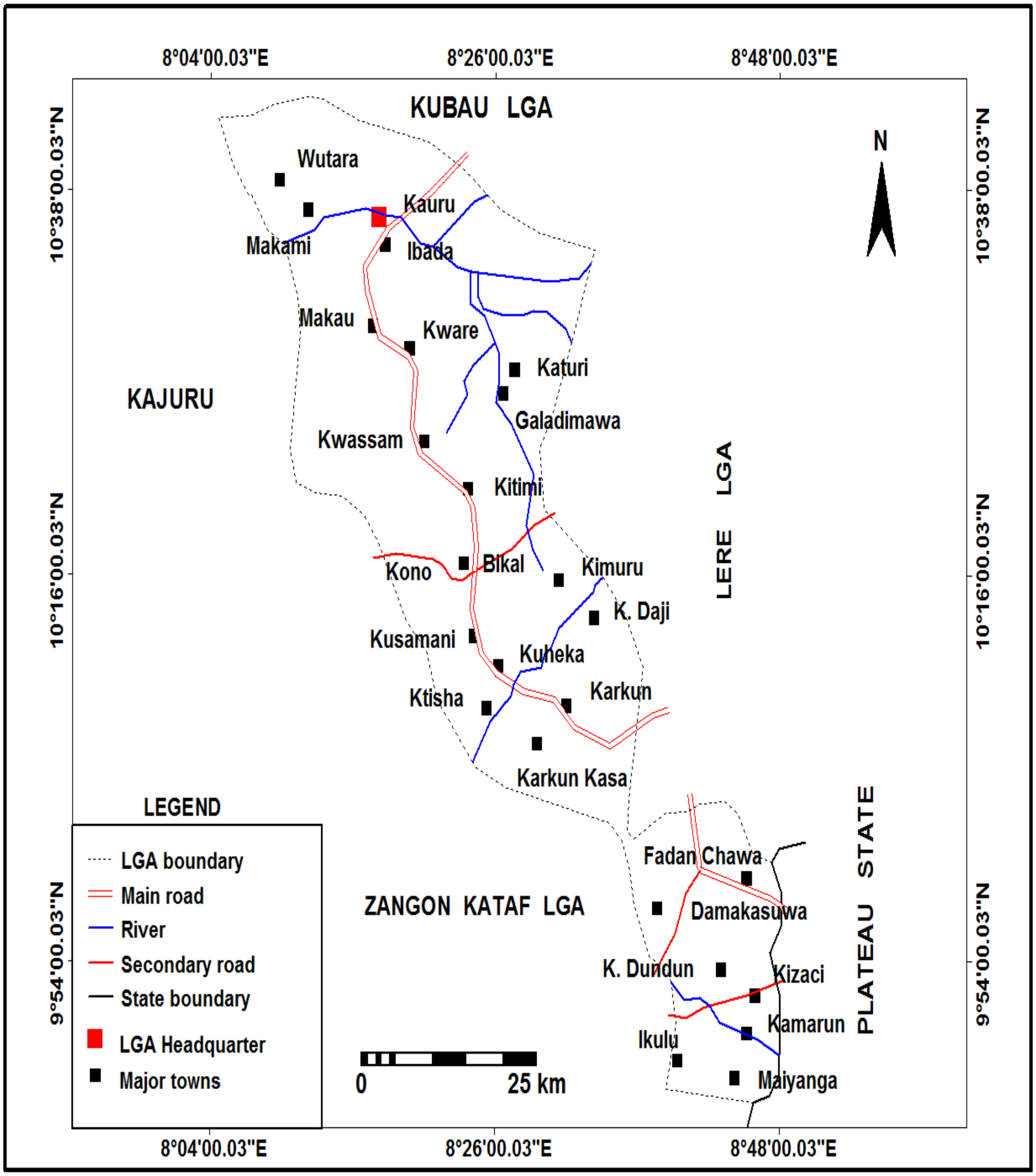


Fig. 3.1: Kauru Local Government Area, (Adapted and Modified from Kauru Local Government Area Map 2006 Nigerian population census)

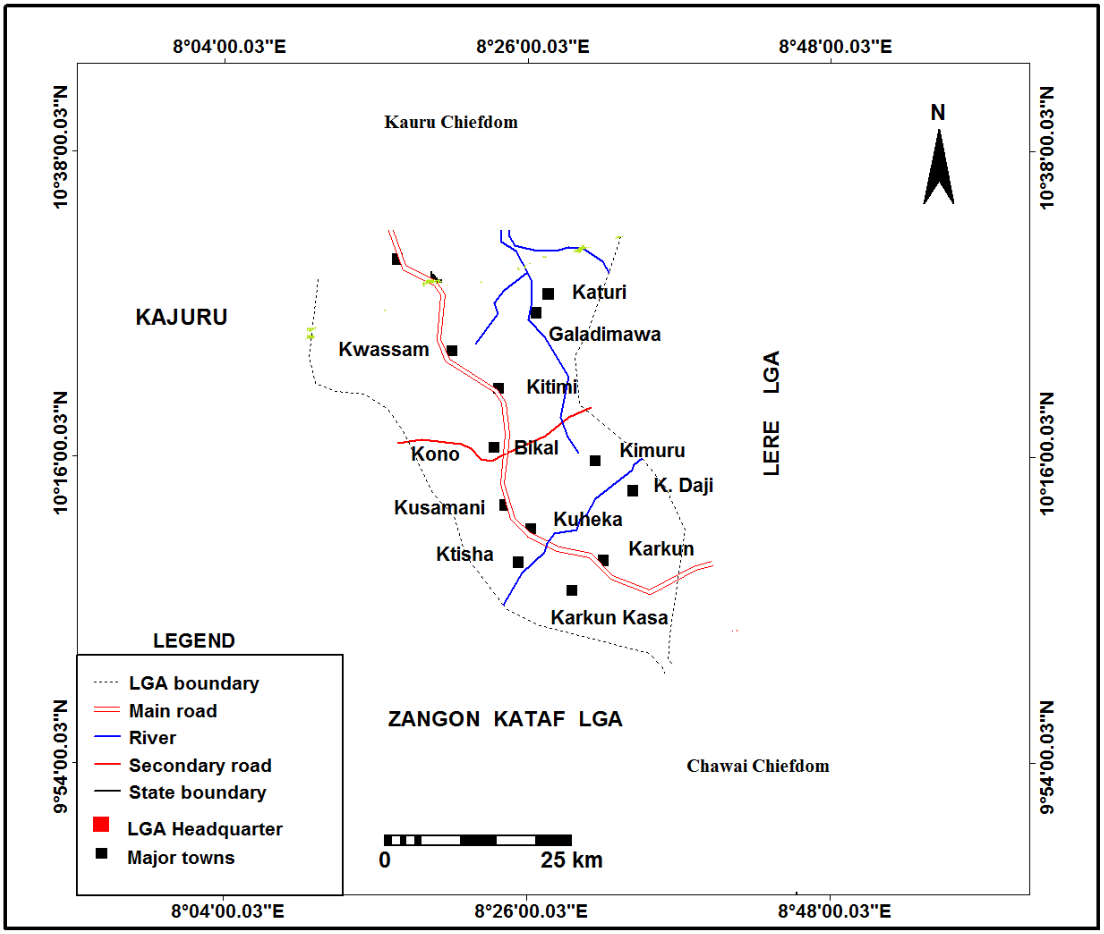


Fig. 3.2: Kumana Chiefdom, Kauru Local Government Area (Adapted and Modified from Kauru Local Government Area Map, 2006 Nigerian population census)

3.3 Study population

3.3.1 Subjects

The total number of subjects that participated in the study was 1,038. The number included 415 girls that were drawn from the nine Secondary Schools, and 623 women who were either, premenopausal, menopausal or postmenopausal.

3.3.2 Sample determination

The sample size will be calculated using the formula below;

Sample size = Z2pq/d2

Where n = desired sample size

Z = standard normal deviation 1.96 at 95% confidence level

d = degree of precision=0.05

p = proportion=0.7 (70%)

q = 1.0-p

n = 304 (Naing *et al.*, 2006)

3.3.3 Inclusion and exclusion criteria

I. **Inclusion criteria**

a. The girls that were used in the study were between the ages of 10 to 22 years, and were indigenes of Kumana

b. The girls had never been pregnant (nulliparous)

c. The women that were used in this study had at least stayed in Kumana chiefdom for a minimum of 10 years, not pregnant and were mentally and physically fit

II. Exclusion criteria

Pregnant girls and women, girls and women that were physically and mentally sick.

3.3.4 Questionnaire

All the subjects were given a structured research questionnaire which they filled. These questionnaires were in two sets, one set was completed by the women and the other set of the questionnaire was completed by the girls who were between ages of 10 and 22. Girls, the women who could not read and write were assisted. The study was a prospective one where the data was collected through the questionnaire that was distributed to 650 women and 450 girls, but 27 of the questionnaires distributed to the women were not returned and 35 were not returned by the girls. The information in the questionnaire included: reproductive history, personal data and socio-demographic data. On the completion of the questionnaire, anthropometric measurement was done and recorded in their respective questionnaire according to the standard stipulated by WHO, (1986) for the anthropometric parameters (WHO, 1986). The blood pressure of all the girls and women were also measured using Omron digital blood pressure monitor, and recorded in their questionnaire. Using the inner scan body composition monitor, the body composition parameters such as the bone mass, muscle mass, metabolic age, basal metabolic rate, visceral fat, total body water, physique rating and percentage body fat were also taken and recorded in their questionnaire.

3.3.5 Ethical approval

i. Ethical approval was obtained from the Ethical Committee of the Faculty of Medicine, Ahmadu Bello University, Zaria (Appendix IV).

ii. Introductory letter was obtained from the Department of Human Anatomy, Ahmadu Bello University, Zaria, which was presented to the Department of Health, Kauru Local Government Area and Principals of the Secondary Schools that were used in this study.

iii. Participants were also given a consent form, which they filled as their agreement of participation in the study (Appendix I).

3.3.6 Data Analyses

i. The data were reported and analyzed using descriptive statistics of mean ± SD. and percentages

ii. Student's *t*- test and analysis of variance to evaluate the difference in the mean of the subgroups.

iii. Chi – square test was used in comparing proportions between subgroups.

iv. Pearson's correlation analysis was used to test relationship between each of the measured anthropometric parameters.

v. Alpha value was set as 5%, and statistical package for social sciences (SPSS) 17 for Windows (IBM, Coop, NY) was used for the statistical analyses, Charts were produced using Microsoft Excel for Windows©

CHAPTER FOUR

4.0 RESULTS

4.1 Descriptive statistics of the study

Table 4.1 shows the mean values body circumferences of the girls and women of the study population. The mean values of the hip circumference for the women and the girls were found to be 92.94 ± 8.81 cm and 86.60 ± 7.30 cm, respectively. The mean values of waist circumference for the women and girls were 80.59 ± 9.25 cm and 75.62 ± 4.20 cm respectively and the mean values of the neck circumference of the women and girls were 31.43 ± 2.61 cm and 30.27 ± 1.92 cm, respectively.

Table 4.2 shows the mean values of height and some anthropometric variables. The means values of the height of the women and girls of the study population were observed to be 154.84 ± 6.12 cm and 151.33 ± 5.86 cm, respectively. The means values of hand lengths of the women and the girls were observed to be 17.91 ± 1.29 cm and 17.53 ± 0.92 cm respectively, the 2D:4D radio of the women and the girls were observed to be 0.94 ± 0.04 and 0.97 ± 0.06 cm, respectively. The means values of the palm lengths of the women and the girls of the study population were observed to be 10.27 ± 0.74 cm and 10.02 ± 0.65 cm, respectively. The means values of the foot lengths of the women and the girls were 23.35 ± 1.37 cm and 22.88 ± 1.45 cm, respectively. The means values of the forearm lengths of the women and the girls were 24.83 ± 1.44 cm and 22.94 ± 1.05 cm, respectively.

Table 4.3 shows the means of the body composition of the study population. The mean values of bone mass of the women and the girls were 2.02 ± 0.20 kg and 2.16 ± 0.16 kg, respectively. The mean values of muscle mass (MM) of the women and girls are 38.33 ± 5.91 kg and 39.86 ± 2.37 kg, respectively. The mean values of total body water percentage (TBW%) the women and girls are 53.21 ± 8.65 % and 51.05 ± 5.00 %, respectively. The mean values of the calorie intake of women and the girls are 2128 ±2 16.55 and 2279.74 ± 156.44, respectively.

Table 4.4 shows the mean values of the ages of the women and the girls of the study population to be 39.28 ± 1.31 years and 15.71 ± 2.28 years, respectively. The mean values of the body mass index of the women and girls of the study population were observed to be 23.73 ± 3.71 m/kg^2 and 19.77 ± 2.79 m/kg^2, respectively. The mean values of systolic pressure of the women and girls were 127.86 ± 19.06 mmHg and 117.95 ± 11.16 mmHg, respectively and the mean values of diastolic pressure of the women and girls of the study population were observed to be 81.02 ± 11.12 mmHg and 70.76 ± 9.54 mmHg, respectively. The mean values for the weight of the women and girls were found to be 57.06 ± 9.35 kg and 45.43 ± 7.83 kg, respectively.

Table 4.5 shows the mean menarcheal age of the women to be 15.577 ± 1.569 years and the mean value of the age at menopause was observed to be 47.172 ± 5.061 years.

Table 4.1: Descriptive statistics of body circumferences of the girls and women in the study population

Variables (cm)	**Women (n = 623)** Mean ± SD	Maximum	Minimum	**Girls (n = 415)** Mean ± SD	Maximum	Minimum
Hip circumference	92.94 ± 8.81	120.00	67.00	86.60 ± 7.30	108.00	58.00
Waist circumference	80.59 ± 9.25	110.00	50.00	75.62 ± 4.20	99.00	16.00
Arm circumference	26.39 ± 2.95	42.00	18.00	24.02 ± 2.14	29.00	18.00
Neck circumference	31.43 ± 2.61	39.00	22.00	30.27 ± 1.92	38.00	25.00
Forearm circumference	20.96 ± 2.32	42.00	15.00	21.06 ± 1.69	25.00	17.00
Elbow circumference	23.95 ± 1.98	32.00	20.00	22.91 ± 1.69	26.50	19.00
Calf circumference	30.55 ± 2.73	40.00	25.00	30.14 ± 2.63	37.00	25.00
Foot circumference	22.00 ± 1.51	32.00	18.00	21.80 ± 1.52	32.00	16.50
Hand circumference	22.44 ± 1.49	28.00	18.00	22.78 ± 1.39	26.00	19.00

Student's *t* -test showed significant difference in hip circumference at $p < 0.001$, waist circumference at $p < 0.001$, neck circumference at $p < 0.001$, foot circumference at $p < 0.001$, and hand circumference at $p < 0.001$

Table 4.2: Descriptive statistics of some anthropometric variables

	Women (n = 623)			Girls (n = 415)		
Variables (cm)	**Mean ± SD**	**Maximum**	**Minimum**	**Mean ± SD**	**Maximum**	**Minimum**
Height	154.84 ± 6.12	174.00	114.00	151.33 ± 5.86	169.00	136.00
2d:4d	0.97 ± 0.04	1.22	0.78	0.97 ± 0.06	1.40	0.81
Hand length	17.91 ± 1.29	22.00	15.00	17.53 ± 0.92	20.50	14.00
Foot length	23.35 ± 1.37	30.00	17.50	22.88 ± 1.45	26.00	16.00
Palm length	10.27 ± 0.74	12.00	8.00	10.02 ± 0.65	12.00	8.50
Forearm length	24.83 ± 1.44	29.00	21.00	22.94 ± 1.05	26.00	20.00

Student t-test showed significant difference in height at $p< 0.001$, 2d:4d at $p < 0.029$, hand length at $p < 0.001$, foot length at $p <0.001$, palm length at $p < 0.001$, forearm length at $p < 0.730$

Table 4.3: Descriptive statistics of body composition of the study population

Variables	Women (n = 623) Mean ± SD	Maximum	Minimum	Girls (n = 415) Mean± SD	Maximum	Minimum
Bone mass (kg)	2.02 ± 0.20	2.90	1.10	2.16 ± 0.16	2.50	1.90
Calories	2128.28 ± 216.55	2874.0 0	1179.00	2279.74 ± 156.44	2718.00	1737.00
Metabolic age (years)	22.09 ± 11.89	58.00	12.00	28.38 ± 12.62	45.00	12.00
Muscle mass (kg)	38.33 ± 5.91	61.80	14.60	39.86 ± 2.37	43.80	34.50
Physique rating	5.58 ± 2.11	15.00	1.00	6.21 ± 1.56	9.00	4.00
Total body water (%)	53.21 ± 8.65	83.60	18.00	51.05 ± 5.00	62.30	45.60
Visceral fat rating	3.75 ± 2.21	12.00	1.00	3.94 ± 1.66	6.00	1.00

Student's – test showed significant difference in Bone mass at $p < 0.001$, Calories at $p < 0.001$, Metabolic age at $p < 0.001$,Total body water% at $p < 0.088$

Table 4.4: Descriptive statistics of age, systolic blood pressure, diastolic blood pressure, body mass index and weight of the study population

Variables	Women (n=623)			Girls (n=415)		
	Mean ± SD	Maximum	Minimum	Mean± SD	Maximum	Minimum
Age (years)	39.28±1.31	80.00	20.00	15.71 ± 2.28	22.00	10.00
Systolic Blood Pressure(mmHg)	127.86 ± 19.06	232.00	80.00	117.95 ± 11.16	147.00	79.00
Diastolic blood pressure (mmHg)	81.02 ± 11.12	123.00	38.00	70.76 ± 9.54	100.00	44.00
Body mass index (Kg/m^2)	23.72 ± 3.71	38.54	7.77	19.77 ± 2.79	27.34	6.81
Weight (kg)	57.06 ± 9.35	95.00	39.00	45.43 ± 7.83	64.00	17.00

Student t-test showed significant difference in age at $p < 0.001$, Systolic blood pressure at $p < 0.001$, Diastolic blood pressure, Body mass index at $p < 0.001$ and Weight at $p < 0.001$

Table 4.5: Descriptive Statistics of reproductive history of women in Kumana chiefdom (n=623)

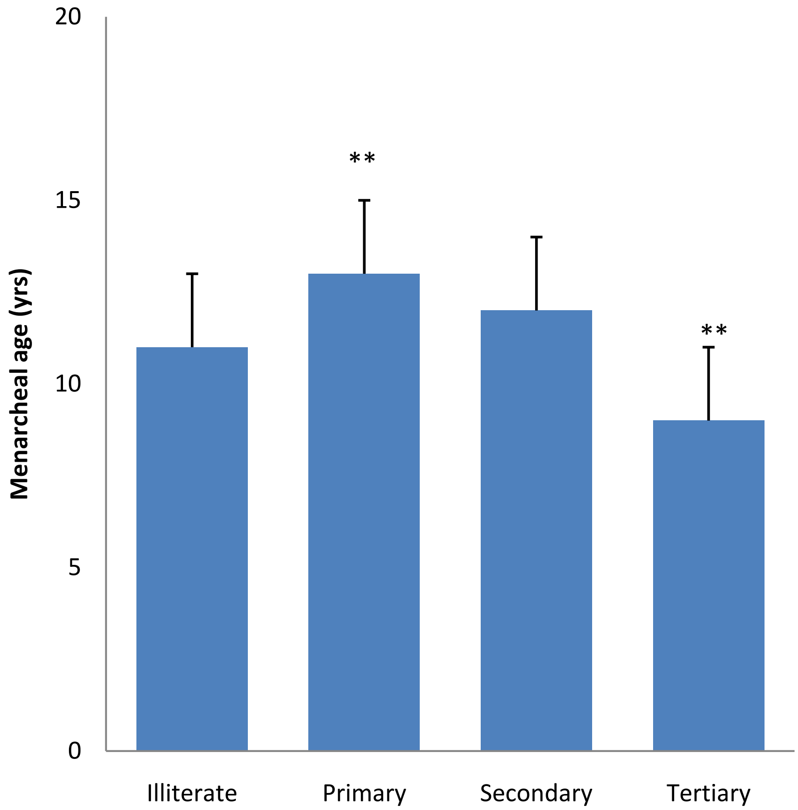
Variable (Years)	Mean ± SD	Minimum	Maximum	Range
Menarche	15.577±1.569	10.000	23.000	13.000
Menopausal age	47.172±5.069	28.000	59.000	31.000
Age at Marriage	18.137±3.244	12.000	35.000	23.000
Age at 1stPregnancy	19.404±3.181	13.000	35.000	22.000
Age at 1st Birth	19.993±3.192	13.000	36.000	23.000
Age at Last Birth	39.598±6.558	18.000	55.000	37.0

Menopause, may be determined by the menarche, age at marriage, age at first pregnancy, age at 1st birth and age at last birth

4.2 Relationship of reproductive characteristics with some anthropometric variables

The study conducted on subjects examined the relationship of anthropometric variables and the menarcheal age of the girls and the women, menopausal age, type of menses Fig.4.19 and miscarriages Fig.4.18 by the women. Fig.4.1 showed girls whose father's educational level was tertiary having lower menarcheal age while those of primary level with higher menarcheal age and the same result was also with their mother's educational in Fig.4.2. The menopausal age of the women was observed to be higher for those women that have attended tertiary education and a study of menopausal age with the birth order of women showed those of the first order to be having higher menopausal age Fig.4.3 and 4.4 respectively. The number of children by a woman was observed not to affect age at menopause while house wives were observed to have higher menopausal age as seen in Fig.4.7 and 4.9, respectively.

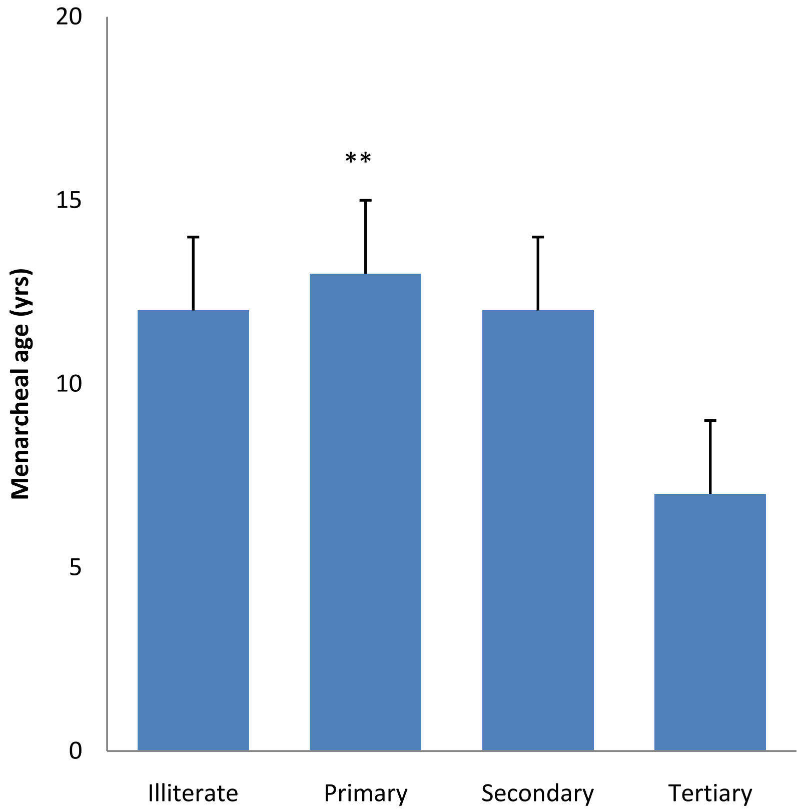
Handedness in the study showed the right handed subject to have lower menarcheal age and the left handed having higher menarcheal age (Fig.4.6). Women born in the rainy season were observed to have lower menarcheal age and higher menopausal age, while girls born in the rainy season were observed to have higher menarcheal age than those born in the dry season. Both systolic and diastolic blood pressure, were observed to be higher in women with higher menopausal age and the same result was observed for menarcheal age of the girls. Fig. 4.17 showed that higher percentage of the women in the study population were premenopausal and Fig.18 showed higher percentage of the women have never had miscarriage and more of the women in the study population have regular menstruation, while 16.7% of the women have moderate menstrual pain, 13.7% experience mild menstrual pain and only 4.3% have severe menstrual pain. The pattern of sexual menstruation of the women show the mean menarcheal age to be 15.58 years and that of the girls was observed to be 13.55 years showing downward trend. Fig. 4.22 showed that higher percentage of the women, were within reproductive age (gynecological age) only 24.4% were observed not to be menstruating.



Educational level

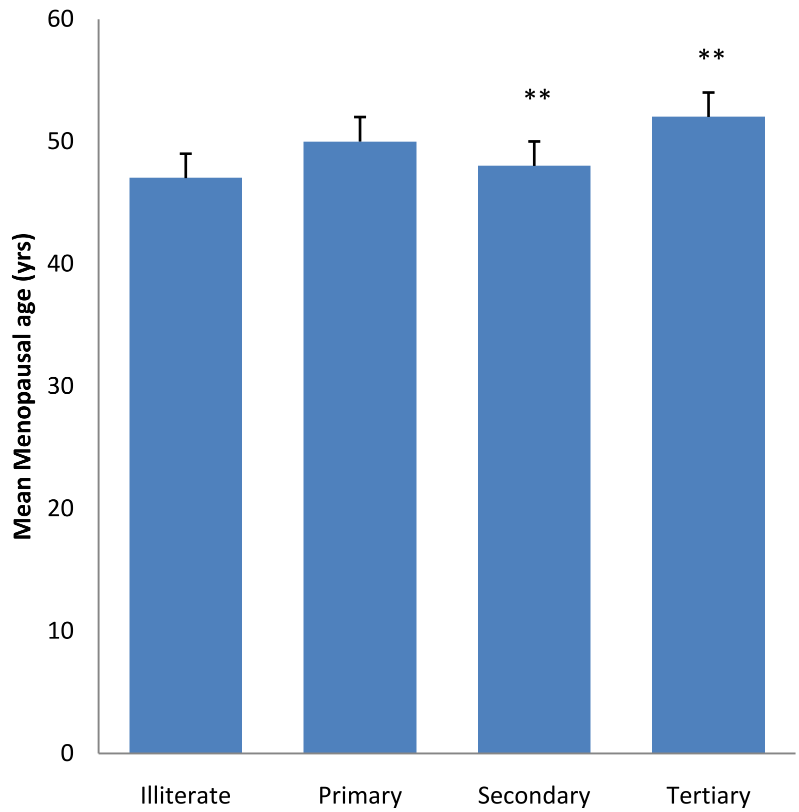
Figure 4.1: Age at menarche of girls with educational level of fathers **

$p < 0.001$



Educational level

Figure 4.2: The age at menarche of girls vs educational level of mothers
** $p < 0.001$



Educational level

Figure 4.3: Age at natural menopause of women vs level of their education

** = $p < 0.001$

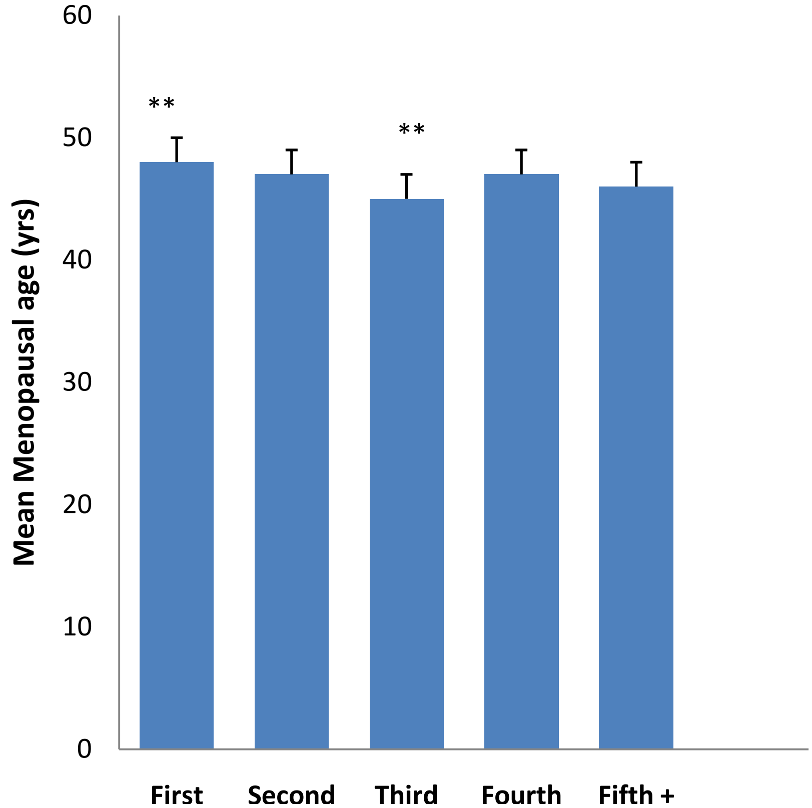


Figure 4.4: Effect of age at natural menopause of women by their birth order
** = $p < 0.001$

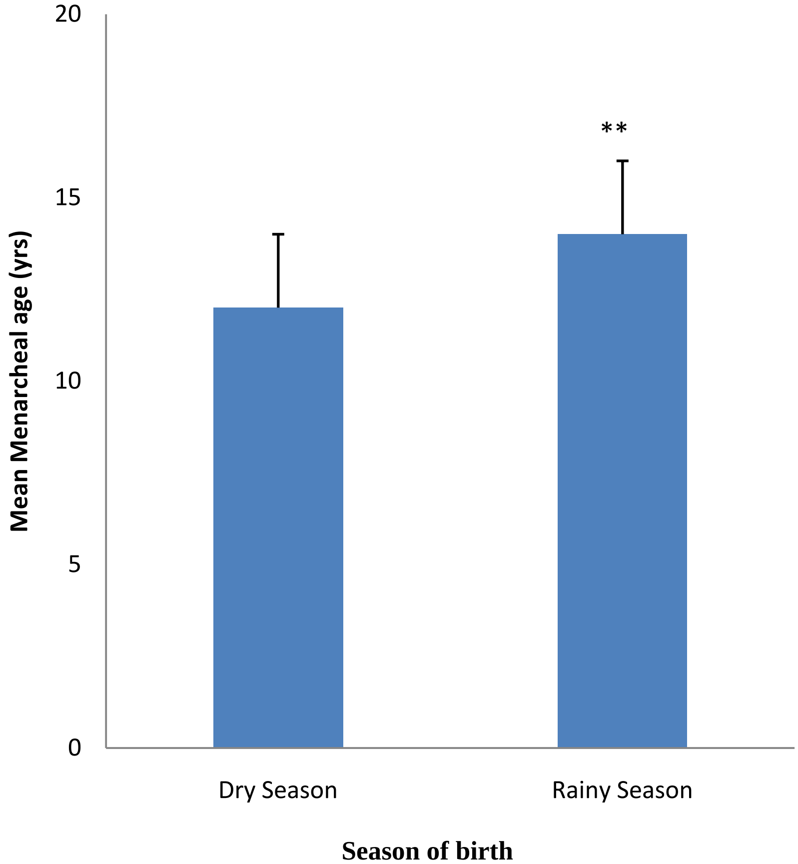


Figure 4.5: Effect of age at menarche of the girls by their season of birth
** = $p < 0.001$.

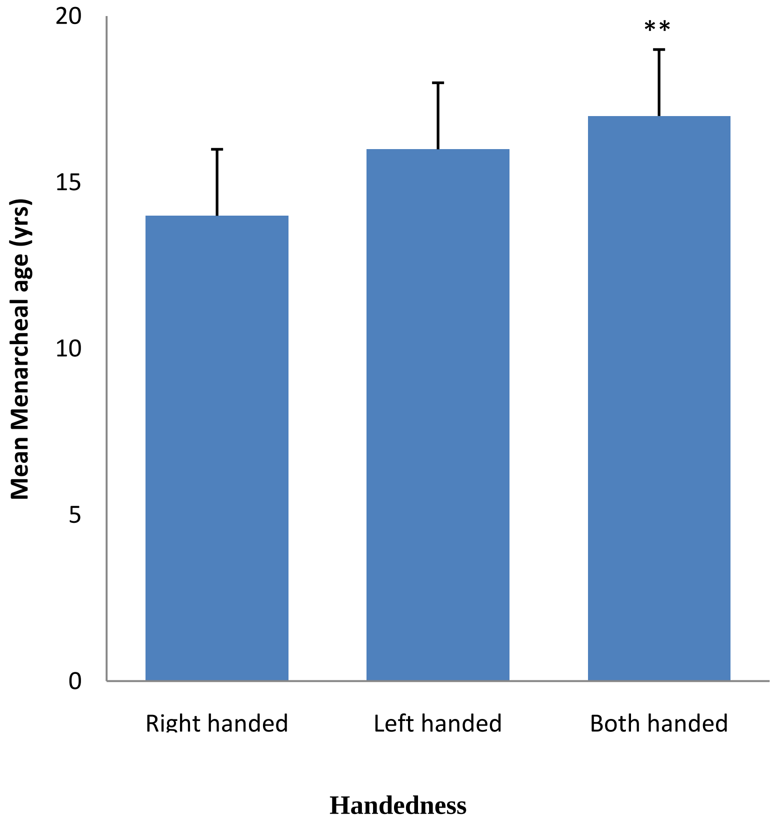


Figure 4.6: Bar chart showing age at menarche of the study population and handedness **p < 0.001

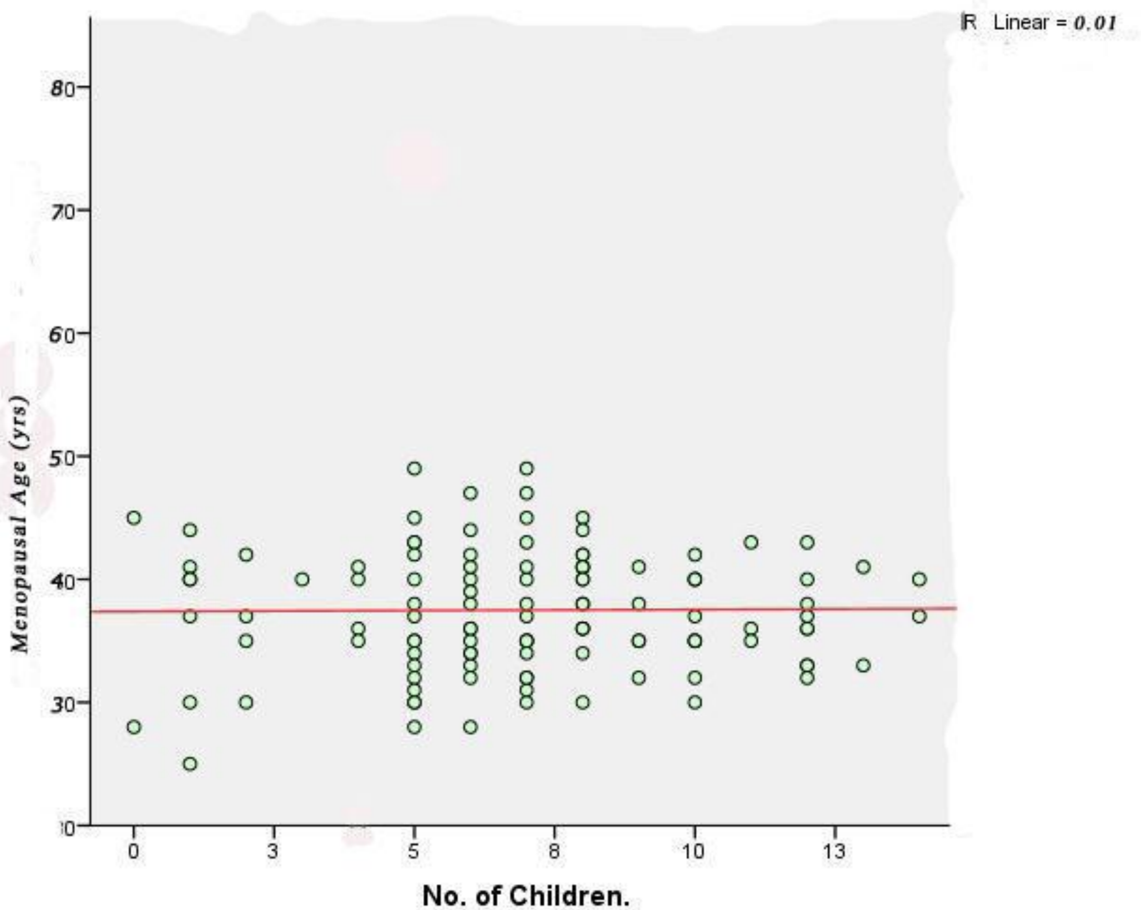


Figure 4.7: Scattered plot showing the relationship between age at menopause of women in Kumana Chiefdom and number of children born

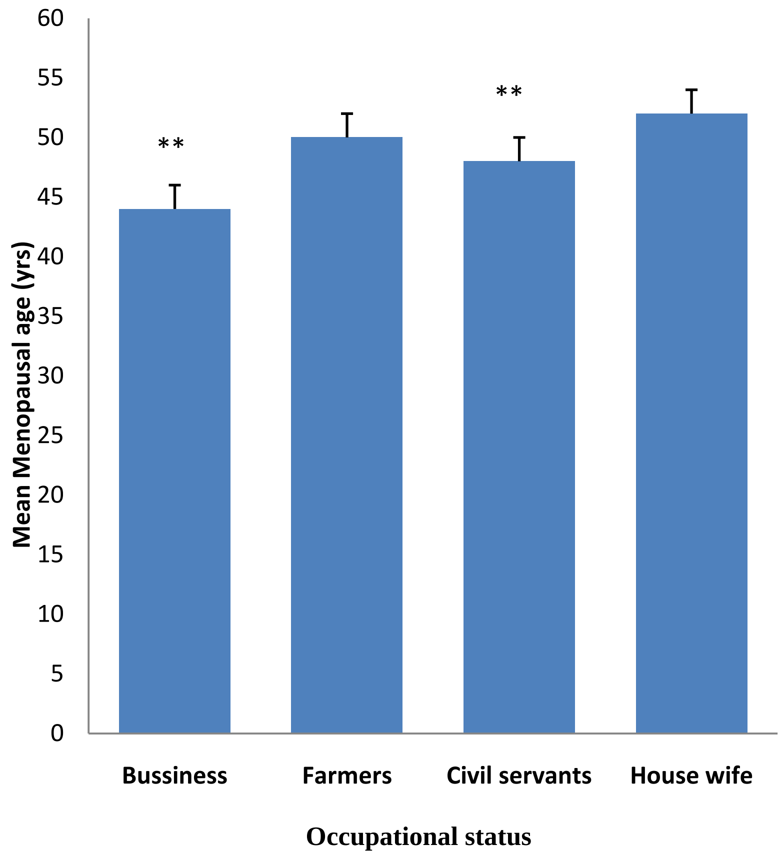


Figure 4.8: Bar chart of age at menopause of women vs their occupational status ** = p < 0.001

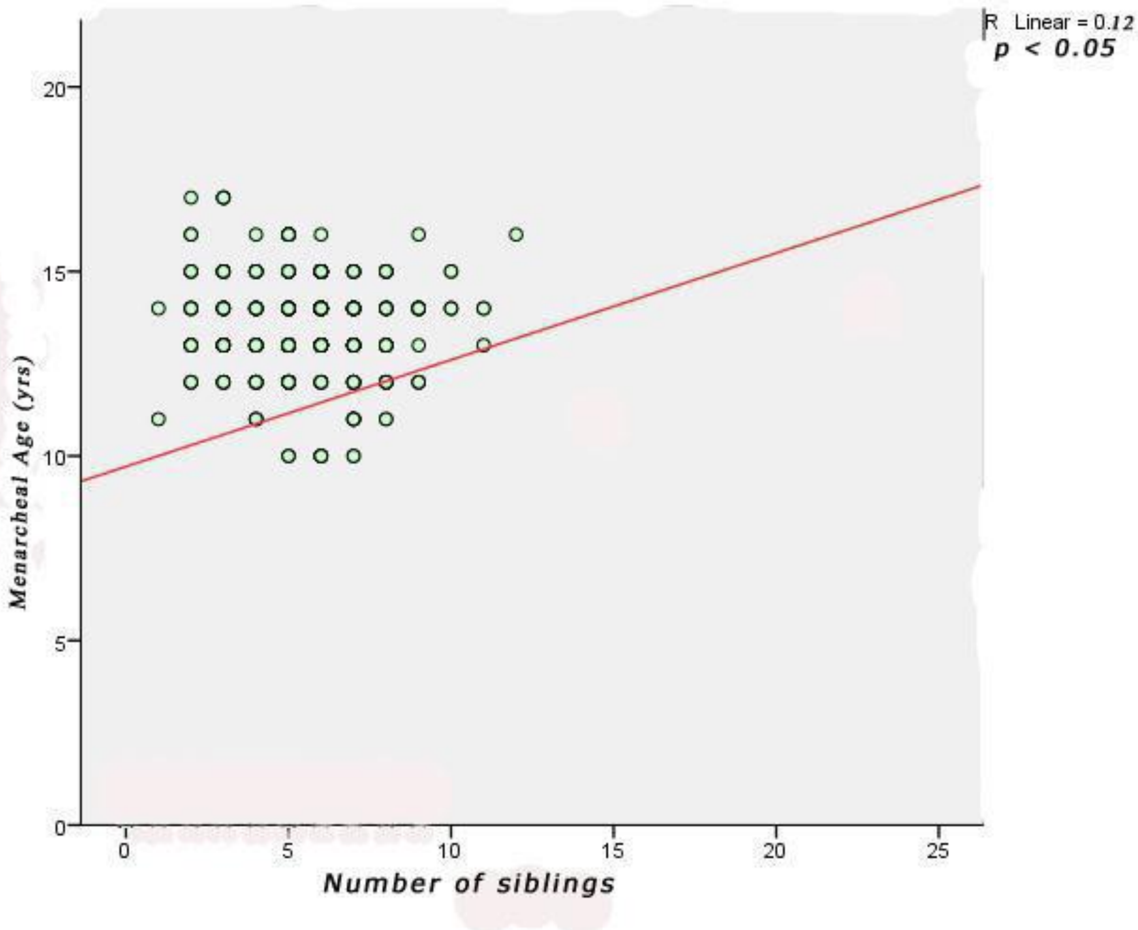


Figure 4.9: Scattered plot showing the relationship between age at menarche of girls and number of siblings (family size) $p < 0.005$

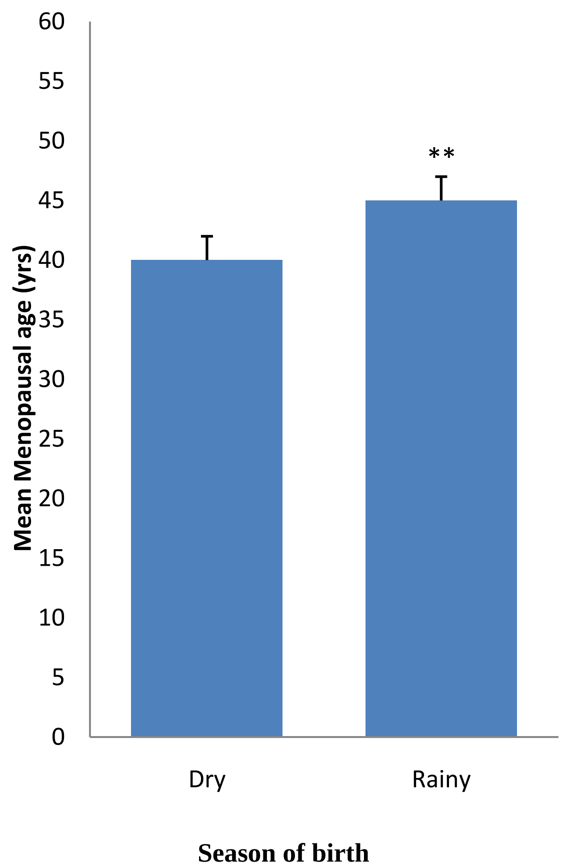


Figure 4.10: Effect of age at menopause of the women on season of birth ** p < 0.001

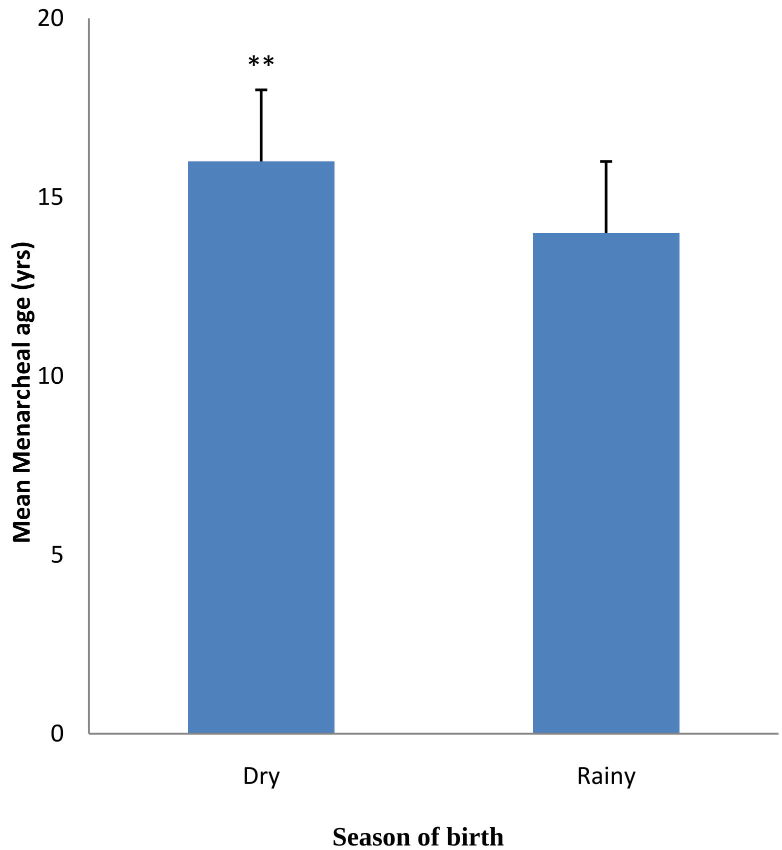


Figure 4.11: Effect of age at menarche of the women on the season of birth ** = $p < 0.001$

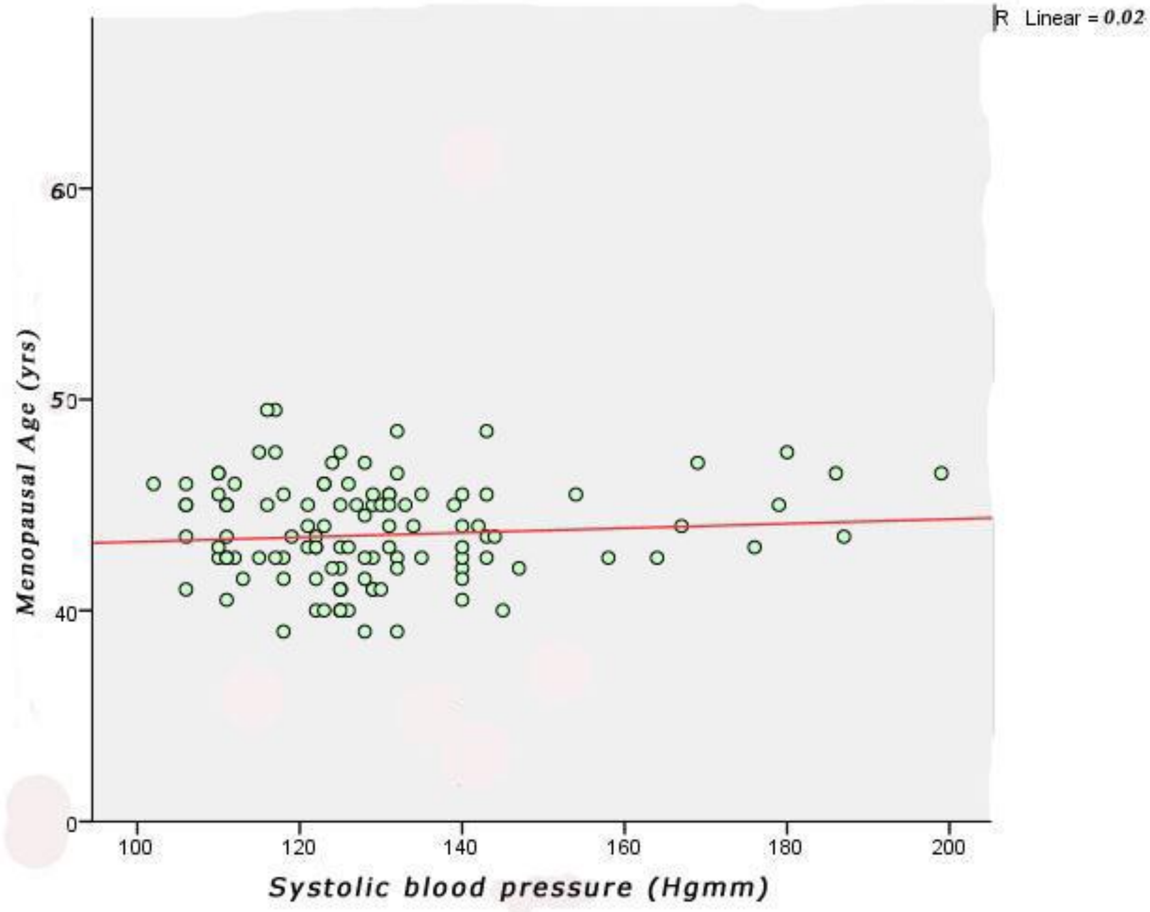


Figure4.12: The relationship between age at natural menopause and systolic pressure of women in Kumana Chiefdom.

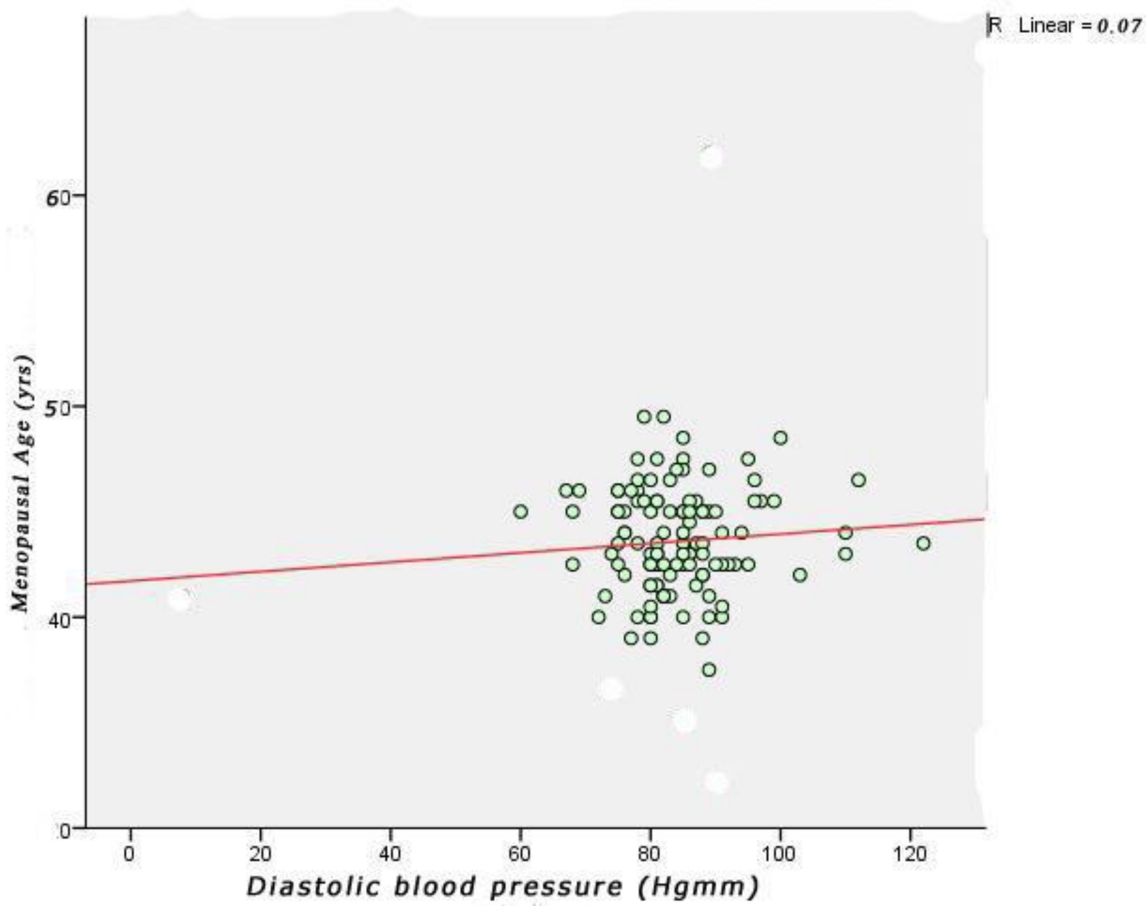


Figure 4.13: Scattered plot showing the relationship between age at natural menopause of women and diastolic pressure of women in Kumana Chiefdom $p < 0.005$

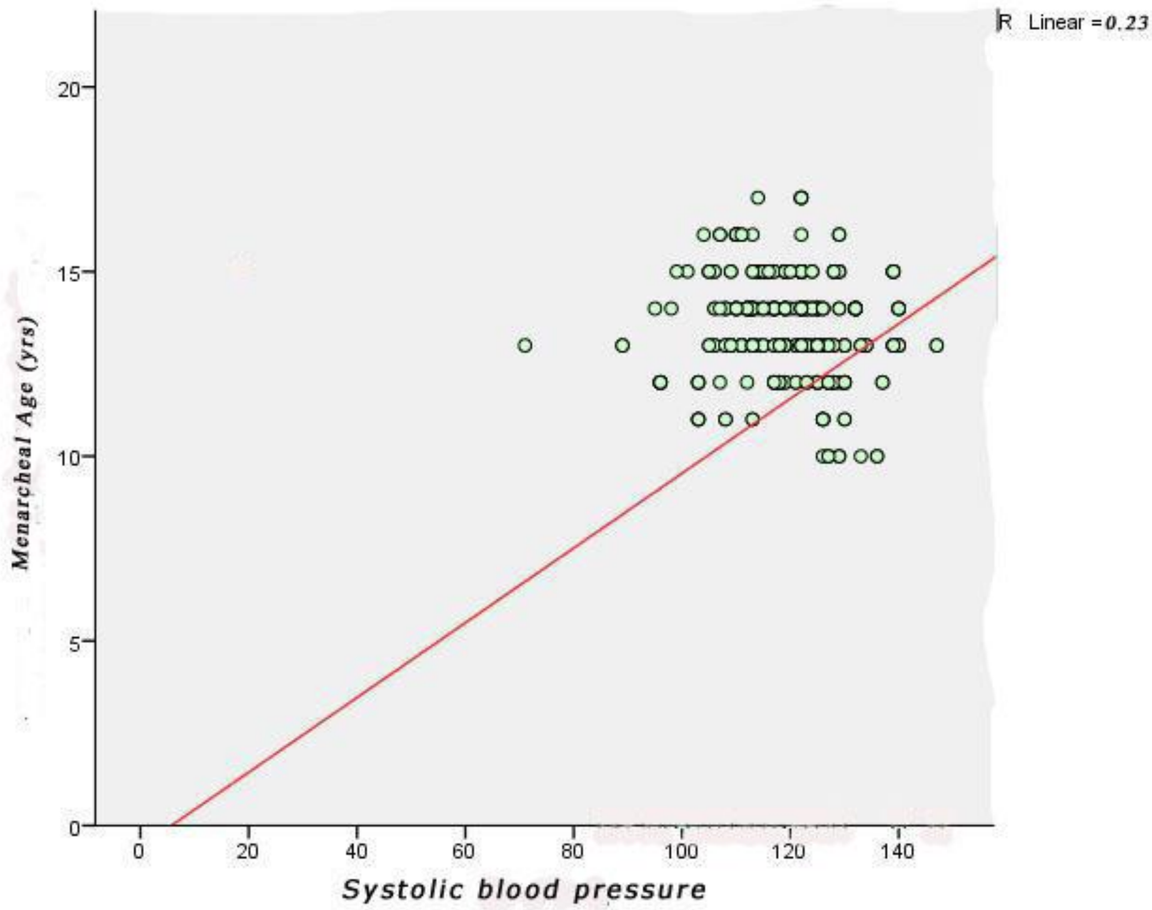


Figure 4.14: Scattered plot showing the relationship between age at menarche of girls vs systolic blood pressure p< 0.005

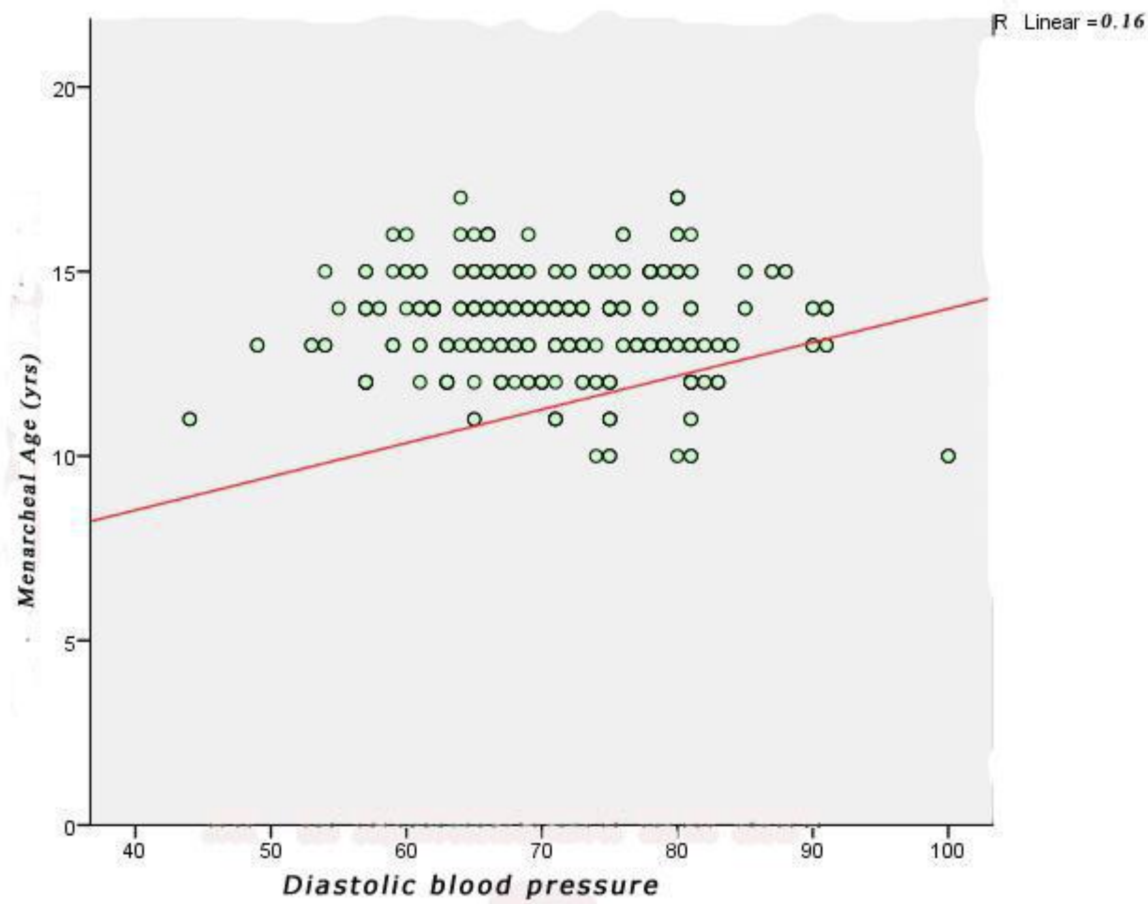


Figure 4.15: Scattered plot showing the relationship between age at menarche of girls and diastolic pressure of women in Kumana Chiefdom

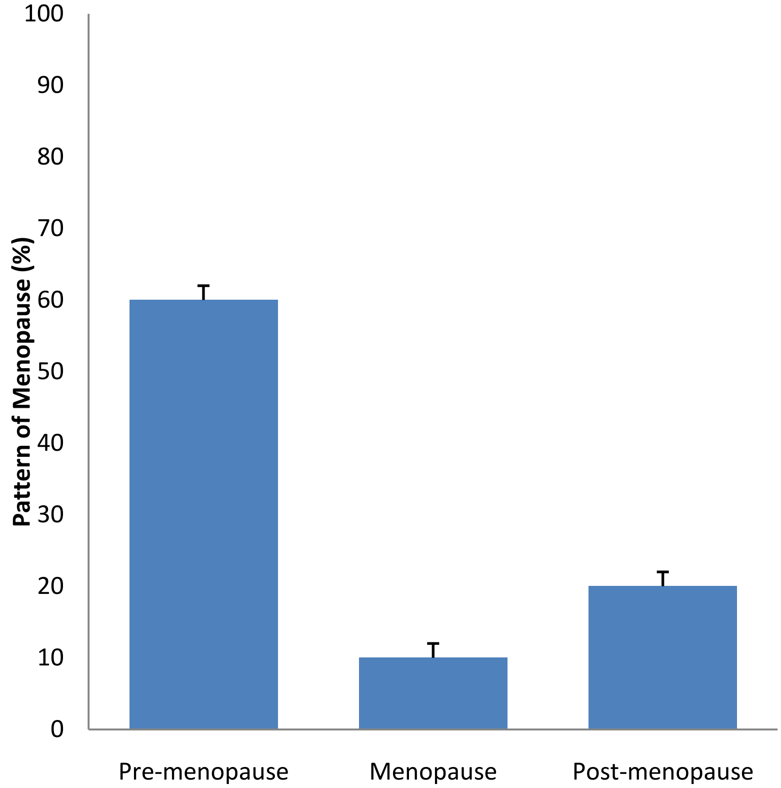


Figure 4.16: Bar chart of pre-menopause, menopause and post menopause

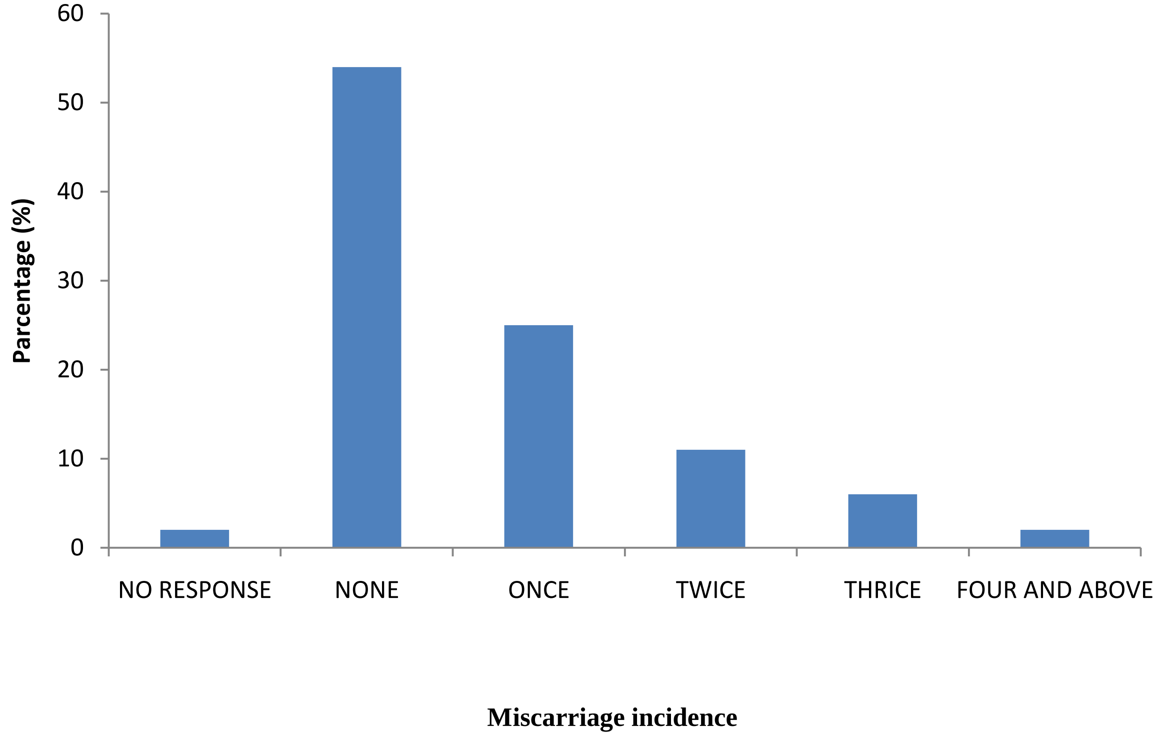


Figure 4.17: Miscarriage incidence of women in Kumana Chiefdom

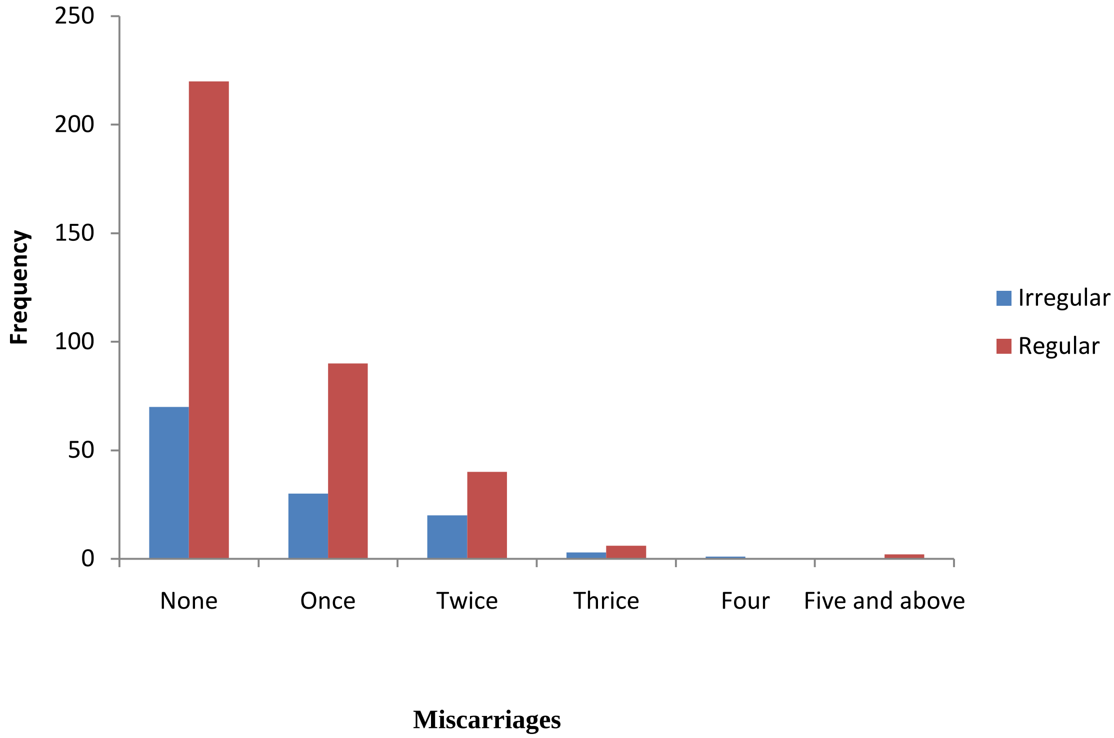


Figure 4.18: The frequency of menstruation and miscarriages of women in Kumana Chiefdom, $p < 0.183$

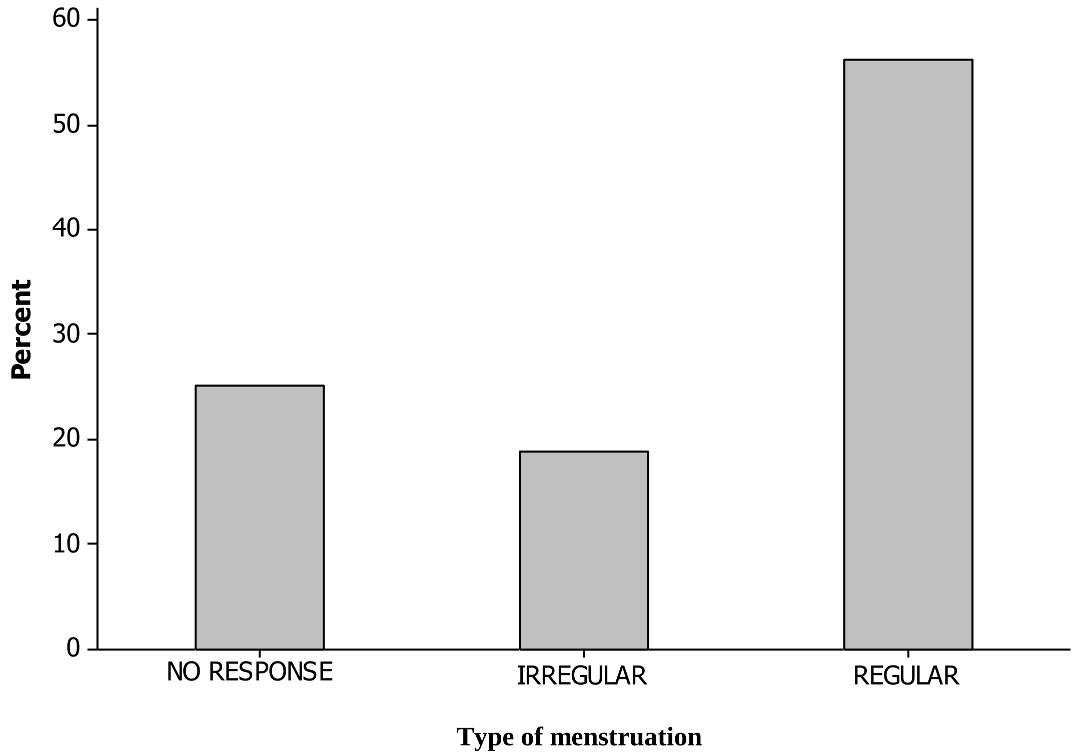


Figure 4.19: Bar chart showing the percentage of regular and irregular menstruation of women in Kumana Chiefdom

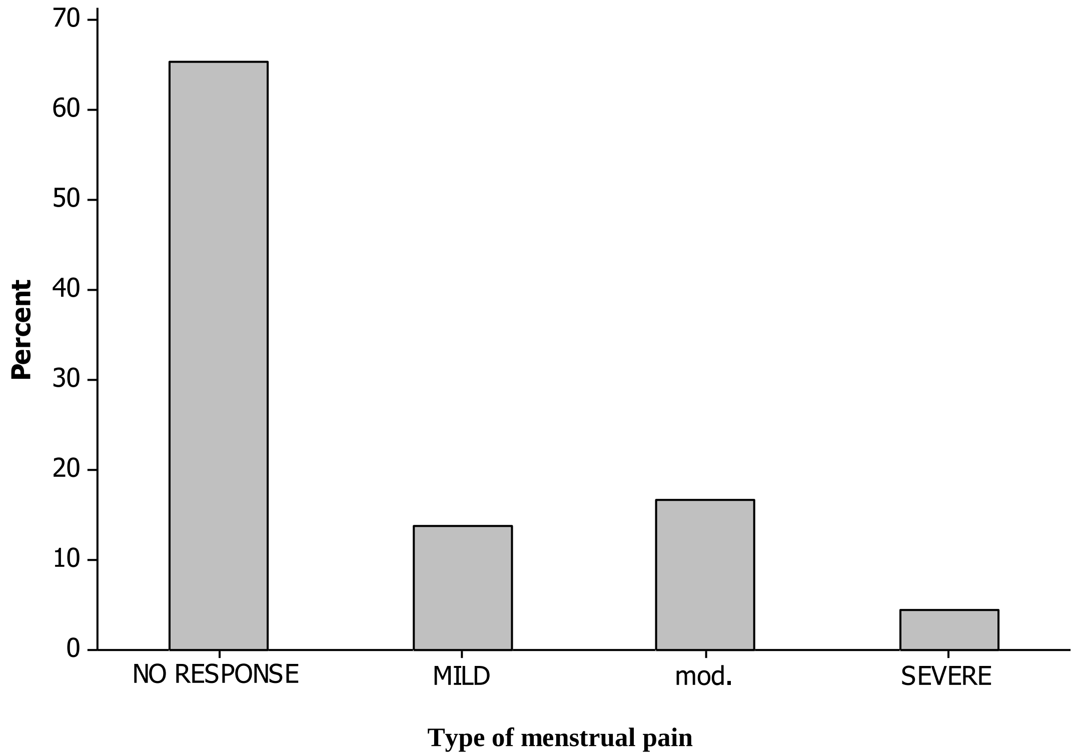


Figure 4.20: Bar chart of percentage of type of menstrual pain of women in Kumana chiefdom

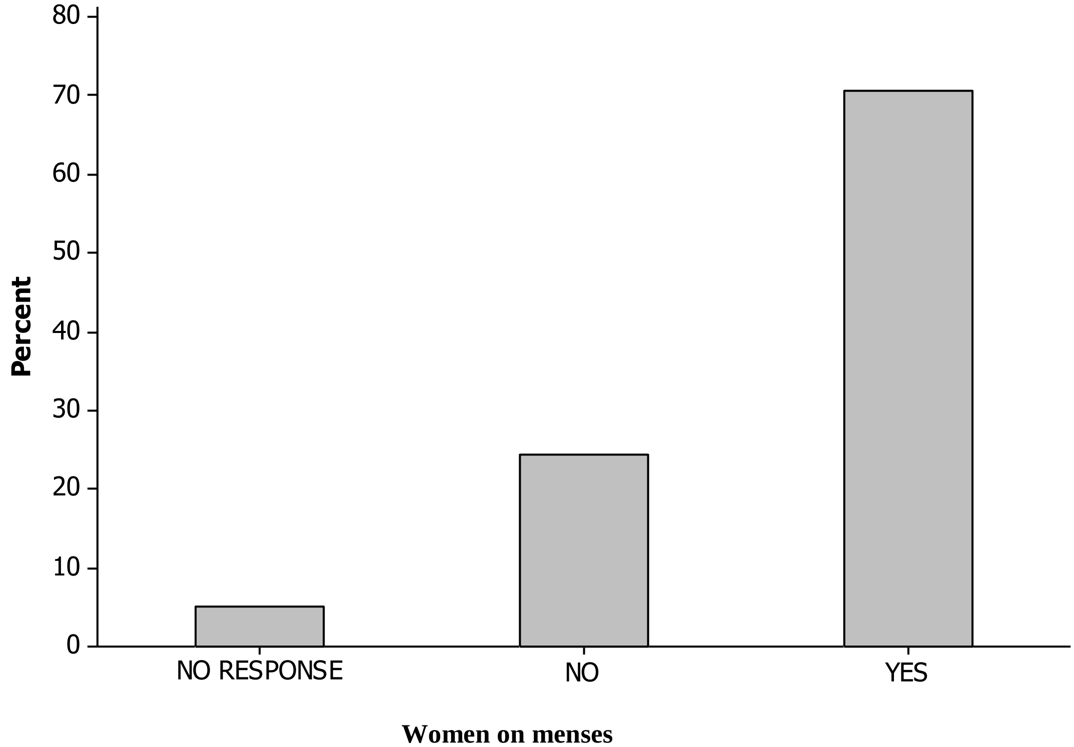


Figure 4.21: Bar chart of percentage of women on menses in Kumana Chiefdom

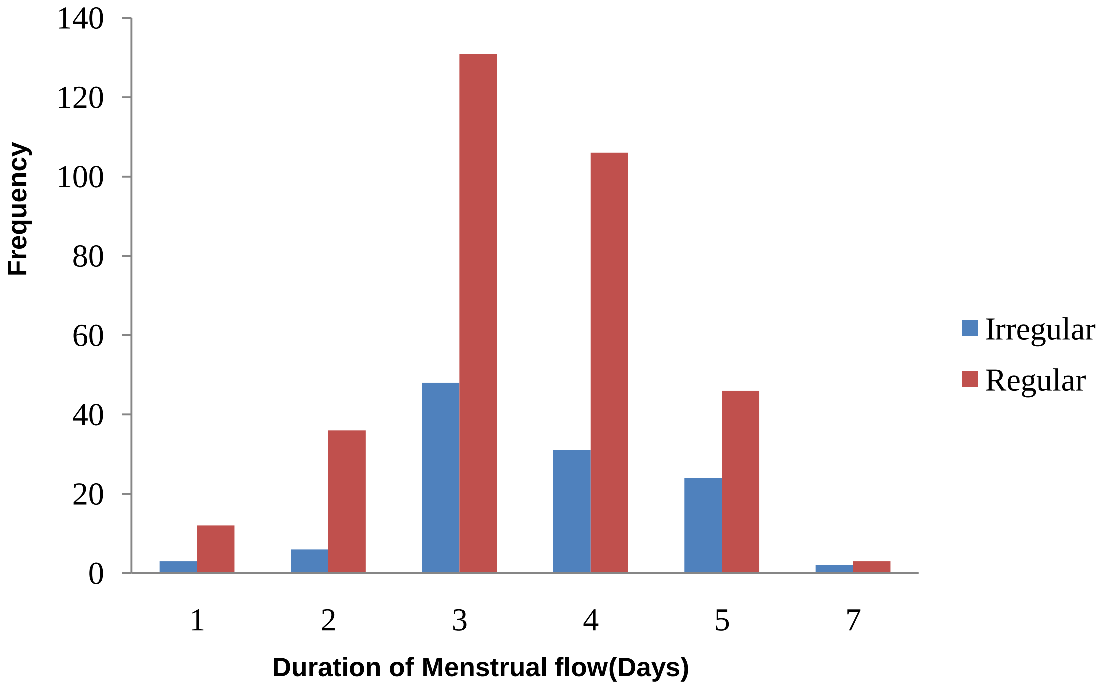


Figure 4.22: Frequency of duration of menstrual flow and type of menses of women in Kumana chiefdom. $p < 0.207$

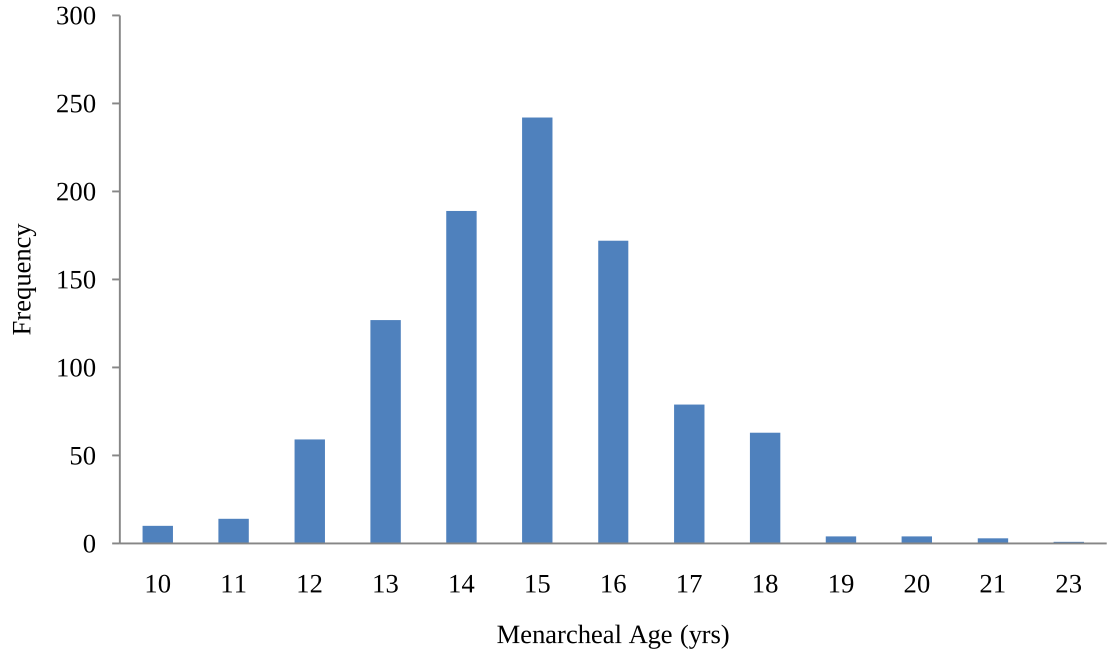


Figure 4.23: Distribution of girls and women according to menarcheal age

(mean menarcheal age = 14.85, SD = 1.78, Mode = 15.00, Median = 15.00)

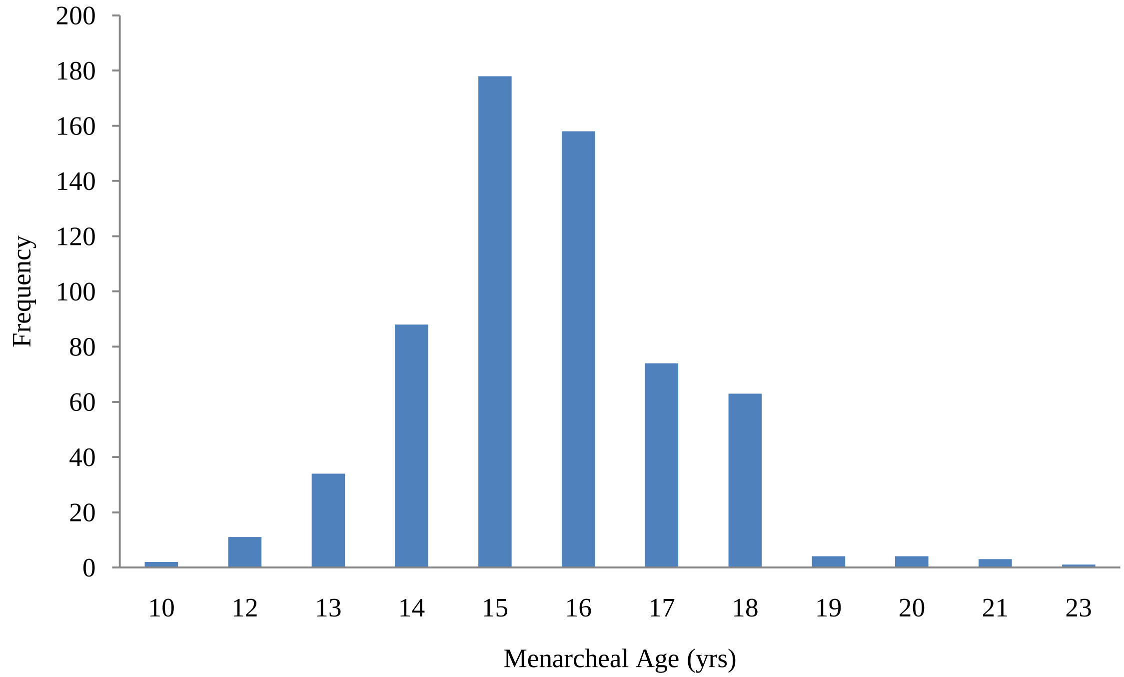


Figure 4.24: Distribution of women according to menarcheal age (mean menarcheal age = 15.58, SD = 1.57, Mode = 15.00, Median = 15.00)

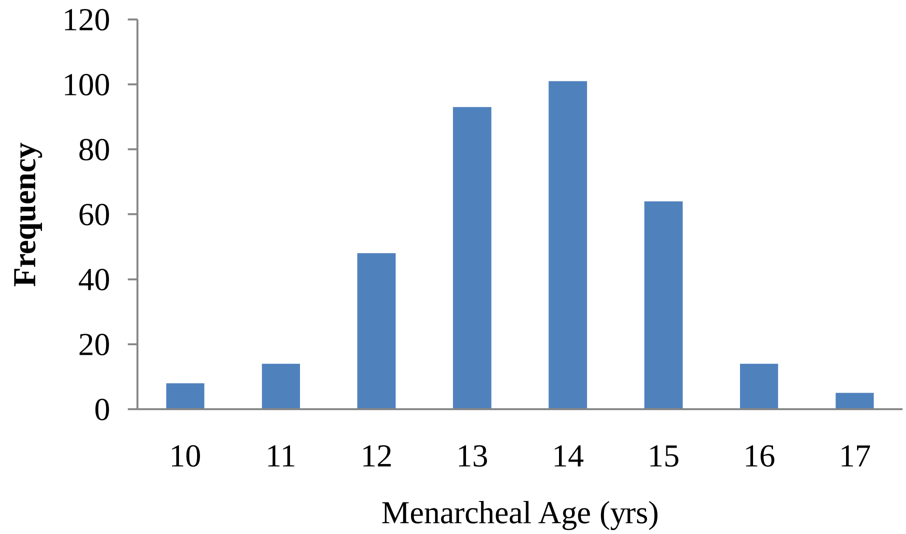


Figure 4.25: Distribution of menarcheal age (yrs) of girls according to menarcheal age,

(Mean menarcheal age = 13.55, SD = 1.35, mode = 14)

4.3 Weight and body mass index of girls and women

The weight of the girls and women of the study population showed significant difference, the women were observed to have higher weight than that of the girls and the same was observed for the BMI in which Student *t*-test showed statistical significant difference in weight and BMI at $p < 0.001$. Fig. 4.27 showed that more of the girls and women in the study population were having normal weight, while only few women were obese and none of the girls were obese.

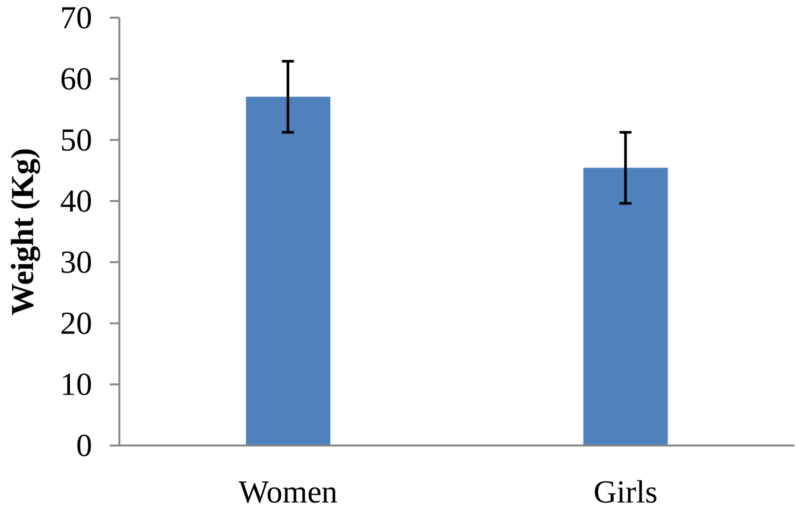


Figure 4.26: Means of weight of women and girls. (Student t-test showed statistical significant difference in weight at $p < 0.001$; $n = 623$ for women, $n = 415$ for girls)

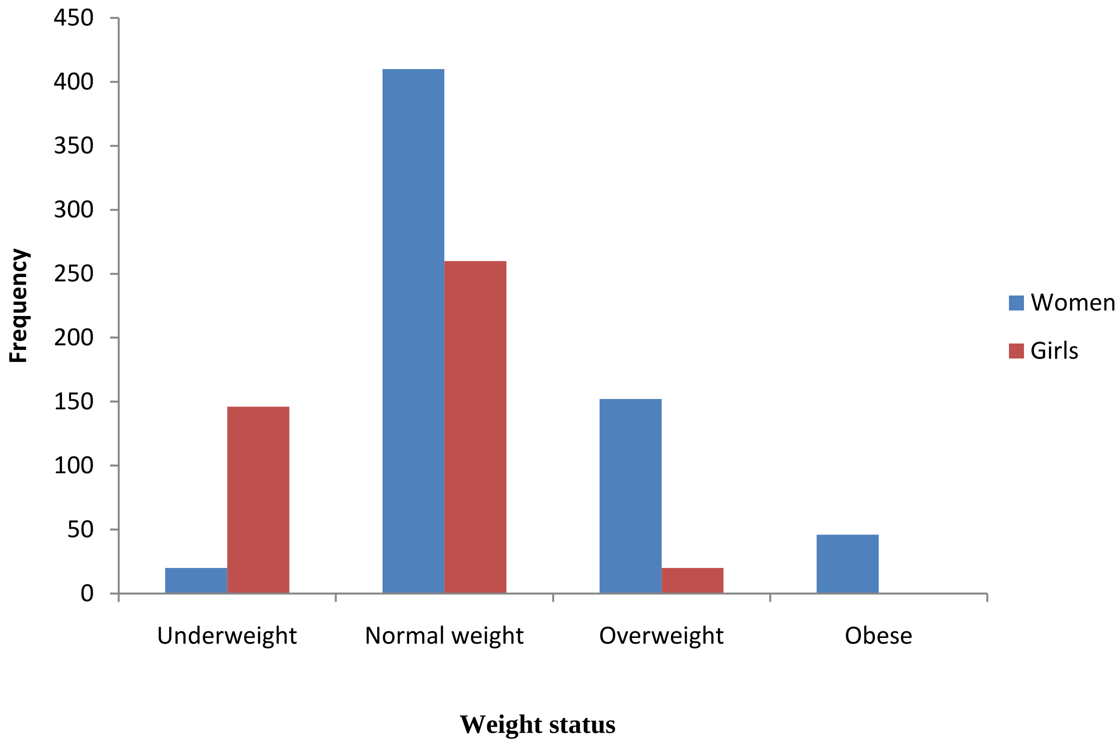


Figure 4.27: Weight status of girls and women in the study population
(n = 623 for women; n = 415 for girls)

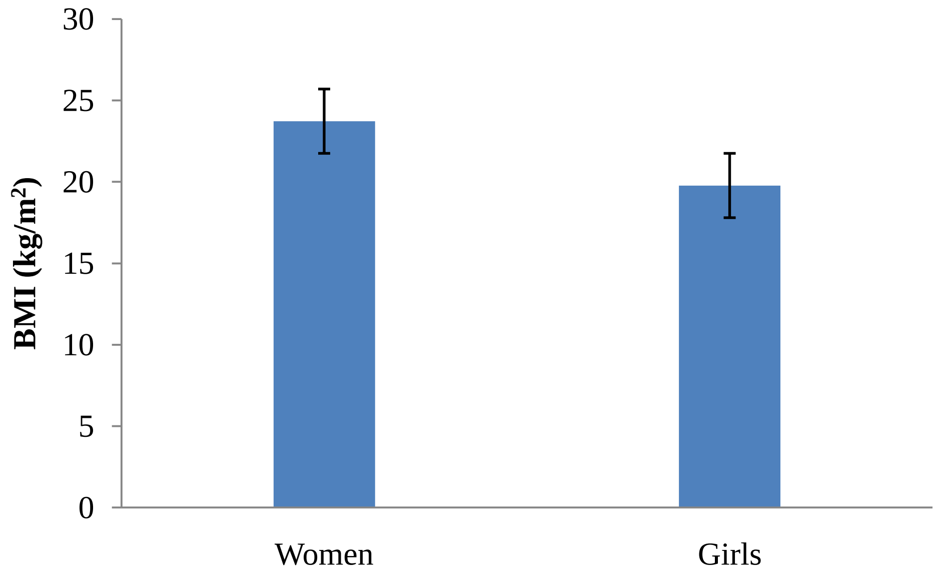


Figure 4.28: Body mass index of women and girls. (Student *t*-test showed statistical significant difference between women and girls BMI, n = 623 for women, n = 415 for girls)

4.4 Body circumferences and body composition of the study population

The hip circumference and waist circumference of the girls and the women in the study population using Student's *t* - test showed significant differences in Hip and Waist circumferences at $p < 0.001$ and $p < 0.007$, respectively. The arm, forearm, elbow and hand circumferences of the girls and women in the study population using Student's test showed significant differences at $p < 0.001$, $p < 0.466$, $p < 0.001$ and $p < 0.001$, respectively. The body fat % and muscle mass of the girls was observed to be higher than that of the women while Total Body Water of the women was found to be higher than that of the girls and were significantly different at $p < 0.155$, $p < 0.001$ and $p < 0.088$, respectively

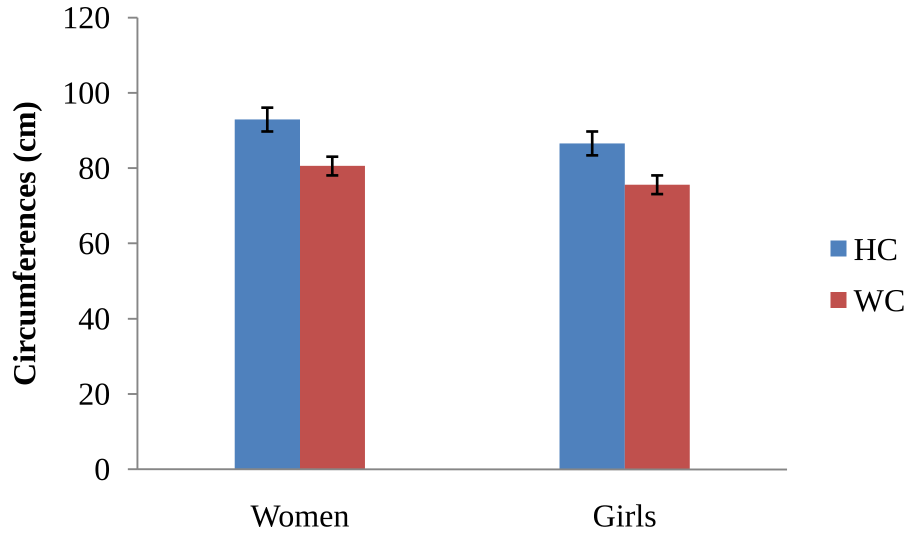


Figure 4.29: Bar chart of hip and waist circumferences of women and girls. (showed significant differences in the hip and waist circumferences at $p < 0.001$ and $p < 0.007$ respectively, n = 623 for women, n = 415 for girls)

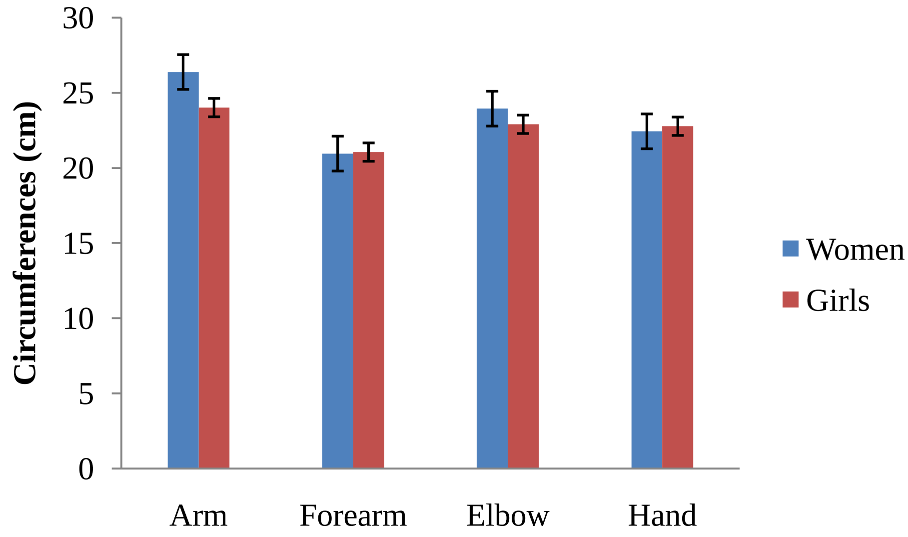


Figure 4.30: Bar chart of arm, forearm, elbow and hand circumferences of women and girls. (showed significant differences in arm, forearm, elbow and hand circumferences $p < 0.001$, $p < 0.466$, $p < 0.001$ and $p < 0.001$ respectively. $n = 623$ for women and $n = 415$ for girls)

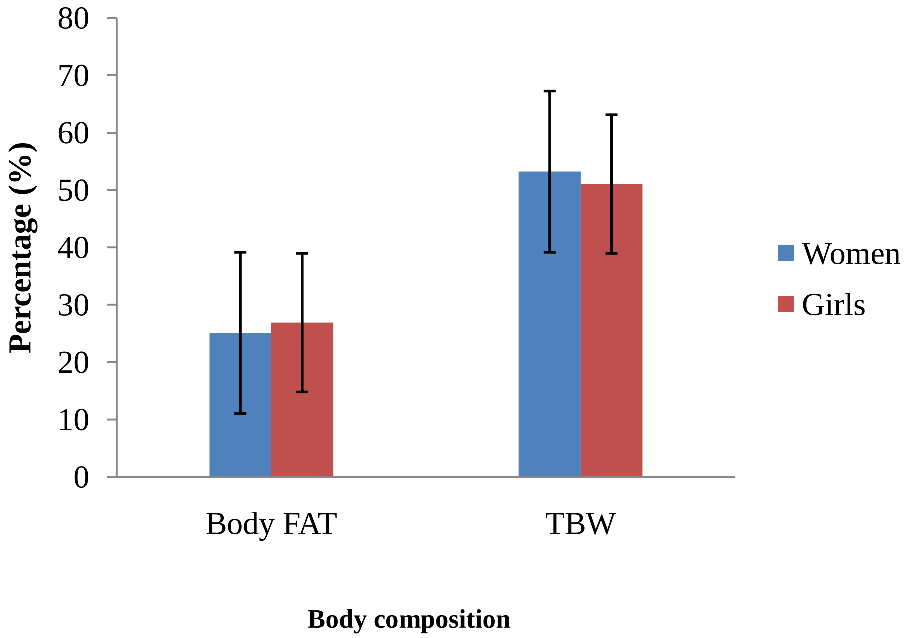


Figure 4.31: Bar chart of body composition of the study population $p < 0.155$, $p < 0.001$ and $p < 0.088$ for body fat, Muscle mass and TBW respectively ($n = 623$ for women and $n = 415$ for girls)

4.5 Perception and attitude of women to menopause

The experience of menopause differ from woman to woman and no two women have the same experience. Fig.4.32 showed that many women in the study population had knowledge of menopause and of the number of these women that had knowledge of menopause only a few of them had consulted a doctor concerning menopause. Fig.4.33 showed the level of education of the women and seeing a doctor on menopause where those women that were illiterate, saw a Doctor more than any other group. Fig.4.34 showed the source of information of the knowledge of menopause and more of the women in this study got their information on menopause from teaching or sermon in the church. Fig.4.35 showed the relationship of knowledge of menopause and occupation, where the house wives were observed to be higher than any occupational group.

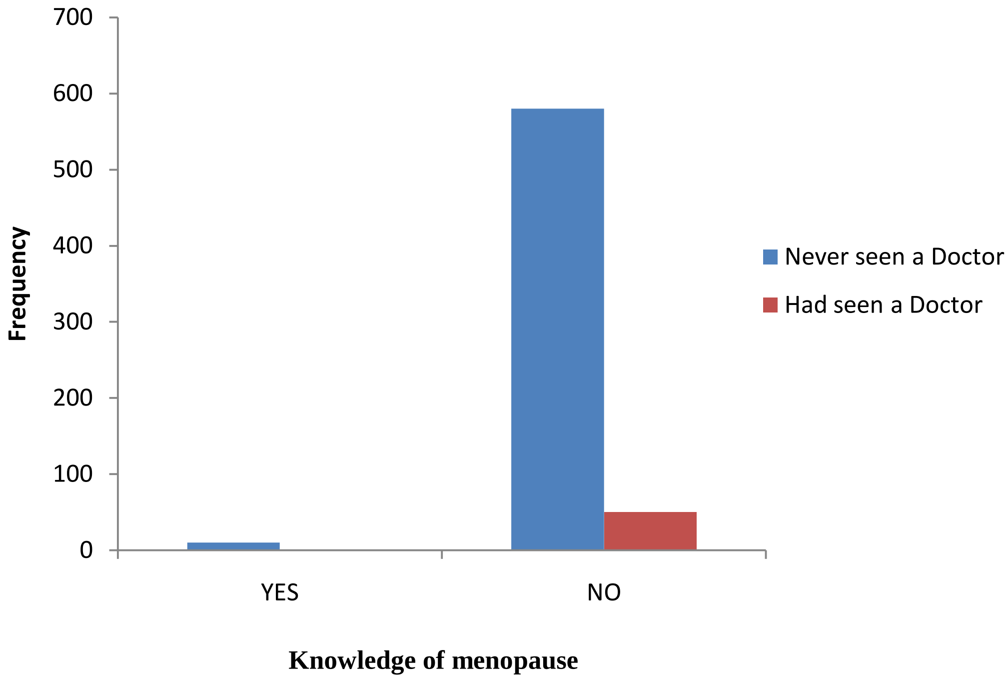
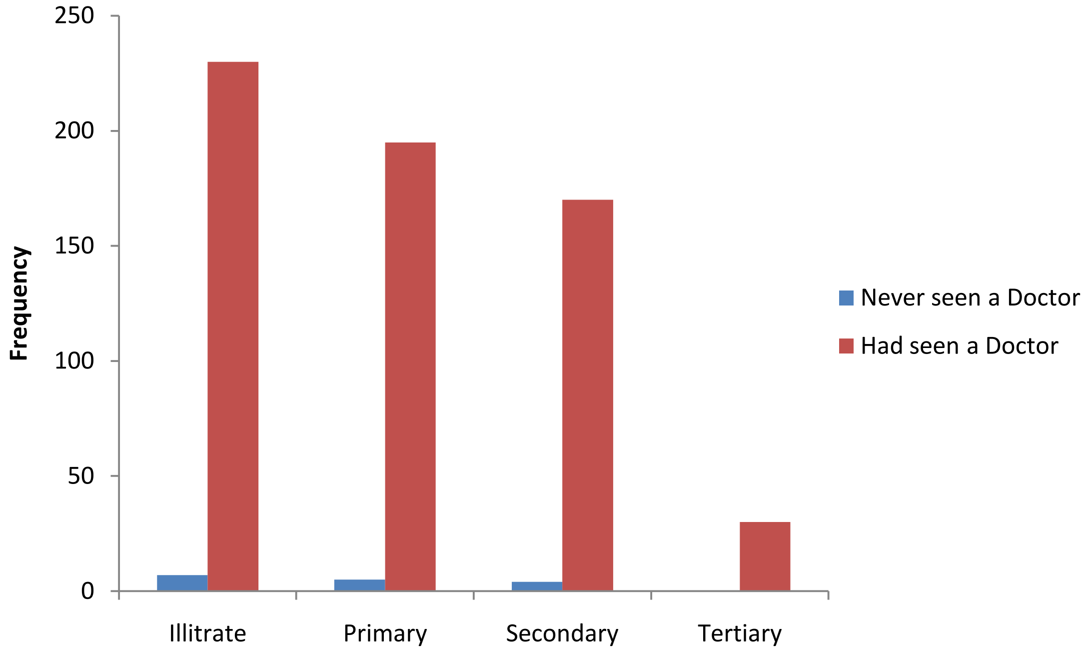
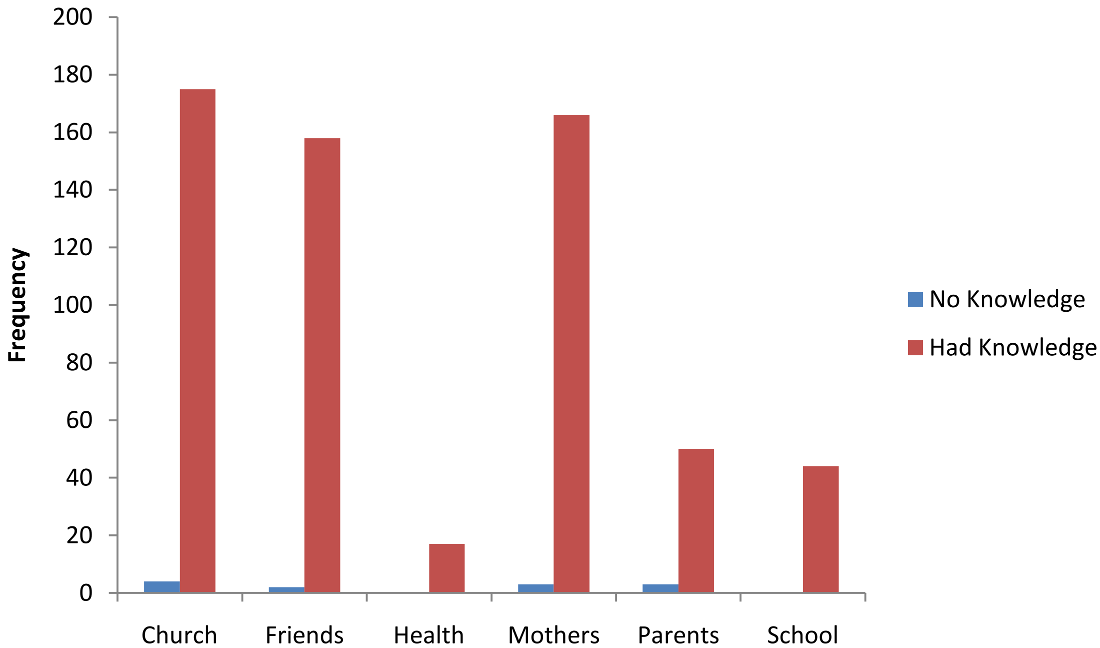


Figure 4.32: Frequency of women with knowledge of menopause and those that had seen a doctor by women of Kumana Chiefdom. $p < 0.335$



Education level and seeing a doctor

Figure 4.33: Level of education and seeing a doctor concerning menopause of women in Kumana Chiefdom.



Source of information of menopause

Figure 4.34: Source of information of menopause knowledge of women in Kumana Chiefdom $p < 0.225$

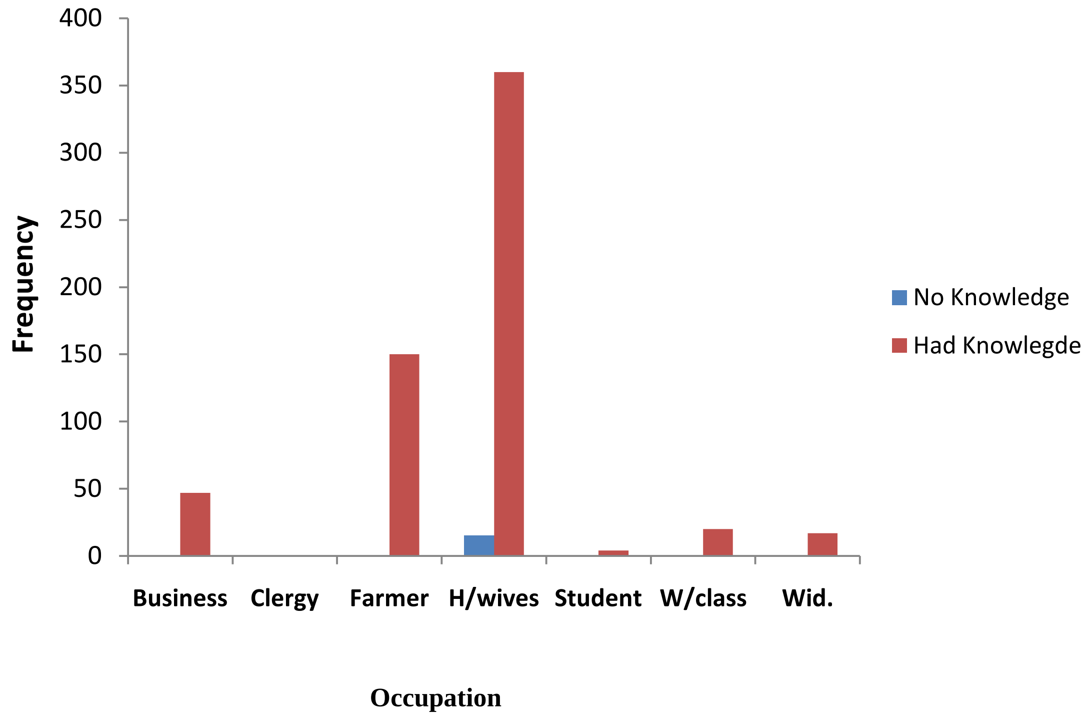


Figure 4.35: Relationship between occupation of the women and knowledge of menopause.

4.6 Correlation analysis of hand and foot anthropometry

Table 4.6 showed that there were positive correlation between height and hand length, palm length, and the middle finger and weak positive correlation between the height and forearm, foot length, the thumb, ring finger, index finger and the little finger while there was negative correlation between height and 2D:4D for the girls. The correlation between the height and these variables were statistically significant at $p < 0.05$ except for the 2D:4D. There was weak positive correlation between hand length with foot length that was statistically significant at $p < 0.05$, while the correlation between hand length and 2D:4D was a negative correlation but statistically significant at $p < 0.05$.

Table 4.7 showed that there was positive correlation between height and hand length, there was weak positive correlation between height with palm length, forearm length, foot length, the thumb, ring finger, middle finger, and the little finger, while there was very weak correlation between height with little finger and 2D:4D ratio for the women. The correlation between the height and these variables were statistically significant at $p < 0.05$ and 2D:4D ratio at $p < 001$, while the relationship between the height and little finger was not statistically significant.

4.7 Correlation between age at first menstruation and some anthropometric variables

Fig. 4.8 showed the correlation of age at first menses of girls of the population study having very weak positive relationship with height and weight, very weak positive correlation occur with date before next period (DBNP), birth order (BO), body mass index (BMI) and hip circumference (HC). The correlation between the age at first menses and height was significant at $p < 0.01$ and the relationship between the age at first menses with weight was statistically significant at $p < 0.05$. There was very negative correlation between age at first menses with neck circumference (NC), digit ratio (DGR) and hand circumference. However, the negative correlation between the age at first menses (AFM) of the girls with the hand circumference was statistically significant at $p < 0.01$.

4.8 Correlation of menopause with some reproductive history of the women

There was no relationship between menopause with age at marriage, the relationship between the menopause and age at first pregnancy was a weak positive one. There was also very weak positive relationship between the menopause with age at first birth while the relationship between the menopause and age at last birth was positive and statistically significant at $p < 0.01$ and the relationship of the menopause and age at first menses was a weak positive one but the relationship was statistically significant at $p < 0.05$.

4.9 Correlation of menopause with some anthropometric variables

The Table 4.9 shows that there was negative correlation between menopause and body mass index, weight, hip circumference, digit ratio and waist circumference. There was strong negative correlation between menopause with birth order, neck circumference and hand circumference. However, the negative correlation of menopause with hand circumference was statistically significant at $p < 0.01$ while the correlation of menopause with birth order and neck circumference were statistically significant at $p < 0.05$

4.10 Correlation of body mass index with some anthropometric variables

Table 4.10 shows positive correlation of body mass index with the body circumferences and the correlation with these variables were statistically significant at $p < 0.05$. The correlation between the body mass index with hip circumference and arm circumference was a strong positive one.

4.11 Estimation of height using some anthropometric variables

The estimation of height is shown in Tab. 4.12, indicating that calf height, palm length, foot length and hand length cannot be use to estimate height, except weight and body mass index (BMI) because these two variables were statistically significant at $p < 0.05$

Table; 4.6: Correlation matrix of height with hand and foot anthropometry of the girls

Variables (cm)	**Height**	**Hand length**	**Palm length**	**Forearm length**	**Foot length**	**1D**	**2D**	**3D**	**4D**	**5D**	**2D:4D**
Height	-										
Hand length	0.46**	-									
Palm length	0.45**	0.68**	-								
Forearm length	0.32**	0.06	0.22**	-							
Foot length	0.32**	0.17**	0.28**	0.24**	-						
1D	0.38**	0.25**	0.27**	0.25**	0.29**	-					
2D	0.40**	0.30**	0.36**	0.30**	0.33**	0.72**	-				
3D	0.46**	0.42**	0.39**	0.22**	0.34**	0.55**	0.74**	-			
4D	0.41**	0.37**	0.36**	0.27**	0.33**	0.64**	0.82**	0.78**	-		
5D	0.33**	0.21**	0.28**	0.24**	0.24**	0.53**	0.61**	0.54**	0.60**	-	
2D:4D	-0.03	-0.13**	-0.01	0.04	0.00	0.11**	0.27**	-0.09*	-0.33**	-0.002	-

1D = first digit, 2D = second digit, 3D = third digit, 4D = fourth digit, 5D = fifth digit ** $p < 0.01$, * $p < 0.05$

Table; 4.7: Correlation matrix of height with hand and foot anthropometry of the women

Variables (cm)	Height	Hand length	Palm length	Forearm length	Foot length	1D	2D	3D	4D	5D	2D:4D
Height	-										
Hand length	0.51^{**}	-									
Palm length	0.41^{**}	0.62^{**}	-								
Forearm length	0.33^{**}	0.14^{**}	0.08	-							
Foot length	0.19^{**}	0.17^{**}	0.31^{**}	0.31^{**}	-						
1D	0.24^{**}	0.28^{**}	0.16^{**}	0.07	-0.02	-					
2D	0.42^{**}	0.55^{**}	0.36^{**}	0.13^{**}	0.19^{**}	0.42^{**}	-				
3D	0.41^{**}	0.49^{**}	0.28^{**}	0.20^{**}	0.21^{**}	0.42^{**}	0.78^{**}	-			
4D	0.36^{**}	0.46^{**}	0.27^{**}	0.17^{**}	0.20^{**}	0.45^{**}	0.69^{**}	0.79^{**}	-		
5D	0.09	0.23^{**}	0.02	-0.05	-0.19^{**}	0.18^{**}	0.28^{**}	0.12^{*}	0.05	-	
2D:4D	0.11^{*}	0.17^{**}	0.13^{**}	-0.04	-0.02	0.02	0.48^{**}	0.07	-0.31^{**}	0.38^{**}	-

1D = first digit, 2D = second digit, 3D = third digit, 4D = fourth digit, 5D = fifth digit ** $p < 0.01$, * $p < 0.05$

Table 4.8: Correlation matrix showing the relationship of some anthropometric variables with each other, of girls in Kumana chiefdom

Parameters	AGE	AFM	DBNP	BO	BMI	HT	WT	HC	WC	NC	HNC	DGR
AGE	-											
AFM	0.28*	-										
DBNP	-0.10	0.04	-									
BO	0.01	0.02	0.07	-								
BMI	0.27*	0.06	-0.16*	0.10**	-							
HT	0.28*	0.14*	-0.13**	0.05	0.16*	-						
WT	0.35*	0.12**	-0.20*	0.11**	0.89*	0.58*	-					
HC	0.31*	0.07	-0.05	-0.05	0.45*	0.51*	0.59*	-				
WC	0.12**	0.03	-0.06	-0.05	0.11**	0.06	0.11**	0.09	-			
NC	0.27*	-0.01	-0.13**	0.01	0.37*	0.37*	0.46*	0.55*	0.37*	-		
HNC	0.05	-0.17*	-0.02	-0.01	0.34*	0.28*	0.40*	0.23*	-0.01	0.07	-	
DGR	0.03	-0.03	-0.07	-0.07	0.17*	0.11**	0.20*	0.08	0.04	0.00	0.23*	-

AFM:Age at first menses, DBNP:Date before the next period, BO:Birth order, BMI:Body mass index, HT:Height, WT:Weight, HC:Hip circumference, WC:Waist circumference, NC:Neck circumference, HNC:Hand circumference, DGR:Digit ratio ** $p < 0.01$,* $p < 0.05$

Table 4.9: Correlation matrix showing the relationship of some anthropometric variables with each other, of women in Kumana chiefdom

Parameters	**AGE**	**AFM**	**MENOP**	**BO**	**BMI**	**HT**	**WT**	**HC**	**WC**	**NC**	**DGR**	**HNDC**
AGE	-											
AFM	0.25*	-										
MENOP	0.42*	0.19**	-									
BO	-0.17*	-0.05	-0.19**	-								
BMI	-0.01	-0.02	-0.04	0.07	-							
HT	0.07	0.02	0.02	0.06	-0.08	-						
WT	0.03	0.00	-0.03	0.08**	0.84*	0.42*	-					
HC	0.09**	0.04	-0.05	0.04	0.46*	0.25*	0.56*	-				
WC	0.16*	0.09**	-0.00	0.01	0.44*	0.21*	0.52*	0.78*	-			
NC	-0.00	-0.02	-0.21**	0.03	0.41*	0.17*	0.47*	0.37*	0.29*	-		
DGR	0.04	-0.06	-0.01	0.02	-0.04	-0.03	-0.05	-0.03	0.05	-0.02	-	
HNDC	-0.02	0.03	-0.22*	-0.02	0.29*	0.16*	0.38*	0.27*	0.25*	0.36*	-0.05	-

AFM:Age at first menses, DBNP:Date before the next period, BO:Birth order, MENOP: Menopause, BMI:Body mass index, HT:Height, WT:Weight, HC:Hip circumference, WC:Waist circumference, NC:Neck circumference, HNC:Hand circumference, DGR:Digit ratio ** $p < 0.01$, * $p < 0.05$

Table 4.10: Correlation matrix of BMI and some anthropometric variables of Women in Kumana Chiefdom

	HC.	WC.	AC.	NC.	FC.	Elb. C.	C.C.	Foot C.	HNDC.	BMI
HC.	-									
WC.	.784**	-								
AC.	.459**	.412**	-							
NC.	.369**	.290**	.455**	-						
FC.	.361**	.333**	.555**	.356**	-					
Elb.C.	.421**	.340**	.750**	.525**	.565**	-				
C.C.	.272**	.297**	.473**	.531**	.295**	.437**	-			
FootC.	.300**	.211**	.407**	.358**	.401**	.450**	.319**	-		
HNDC.	.274**	.252**	.431**	.355**	.307**	.462**	.379**	.469**	-	
BMI	.463**	.438**	.454**	.414**	.342**	.447**	.366**	.243**	.293**	-

HC: Hip circumference, WC: Waist circumference, AC: Arm circumference, NC: Neck circumference, FC: Forearm circumference, ELB. C: Elbow circumference, C.C: Calf circumference, Foot C: Foot Length, HNDC: Hand circumference, BMI: Body mass index *p < 0.01

Table 4.11: Correlation matrix of menopausal age and some anthropometric variables of women in Kumana Chiefdom

	Age at Marriage	Age at 1st Pregnancy	Age at 1st Birth	Age at Last Birth	AFM	ANM
Age at Marriage	-					
Age at 1st Pregnancy	**.800***	-				
Age at 1st Birth	**.792***	**.964***	-			
Age at Last Birth	.040	**.163***	**.207***	-		
AFM	**.164***	**.259***	**.252***	.052	-	
ANM	-.037	-.011	.004	.052	.006	-

AFM: Age at first menses, ANM: Age at natural menopause ***** $p < 0.05$

Table 4.12: Estimation of height using some anthropometric variables

Variable	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error			
AGE	-.001	.017	-.002	-.075	.941
Weight	1.177	.047	1.970	25.170	.000
Calf height	.051	.090	.026	.562	.576
Hand length	.047	.098	.015	.478	.634
Foot length	-.003	.077	-.001	-.036	.972
Palm length	.000	.003	-.005	-.100	.920
BMI (kg/m^2)	-2.783	.113	-1.778	-24.605	.000

CHAPTER FIVE

5.0 DISCUSSION

5.1 Age at menarche

Menarche indicates functional development of the female reproductive system and indicates their age of puberty or maturity (Ayatollahi *et al.*, 2002). In the present study, the mean menarcheal of the subjects was found to be 14.85 ± 1.78 years, which was higher than the one reported in the study carried out in Maiduguri by Jack *et al* (2005), where they found the age at menarche to be 13.6 years. The mean menarcheal age of girls and women were observed to be 13.55 ± 1.35 years and 15.58 ± 1.57 years respectively, which was seen to show some secular trend of decreasing with age, supporting the study conducted by Thomas *et al* (2001). The mean menarcheal age of the girls in the study population was found to be higher than the one reported by Ikaraoha *et al* (2005) in Rivers State, where the mean menarcheal age was reported to be 13.19 years. The differences could be due to the fact that the present study was done in a rural area and the influence of socio-economic status. The mean menarcheal age of women was observed to be higher than that of the one found on the Saharia women according to study conducted by Biswar and Kapoor, 2004. A study conducted by Anderson *et al* (2003) on American girls showed a decrease in menarcheal age from 12.75 years to 12.54 years, which proved a decreasing trend, which showed some similarity with the present study. In this study, the menarcheal age of the girls was found to be higher than the 13.0 years found by Amaza *et al* (2012) in Maiduguri, but lower than the 15.26 years found by Tunau *et al* (2012) in Sokoto. It may be that environmental factor had played greater role in the differences of the results in comparison to these two reports. The result of this study was found to be similar to that of Mpora *et al* (2014), who reported 13.6 years to be the menarcheal age of girls in the rural area of Northern Uganda. The result of this study was found to be higher than the 13.44 years, but lower than the 13.65 years obtained by Nwanko *et al* (2016), on Igbo and Hausa ethnic groups respectively, which could be as a result of ethnic difference and the area of study. The present study was conducted in the North-Western part of Nigeria, while Aribo *et al* (2015), conducted their study in Calabar, South-South Nigeria, where they reported the menarcheal age to be 13.70 years higher than the report of this study, even though the area is a rural area compared to Calabar that is an urban area.

The effect of educational status of parents on the menarcheal age of the girls showed that the menarcheal age of the girls whose parents have attended tertiary education were lower than those whose parent have only attended primary schools, which is an indication of the effect of socio-economic and nutritional status of the family. This study was in agreement with those conducted by Fawole *et al* (2002), better nutrition and improved socio-economic status are among the factors that causes lower menarcheal age (Karapanou and Papadimitriou, 2010).

The correlation of age at first menses of girls in the population study had very weak positive relationship with height, similar to study conducted by Kabir *et al* (2007), Biro *et al* (2012) and weight. Very weak positive correlation occurred with date before next period (DBNP), birth order (BO), body mass index (BMI) but Danborno and Oyibo (2008) and Goon *et al* (2010) reported a negative correlation between menarcheal with BMI, and hip circumference (HC). This could be as a result of the effect of other factors on the study population. Study conducted by Akbar *et al* (2013), Onland-Moret *et al* (2005) discovered that increasing BMI the menarche occurrence rate also increase and their studies also found out that girls who attend menarche early have shorter height in adulthood, and that taller girls experience menarche earlier than shorter girls. This study also discovered that right handed subjects have lower menarcheal age and left handed subjects had higher menarcheal age contrary to studies conducted by Harlow and Signorello (2000) on effect of handedness on sexual maturation. The result obtained on handedness could have been influenced by the sample size.

5.2 Age at menopause

The age at menopause of women in this study population was discovered to be 47.172 ± 5.061 years, which was within the range of 45 and 55 years worldwide according to Thomas *et al* (2001). The age at menopause of this study indicated decrease from the 51 years considering the studies conducted by Hunter and Rendall (2007); Kuhle (2007). Achie *et al* (2011) conducted a study in Zaria Nigeria, found the age at menopause to be 46.7 years, while Biswar and Kapoor (2004), conducted their study in Pradesh, India, where they found the menopausal age to be 44.6 years, which were lower than the one obtained in the present study. The present study was conducted in a rural area, which could be the reason of the differences in the result. The differences could be influenced by genetic and environmental factors. However, the result of this study was found to be lower than those obtained in studies conducted by Ande *et al* (2011), who found the menopausal age to be 49.8 years in Benin City, Jack-ide *et al* (2014), reported the age at menopause to be 48.8 years in Niger Delta. Ayatollahi *et al* (2002 and 2005), conducted their studies and discovered the age at menopause to be 48.3 years, while Mohammed *et* *al*., (2011), discovered the menopausal age to be 49.6 years in Iran. The age at menopause in the present study was found to be similar to those of, Kriplani and Banerjee (2005) in Northern India, Malik (2008), in Karachi Pakistan, Mustafa and Sabir (2012), Erbil City Irag, who reported 46.70 years, 47.40 years and 47.44 years, respectively. The influence of environmental and geographical factors could be reasons behind the variations in the menopausal age between the present study and previous studies.

Negative correlation between menopause with body mass index, weight, hip circumference, digit ratio and waist circumference was observed, which supported the findings of Recker *et al* (2000) and Murkey *et al* (2011) in which thinner women reached menopause earlier. There was strong negative correlation between menopause with birth order, neck circumference and hand circumference. There was no correlation between menopause with age at marriage unlike the study conducted by Ayatollahi *et al* (2002) and Nkwo (2009). The correlation between the menopause and age at first pregnancy was a weak positive one. Very weak positive correlation between the age at menopause with age at first birth was found. However, Ayatollahi *et al* (2002), found no association between menopausal age and age at first birth and this. Correlation between the age at menopause and age at last birth was positive and statistically significant at $p < 0.01$, which supported the findings of Garrido-Latorre *et al* (1996). Cassou *et a,* (2007), also discovered positive correlation between age at menopause and age at last birth, but the correlation was not significant. The correlation of the age at menopause and age at first menses was observed to be a weak positive one which supported the work of Nicolas *et al* (2010) but contrary to the findings of Ayatollahi *et al* (2002). The number of children born by a woman was observed not to affect age at menopause, contrary to the study conducted by Garrido-Latorre *et al* (1996), Cassou *et el* (2007), Parazzini *et al* (2007). The result of this study also discovered that right handed women had lower menopausal age, while the left handed women had higher menopausal age, contrary to studies conducted by Harlow and Signorello (2000), Dane *et al* (2009), but in accordance with Ayatollahi *et al* (2005).

5.3 Anthropometric variables

The mean of the hip circumference for the women and the girls were found to be 92.94 ± 8.81cm and 86.60 ± 7.30 cm, respectively. The values were below the one of 99.2 ± 10.17 cm obtained by Saka *et al* (2014), sample size and area of study could be responsible for the differences. The mean waist circumference for the women and girls were 80.59 ± 9.25 cm and 75.62 ± 4.20 cm, respectively. The waist circumference for the women was found to be within the cut-off point of 80 cm to 88 cm as described by Willis *et al* (2007). The value for the women was a little above by 2.72 cm and for the girls a little below by 2.08cm from the 77.70 ± 12.8 cm obtained by Saka *et al* (2014), and the mean of the neck circumference of the women and girls are 31.43 ± 2.61cm and 30.27 ± 1.92cm, respectively, which were below the value of 33.43 ± 3.17cm obtained by Saka *et al* (2014). The means of the height of the women and girls of the study population was observed to be 154.84 ± 6.12 and 151.33 ± 5.86, respectively. The mean height of the girls was higher than the value stipulated for taller girls of 148.60 cm meaning that girls in this location may attend menarche earlier according to Kaplowitz *et al* (2001). The means of hand lengths of the women and the girls were observed to be 17.91 ± 1.29 cm and 17.53 ± 0.92 cm, respectively. The 2D:4D radio of the women and the girls was observed to be 0.94 ± 0.04 cm and 0.97 ± 0.06 cm, respectively. The means of the palm lengths of the women and the girls of the study population were observed to be 10.27 ± 0.74 cm and 10.02 ± 65 cm, respectively. The means of the foot lengths of the women and the girls were 23.35 ± 1.37 cm and 22.88 ± 1.45 cm, respectively. The means of the forearm lengths of the women and the girls are 24.83 ± 1.44 cm and 22.94 ± 1.05 cm, respectively. The means of the ages of the women and the girls of the study population are 39.28 ± 1.31 years and 15.71 ± 2.28 years, respectively. The means of the body mass index of the women and girls of the study population was observed to be 23.73 ± 3.71 kg/m² and 19.77 ± 2.79 kg/m², respectively. General and central obesity measures were used in assessing adiposity related risk including body mass index (BMI), waist circumference (WC) and hip circumference (HC) even though the relative utility of the various anthropometric measures in assessing the cardiovascular risks remains unclear and the correlation of waist circumference and body mass index was seen to be very significant, similar to study conducted by Odenigbo *et al* (2011). The value of the BMI for women was found to be a little above the 22.9 ± 4.34 kg/m² obtained by Saka *et al* (2014), and was within the normal value, while that of the girls was found to be below the normal value.

In this study more of the women were having normal weight and only few were found to be obese, which was in line with the report of Kaur *et al* (2005). The study observed menstrual characteristics in terms of menstrual bleeding, regularity and irregularity of the menstruation and menstrual pain experience by the women. It was observed that about 70.6 % of the women were undergoing menstruation. The percentage of the women that experienced menstrual flow for the duration between 3 days to 7 days were observed to be more, similar to studies conducted on Kaduna State women by Victor *et al* (2015).

Padez and Rocha (2003) discovered that 59% of women in Coimbra, Portugal, had their duration of menstrual flow to last between 3 – 5 days. Most women in Calabar were found to have their menstrual flow lasting between 4 – 5 days (Aribo *et al.*, 2015). About 56.1 % of the women were observed to have regular menstruation which was an indication of high reproductive success among the women in the study population. 54.1 % of the women were also observed not to have ever had miscarriage in their life time, that was to say that the gynecological age of the women in the study population was observed to be high, which implied that, majority of the women had normal ovulatory cycles and were more likely to become pregnant, which was in line with the report of Rowland *et al* (2002).

5.4 Body composition

The means of bone mass of the women and the girls were 2.02 ± 0.20 and 2.16 ± 0.16, respectively. Dietary status of subjects in the study population could be a reflection of bone mass shown in this study according to Macdonald *et al* (2004). Genetics and environmental factors also have influence on bone mass (Zalloua *et al.*, 2007). The mean value of muscle mass of the women and girls were 38.33 ± 5.91m^2 and 39.86 ± 2.37 m^2, respectively. The value of muscle mass in this study appeared to be closer to the one reported by Akarolo-Anthony *et al* (2013). The means of total body water percentage of the women and girls were 53.21 ± 8.65 % and 51.05 ± 5.00 %, respectively, while the mean value of the calorie intake of women and the girls were 2128 ± 216.55 and 2279.74 ± 156.44, respectively. Body fat had positive correlation with muscle mass, bone mass, number of children and income, which was associated with nutritional status in line with Adebisi (2008) and Musa *et al (*2012) reports. The body fat was observed had strong physique rating of the women and girls were observed to be 5.58 and 6.21, respectively, and this indicated the presence of average body fat in the subjects (Hamdy *et al.*, 2006). Most of the parameters differ from those reported by other investigators, these could be due study location and sample size

5.5 Correlation of height of the girls with hand and foot anthropometry

There was positive correlation between the height with hand length, forearm length, palm length, and finger lengths which was in agreement with reports of Danborno (2009), Habib and Kamal (2010), Vijaykumar *et al* (2013), Kaur *et al* (2013b), Suseelamma *et al* (2014). The correlation between the height and these variables were seen to be statistically significant at $p < 0.01$. There was negative relationship between the height and 2D:4D ratio.

5.6 Correlation of height of the women with hand and foot anthropometry

There was positive correlation between the height with hand length, forearm length, palm length finger lengths and 2D:4D ratio, which was in agreement with reports of Danborno (2009), Habib and Kamal (2010), Vijaykumar *et al* (2013), Kaur *et al* (2013b), Ibegbu *et al* (2013) and Suseelamma *et al* (2014). The correlation between the height and these variables were seen to be significant at $p < 0.01$ but the correlation between height and fifth finger was not significant. The relationship between the height and 2D:4D ratio was significant at $p < 0.01$. The result of this study was in agreement with earlier investigations in spite of the difference in the study location.

5.7 Correlation between anthropometric variables and body composition

Correlation was observed between age and mid arm circumference, age and hand length, age and palm length, age and height, age and forearm circumference. The correlations were observed to be positively weak, giving the indication that, as the anthropometric variable increase the other slightly increase and the correlation were significant at $p < 0.05$. The correlation between the anthropometric variables with each other were similar to the report of Nwokoro *et al* (2006). There was a report by Nwokoro *et al* (2006) that showed existence of positive correlation between age and height, age and weight, age and hip circumference, age and neck circumference, age and body mass index that were significant at $p < 0.05$. The result of this study had produced similar correlations. In this study, BMI had negative correlation with total body water and physique rating, indicating that, individuals with high BMI may be seen to have low total body water and physique rating. The result of this study also produced very strong positive correlation between BMI and weight, BMI and hip circumference that were significant at $p < 0.05$. The positive correlation observed existing between the BMI and waist circumference was significant at $p < 0.01$. The result was in line with the findings of Okorodudu *et al.* (2010), who showed that measurement of height and weight (hence body mass index) is the easiest technique used in epidemiological studies, when assesing body composition. Waist circumference has been shown to be a simple, inexpensive and effective way in assessing central obesity (WHO, 2004), having high association with cardiovascular risk and mortality (Pouliot *et al.*, 1994; Saka *et al.*, 2014).

5.8 Correlation of menopause with some reproductive history

There was no relationship between menopause and age at marriage. The correlation between menopause and age at first pregnancy was a weak positive one, there was also a very weak positive correlation between menopause and age at first birth while the correlation between menopause and age at last birth is a positive correlation and this correlation is statistically significant at $p < 0.01$, and the weak positive correlation observed between menopause and age at first menses was significant at $p < 0.05$. The result was in agreement with works of Nicolas *et a.* (2010), Harlow and Signollero (2000) and Ubirani *et al* (2010), who showed that increase in the anthropometric variables lead to increase in the menopausal age. Sample size and the measurement technique employed in the study could be responsible for the differences observed with other studies.

5.9 Correlation of age at menarche with some anthropometric variables

Weak positive correlation was found between age at first menses with birth order, body mass index, contrary to report of Pierce and Leon (2005) and similar to Akbar (2013). Age at menarche was also seen to be positively correlated with hip circumference and height, which was in agreement with Kaplowitz *et al* (2001) and Akbar (2013). The positive correlation that was seen between, age at menarche with weight and waist circumference was contrary to the report of Khakbazan *et al* (2005), but in agreement to Karapanou and Papadimitriou (2010). The correlation between the age at first menses with weight and height were significant at $p < 0.01$ and $p < 0.05$ respectively. There was negative correlation between age at first menses with neck circumference, hand circumference and digit ratio, the negative correlation between the age at first menses with hand circumference was significant at $p < 0.05$. Thus, age at menarche was found to be inversely proportional to decrease in body circumferences.

5.10 Estimation of height using some anthropometric variables

The result of this study showed positive correlation between height with hand length, foot length, palm length, finger lengths, BMI and weight, but Tab.4.12 showed that, none of the variables could be used to estimate height, except BMI and weight which was contrary to the report of Amirsheybani *et al* (2000), who discovered that these anthropometric variables were used to estimate height. The reason could be as a result of different measurement technique employed.

5.11 Perception, attitude and knowledge of menopause

The experience of menopause by women differs, no two women will ever experience menopause at the same time. Karim *et al* (2013), discovered that most women do not know about symptoms and health hazards of menopause and that some of them don't even want to be treated of the menopausal symptoms. Few women expressed desire to receive education about menopause (Mazhar and Erum, 2003; Leon *et al.,* 2005; Kowalcek, *et al.*, 2005; Malik, 2008; Noroozi, *et al.*, 2013). Perception and experience of menopause by women is found not to be universal and wide variations occur due to ethnic origin (Karim *et al.*, 2013). Many women have positive attitude towards menopause and they believed that it is a normal phase of life, where they view it to be a good experience (Pan *et al.,* 2002; Biri, *et al.,* 2005; Loutfy *et al.,* 2006; Bairy *et al.*, 2009; Delavar and Hajiahmadi, 2011).

In this study, many of the women had the knowledge of menopause (Karim *et al.,* 2013) and few of them had seen a Doctor concerning menopausal problems (Mazhar and Erum, 2003; Leon *et al.,* 2005; Malik, 2008; Bairy *et al.,* 2009; Delavar and Hajiahmadi, 2011). The influence of level of education on seeing a Doctor concerning menopause appeared to be confusing according to this study, in which women that had some form of education saw a Doctor less than those that were illiterate. Both educated and uneducated women were discovered to be aware of menopause and its implication, which was in line with the findings of (Ozumba *et al.,* 2004; Baig and Karim, 2006; Nusrat *et al.,* 2008; Dhia a Sadik, 2009; Mustafa and Sabir, 2012). It was also observed that the source of knowledge about menopause came more from sermons in the Churches, followed by Health institutions, which was contrary to the findings of (Sowers, 2000; Cassou *et al.*, 2007). This might not be unconnected to the lack of adequate health facilities in the study location

CHAPTER SIX

6.0 SUMMARY, CONCLUSION AND RECOMMENDATION

6.1 Summary

The study on the anthropometric and reproductive characteristics of the girls and women in Kumana Chiefdom presented interesting results, because some of the results agree with findings of others' while a handful did not agree with previous reports.

The result of regression analyses presented in Tab.4.12 did not agree with many reports that found that, height could be estimated using palm length, hand length, foot length and finger lengths. The result of this study showed that height can only be estimated using the weight and body mass index (BMI) of the individual.

The most interesting aspect of this study was that the majority of the women had the ability to become pregnant, because there were many women with high reproductive success. Many women were observed to be undergoing menses, with few of them having irregular menstruations. It was also discovered that, many of the women had never had any miscarriage.

Another aspect of this study was that, the majority of the women had normal weight, only few of the women were seen to be obese, which is a clear indication that cases of cardiovascular disease could be rare in this study population. The normal weight observed in many of the women could have happened due to standard of living of the families and minimal nutritional stature of the families. Occupational status of the women and parents of the girls was another factor that could be responsible for the normal weight and BMI seen in this study, because almost everyone of the subjects were involved in farming and only few were found to be civil servants, which meant that there was some level exercise that many subjects used to undergo at some time.

There was knowledge of menopause among the different class of the women and the source of knowledge of menopause was obtained from sermons received from churches because of high percentage of illiteracy in this area of study. The age at menarche of the women was observed to be higher than that of the girls, in agreement with the secular trend of events over the years and this also showed that there was improvement in the nutritional status of the study population.

6.2 Conclusion

The risk of diseases associated with menarcheal age and menopause age could be very low, considering that the reproductive characteristics were not strongly correlated with the anthropometric characteristics that could trigger any of the diseases. For example breast cancer and arteriosclerosis, because most of the female were seen to be within the normal BMI and blood pressure. The women that were menstruating were observed to be many, indicating higher gynecological age in the study population.

6.3 Recommendations

The following recommendations are made in view of the observation on the results:

i. Further studies should be conducted to compare with other ethnic groups or other chiefdoms in the Local Government Area

ii. Further studies should be conducted to ascertain genetic influence on the anthropometric characteristics in this study population

iii. Further investigation should be done on the anthropometric characteristics involving both sexes

iv. Another study should be done using larger sample to ascertain the influence of ethnicity on menarcheal and menopausal ages in the Local Government Area

v. Further investigation on the reproductive characteristics should be done to include sisters, twins, daughters and mothers and even the absence any of the parents

6.4 Contribution to knowledge

The study was able to established the following;

- The BMI of the girls and women of Kumana Chiefdom are 19.77 ± 2.79 $kg/m^2$and 23.72 ± 3.71 kg/m^2 respectively.

- The blood pressure of girls and women are117.95 ± 11.16 mm Hg and 127.86 ± 19.06 mm Hg respectively, for the systolic, as well as 70.76 ± 9.54 and 81.02 ± 11.12 mm Hg respectively, for the diastolic.

- The waist circumference of 80.59 ± 9.25cm for women and75.62 ± 4.20 cm for the girls.

- Menarcheal and menopausal ages of the women were 15.577±1.569 years, and 47.172 ± 5.069 years respectively, and menarcheal age of 14.85 ± 1.78 years for the study population and 13.55 ± 1.35 years for the girls.

- Left hander subject had higher menarcheal age than the right handed of 17.05 ± 2.19 years and 14.26 ± 1.89 years, respectively
- Menarcheal of girls born in the dry season were found to be (12.54 ± 1.56 years) lower than the girls born in the rainy season (14.32 ± 1.73 years), it was also found that the menopause age of women born in the dry season (40 ± 4.31 years) was lower than for those born in the rainy season (45 ± 4.89 years)

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APPENDIX I

QUESTIONNAIRE FOR WOMEN

A. Personal Data

I. How old are you ………………….
II. When were born,(Day ………….) and (Month …………..)
III. How old are you now ………………………… Year
IV. What is your present level of education …………………………………….
V. Are you a full housewife or a working class woman? …………………………
VI. If you are working, what type of work do you do? …………………………..
VII. Indicate your present income per year ……………………………………………
VIII. What is your Marital status now? (Single) (Married) (Divorced) (Widowed)
IX. What was your age at marriage ………..Years
X. Do you have children? (Yes) or (No)
XI. If you have, how many do you have ? ....
XII. At what age did you had your first pregnancy? ………………..
XIII. How old were you when you gave birth to your first child ? ……………………..
XIV. Have you stop giving birth? (Yes) or (No)
XV. If yes, at what age did you stop giving birth? ……………………..
XVI. Have you ever had miscarriages? (None) (once) (twice) (three times) (many times)
XVII. How long do you breastfeed your child? ……………………..
XVIII. How many siblings do you have? ………………..
XIX. What is your position among your siblings? ………………
XX. Which of your parent is still alive? (Father)/ (Mother)
XXI. Which hand do you often use? (Right hand)or (Left hand)

Reproductive History

XXII. How old where you when you first experience your menses? …………..
XXIII. Are you currently on any contraceptives? (Yes) or (No)
XXIV. If yes, what type of contraceptives? ………………………..
XXV. Do you still experience menses? (Yes) or (No)
XXVI. If yes, how long does the menstruation last? (1day) (2days) (3days) (4days) (5days)
XXVII. How do you experience it? (regularly) or (irregularly)
XXVIII. Are your periods painful? (Yes) or (No). If yes how painful? (Mild), (Moderate) or (Severe)
XXIX. Do you have spotting or bleeding between your periods? (Yes) or (No)
XXX. If no, when did the menses stop? (Month ………….) and (Year ………..)
XXXI. What age where you when the menses stop? …………….
XXXII. Have you been hospitalized before? (Yes) or (No)
XXXIII. If yes, try to remember why you were hospitalized …………………………………
XXXIV. Can you remember how you felt before the menses finally ceases? (hot flashes) (night sweats) (forgetfulness) (laziness) (depression) (irregular menses)(difficulty sleeping) (changes in hair growth)(memory problems)(longer periods)(shorter periods)(………….)
XXXV. Do you know the age at which any of your sister's stop experiencing menses? (Yes) or (No)
XXXVI. If yes, at what age did the menses ceases? (I ……… years), (II ………..years), (III ………years.), (IV ………years) and (V ………years)

XXXVII. What was your mother's menarcheal age? ……………
XXXVIII. At what age did your mother's menses ceases? ……………..

B. Anthropometric Measurements

i. Weight (kg) ………………….
ii. Hip circumference (cm) ………………..
iii. Waist circumference (cm) ……………….
iv. Height (cm) …………….
v. Midarmcircumference(cm)………….
vi. Neck circumference (cm) ………..
vii. Forarm circumference (cm) ………..
viii. Arm circumference (cm)…………..
ix. Forarm length (cm)……………
x. Skinfold abdominal (cm)……………….
xi. Skinfold arm (cm)………………
xii. Skinfold forarm (cm)……………
xiii. Skinfold waist (cm)………………
xiv. Blood Pressure(Systolic (Hg mm)…………)(Diastolic (Hg mm)…………..)

C. Perception and Attitude to menopause

I. Have you ever consult a Medical Doctor about your reproductive state? (Yes) or (No)
II. Do you know what is Menopause? (Yes) or (No)
III. If yes, are you comfortable with it? (Yes) or (No)
IV. What was the source of your knowledge on the menopause?

APPENDIX II

QUESTIONNAIRE FOR THE GIRLS

A. Personal data

I. How old are you? ……………….
II. Date of birth (Month………………) (year………………)
III. Place of birth ………………………………
IV. Your level of Education (Primary), (Secondary) or (Tertiary)
V. Mother's level of education (Illiterate), (Primary), (Secondary)or (Tertiary)
VI. Father's level of education (Illiterate), (Primary), (Secondary)or (Tertiary)
VII. Mother's Occupation ……………………………………………..
VIII. Father's Occupation ……………………………………………….
IX. Are both your parents alive? (Yes) or (No)
X. Which of your parents is deceased and when? (Mother …) or/and (Father ………….)
XI. How many siblings do you have? (Number of Brothers ……………) and (Number of Sisters ……………)
XII. What is your birth order? ………………….
XIII. Which hand do you often used? (Right hand)or (Left hand)

B. Reproductive history

I. At what age did you experience your first menses? …………………..
II. What was your reaction?............................
III. Who did you first inform? (Mother) or (Friends)
IV. Did you have a prior knowledge that it was going to happen? (YES/NO)
V. If yes, from who? (Mother), (Friends) or (Teacher)
VI. Are you using oral contraceptives? (YES/NO)
VII. How many days do you do before seeing your next menses, for at list the past 6 months? …………………….
VIII. Do you experience the menses (REGULARLY or IRREGULARLY)
IX. Do you experience any of these symptoms during your menstruation? I-Anxiety, II-Depression, III- Headache, IV- Increase in the size of Breast, V- Fatigue, VI- Nausea
X. Do you experience any of these symptoms before menstruation? I- Body pains, II-Aggression, III- Pimples on the face, IV- Headache, V- Fatigue, VI- Increase in body weight, VII- Painful Breast

C. Anthropometric Data

I. Height(cm) ………………………………………………….
II. Weight(Kg) ………………………………………………….
III. Waist Circumference(cm) …………………………..
IV. Hip Circumference(cm)……………………………….
V. Chest Circumference(cm) …………………………..
VI. Thigh Circumference(cm) ……………………………
VII. Arm Circumference(cm) ……………………………..
VIII. Neck Circumference(cm) …………………………….
IX. Head Circumference(cm) …………………………….
X. Fingers Length(cm) ……………………………………

APPENDIX III.

WRITTEN CONSENT TO PARTICIPATE IN RESEARCH

Anthropometric and Reproductive Characteristics of Girls and Women in Kumana Chiefdom, Kauru Local Government of Kaduna State

You are asked to participate in a research study conducted by MURDAKAI TANKO **from the** Department of Human Anatomy, Faculty of Medicine, Ahmadu Bello University, Zaria.
The results of the study will contribute immensely to my dissertation to be presented to the Department of Human Anatomy, Faculty of Medicine, Ahmadu Bello University, Zaria for the award of Ph.D in Human Anatomy.

If you have any questions or concerns about the research, please feel free to contact any of these persons: (i) Dr. S. S. Adebisi (ii) Dr. B. Danborno (iii) Prof. S.A.O jo, who are my Supervisors

PURPOSE OF THE RESEARCH
To investigate the relationship between the Anthropometric and reproductive characteristics of girls and women in Kumana Chiefdom, Kauru Local Government Area of Kaduna State.

PROCEDURES
If you volunteer to participate in this study, we would ask you to do kindly do the following things:

(i) Answer the questions` written on the paper(s) given to you
(ii) Allow me take some measurements on you

The result of every answer given by you and measurements done on you would be known and interpreted to you.

POTENTIAL RISKS AND DISCOMFORTS
The research does not have any risk or discomfort, so participant should not be afraid of participating.

POTENTIAL BENEFITS TO PARTICIPANTS AND/OR SOCIETY
Similar studies have been conducted on other populations and used as baseline data,this study is important, because it would be of health benefits to the society and to you also.

PAYMENT FOR PARTICIPATION
There shall be no any financial benefit that will be given to you. I want you to kindly do this so as to achieve the purpose stated earlier.

CONFIDENTIALITY

Every effort will be made to ensure confidentiality of any identifying information that is obtained in connection with this study, the information will be released to my Supervisors, Departmental Library, Faculty Library, Postgraduate School and none other.

PARTICIPATION AND WITHDRAWAL

You can choose whether to be in this study or not. If you volunteer to be in this study, you may withdraw at any time without consequences of any kind. You may exercise the option of removing your data from the study. You may also refuse to answer any questions you don't want to answer and still remain in the study. I may withdraw you from this research if circumstances arise that warrant doing so.

RIGHTS OF RESEARCH PARTICIPANTS

You may withdraw your consent at any time and discontinue participation without penalty. You are not waiving any legal claims, rights or remedies because of your participation in this research study. This study has been reviewed and received ethics clearance through the Ahmadu Bello University, Zaria Research Ethics Committee. If you have questions regarding your rights as a research participant, you may contact: The Research Ethics Committee Chairman.

SIGNATURE OF RESEARCH PARTICIPANT

I have read the information provided for the study [Anthropometric and Reproductive Characteristics of Girls and Women in Kumana Chiefdom, Kauru Local Government of Kaduna State] **as described herein. My questions have been answered to my satisfaction, and I agree to participant in this study. I have been given a copy of this form.**

____

____

Name of Participant **Signature/Date of Participant**

____

____

Name of Witness **Signature/Date of Participant**

APPENDIX I
Ethical approval

HEALTH RESEARCH ETHICS COMMITTEE
AHMADU BELLO UNIVERSITY TEACHING HOSPITAL
SHIKA - ZARIA, NIGERIA.

E-mail: abuthshika@yahoo.com *website: www.abuth.org*

Chairman of Board: **Chief. Shuaib Oyedokun Afolabi** *Fnil*
Chief Medical Director: **Prof. Lawal Khalid,** *MBBS, FMCS, FWACS, FRCS(ED) mnl*
Chairman, Medical Advisory Committee: **Prof. Abdullahi Mohammed,** *MBBS, FWACP, FICS*
Director of Administration: **Barr. Ishak Bello,** *LL.B, BL., LL.M, PGDM, AHAN, FCAI*

*Our Ref:*______________________ *Date:* 23[th] September, 2015

Your Ref: **ABUTH/HREC/CL/05**

ABUTH HREC FULL ETHICAL CLEARANCE CERTIFICATE

Anthropometric and Reproductive Characteristics of Girls and Women in Kumana Chiefdom, Kauru Local Government of Kaduna State.

ABUTH Ethics Committee assigned number:	-	ABUTHZ/HREC/N09/2015
Name of the principal Investigator:	-	Mr, Murdakai Tanko
Address of the Principal Investigator:	-	Dept. of Human Anatomy, ABU, Zaria.
Date of receipt of valid application:	-	15/7/ 2015
Date of meeting when final determination **On ethical approval was made:**	-	4[th] & 5[th] September, 2015

This is to inform you that the research described in the submitted protocol, the consent forms and other participant information materials have been reviewed and ***given full approval by the Health Research Ethics Committee.***

Please note: this approval dates from **23[rd] September, 2015 – 23[rd] September, 2016**

No participant recruitment into this research may be conducted outside these dates.

All informed consent forms in this study must carry the ABUTH HREC number assigned to this research and the duration of ABUTH HREC approval of the study.

This HREC expects that you submit your application as well as an annual report for ethical clearance renewal 3 months prior to expiration of study dates. This is to enable you obtain renewal of your approval and avoid interruption of your research.

If there is delay in starting the research, please inform the ABUTH HREC so that starting dates can be adjusted accordingly.

No changes are permitted in the research without prior approval by ABUTH HREC, except in circumstances outlined in national code for Health Research Ethics: http://www.nhrec.net.

ABUTH HREC reserves the right to conduct compliance assessment visits to your research site without prior notification.

Prof. A. I. Mamman MBBS, FMCPath
Chairperson, ABUTH HREC