

Age at Natural Menopause and Anthropometrical Parameters for Rural Nigerian Women in Zuturung District, Kaduna State, Nigeria

Achie LN^{1*}, Igashi J², Olorunshola, KV³

¹Department of Human Physiology, Ahmadu Bello University, Zaria.

²Department of Radiology, Ahmadu Bello University Teaching Hospital, Shika, Zaria, Nigeria.

³Department of Human Physiology, College of Medical Sciences, University of Abuja, Abuja, Nigeria.

Article Metrics

Date submitted: 22/03/2021

Date Accepted: 22/07/2021

Date Published: 20/08/2021



ABSTRACT

Background: Background: Menopause is the expected end of reproductive life in a woman. The age at menopause is an important determinant of future health outcomes.

Method: We examined the associations of menopausal age and anthropometric parameters in rural Nigerian women. Data was obtained from a cross sectional study of one hundred and thirty five rural subjects in Zuturung district, Zangon Kataf Local Government Area of Kaduna State, Nigeria. They comprised of 38 premenopausal, 22 perimenopausal and 75 postmenopausal cohort of women. The subjects were selected based on some inclusion and exclusion criteria. After administering a questionnaire, the height (m), weight (g), and waist circumference (cm) of the women were determined using standard methods while the body mass index (BMI, kg/m²) was calculated. Results were presented as mean \pm SD and data were analyzed using ANOVA with $p < 0.05$ being considered as statistically significant. A posthoc test using Tukey was also utilized where differences were observed.

Result: The subjects had a mean age per group of 33.60 ± 4.59 years, 46.00 ± 5.80 years and 57.67 ± 9.19 years respectively for the premenopausal, perimenopausal and postmenopausal women. The study showed a mean and median age at menopause of 44.23 ± 2.74 years and 44 years respectively. Postmenopausal and perimenopausal subjects were more likely to be overweight (mean BMI 26.07 ± 5.99 kg/m², 26.42 ± 7.27 kg/m² respectively) as compared with their premenopausal counterparts (25.18 ± 3.48 kg/m²); $p < 0.001$. The postmenopausal and perimenopausal subjects also had a higher waist circumference (89.63 ± 10.66 cm, 92.19 ± 11.91 cm) as compared with the premenopausal subjects (83.73 ± 8.00 cm) $p < 0.001$. Only 73.86% of the postmenopausal subjects had a BMI ≥ 25 kg/m² whereas the prevalence of central obesity (determined using the waist circumference) among the postmenopausal women was 79%.

*Correspondence: LN Achie, P O Box 619, Zaria, Kaduna State, Nigeria. Email: nzug@yahoo.com Tel: +2348036003607

Access to the article



website: <http://www.jmbsr.com.ng>

doi: <https://doi.org/10.46912/jmbsr.41>

Find our articles on Google Scholar, fully indexed

How to cite this article:

Achie LN, Igashi J, Olorunshola, KV. Age at Natural Menopause and Anthropometrical Parameters for Rural Nigerian Women in Zuturung District, Kaduna State, Nigeria. J Med Bas Sci Res 2021;2(2):9-20.

Conclusion: These findings suggest a lower mean age at menopause, a higher BMI and waist circumference for the postmenopausal women as compared with their premenopausal women. We recommend the improvement of nutrition in the girl child and establishment of menopause clinics in rural areas for early screening, counselling and follow up of menopausal women.

Keywords: Body mass index, Age at menopause, Menopause, Zangon Kataf, waist circumference, Zuturung.

INTRODUCTION

Although menopause is a universal phenomenon among women, the timing of the onset is not. The age at menopause holds intrinsic clinical and public health interest because it serves as a marker of aging and health. Later age at menopause has been associated with a longer life expectancy, reduced risk of cardiovascular disease and less loss of bone density.^[1,2] While a lower age at menopause is associated with an earlier decline in cognitive function and an increased risk of cardiovascular disease. The factors leading to this earlier onset of menopause include racial/ethnic, geographical, not using oral contraceptives, mother's age at menopause, lower BMI and lower socioeconomic status.^[3] The age at menopause is more sensitive to varying rates of atresia of ovarian follicles than to the absolute number of oocytes depleted, but menopause is reached when depletion of follicles reaches approximately 1000.^[4]

Both menopause onset and anthropometric parameters vary by geographical regions, race, ethnicity and socioeconomic status. Almost all studies on age at menopause in Nigerian women come from studies on urban Nigerian women. Such studies also happen to be clinic/ hospital based.^[5,6] In our study we aimed at carrying out a community based study, determining the age at menopause and its association with the anthropometric parameters among rural Nigerian women in Zuturung district, Kaduna State, Nigeria.

MATERIALS AND METHODS

The study was carried out in Zuturung District. It is in Zango Kataf Local Government Area of Kaduna State, Nigeria. Zuturung district lies in the tropics and is located within the North Guinea Savannah zone. The district area under study is made up of 5 settlements having 5 village heads. They had a population, during the 2006 census, of 4,767 people. Two major ethnic group constitute the community; the Bajju and Ikulu tribes. They are a rural and agrarian community that farm mostly for subsistence while all the settlement share one Primary Health Care Center.

The study was a cross-sectional community based study of women in Zuturung district. They were randomly selected from a housing list derived in the course of mapping the settlement in a snowball fashion. In this technique, women were identified and asked for information of other subjects who met the eligibility criteria; these subjects in turn were contacted, screened for eligibility and asked for the names of other appropriate subjects. The process was continued until a sufficient number of eligible subjects were identified. The women groups of the community were also another focal point used for identification of eligible participants. Eligible subjects were then given an appointment to be seen at the community Primary Health Centre for data collection.

Participants consisted of one hundred and thirty five subjects. They comprised of 38 premenopausal, 22

perimenopausal and 75 postmenopausal subjects. The sample size (n) was determined as follows:

$$n = \frac{Z^2 P(1-P)}{d^2}$$

(Z statistics for a level of confidence, P= expected prevalence or proportion, d= precision in proportion of one: if 5% d=0.05)

$$n = \frac{(1.96)^2 \times 0.0571(0.943)}{0.025}$$

$$n = 82$$

The perimenopausal women were fewer in number due to further pruning of the women that constituted that group. Some of them were confirmed to have presented with menstrual irregularities mimicking perimenopause caused by the withdrawal of the norplant implant.

Menopausal status was defined as: *Natural menopause* if menses had stopped for at least 12 months without surgery, *Late perimenopause* if menses had occurred in the past 12 months but not in the last 3 months. *Early perimenopause* if menses had occurred in the past 3 months but had become less predictable and *Premenopause* if menses had occurred in the past 3 months with no decreased predictability^[7]

Eligibility criteria were as follows: premenopausal subjects aged 15 – 45 years (peak bone mass is attained by age thirty), subjects resident in the community (>1year), regularly menstruating, non-pregnant, not on hormonal contraceptive (the last 1 year), not on steroid treatment (> 3months) nor lactating were included in the study. Perimenopausal subjects aged 35 – 50 years who had menstruated within the last 12 months but had either decreased predictability in the last 3 months or menses had ceased in the last 3 months were included. They had to be subjects who were non-pregnant, not on hormonal contraceptive (the last 1 year), not on steroid treatment (> 3months) nor lactating. Postmenopausal subjects selected were women aged

between 40 – 70 years, amenorrhoeic for 12 months (if amenorrhoea is secondary to medication, radiotherapy or surgery they were excluded), non-smokers and ambulatory. A previous history of a fracture (<5 years), the presence of a skeletal deformity, use of hormone replacement or medication that can affect bone turnover and a history of malignancy also served as exclusion criteria.

Informed consent was obtained from the participants after approval of the study by the Ethical Committee on Human Research of the Ministry of Health, Kaduna State.

Data Collection

All variables of interest in the participating women were obtained by self – report in an interview. Information on the socio-demographic details, lifestyle factors, obstetric and gynecologic history and other health characteristics of the women was collected by means of a questionnaire. The interviews of the women was in English, Hausa and Jju (the local dialect and lingua franca of the region).

The weight of the subjects was determined with the subjects in light clothing using a calibrated weighing scale (Vins Medical, England) to the nearest 0.2kg. Height was measured to the nearest 0.5 cm with a stadiometer (Vins Medical, England). Each subject was measured without shoes, with her heels, buttocks and back to the stadiometer backboard. The patient's head was maintained in the Frank-fort plane, with the lower edge of the left eye socket in the same horizontal plane as the notch superior to the tragus of the left ear. The patient was then instructed to stretch to a fully erect position, keeping her feet flat on the floor while the height was recorded during normal respiration.^[8]

The body mass index was calculated as weight in kilograms (kg) divided by height in meters squared (m²).^[9] Waist circumference was measured with a

flexible metric tape at the level midway between the lower rib margin with the iliac crest with the participants standing without heavy outer garments, in duplicate to the nearest 0.5 cm.^[10] Hip circumference was measured at the maximal protrusion of the hips at the level of the pubic symphysis, to the nearest 0.5 cm. The waist-hip ratio (WHR) was calculated as the ratio of waist circumference over the hip circumference.^[11]

Blood pressure at rest was measured using standard auscultatory methods. Each subject was seated comfortably for 5 minutes, asked to remove their clothing where it covered the location of the cuff, after which the blood pressure was measured. Systolic and diastolic blood pressures were recorded at the first and fifth Korotkoff sounds, respectively, using a mercury sphygmomanometer (Acosson, A. C. Cossor & Son (surgical) LTD, London) and a stethoscope (3M Littmann Classic II S.E. Stethoscope, 3M Health Care, U.S.A).^[12,13]

Statistical Analysis

Results were presented as mean \pm SD and data were analyzed using one way analysis of variance (ANOVA) which was followed by Tukey post-hoc test. A p-value of <0.05 was considered statistically significant while associations between variables were determined by Pearson's correlation using SPSS version 23.

RESULTS

A total of 135 subjects participated in the study. They comprised of 38 premenopausal women, 22 perimenopausal women and 75 postmenopausal women. The results for the mean ages of all the three group of women is as in table 1. The mean age at menopause, median age at menopause alongside minimum and maximum ages for the postmenopausal women is in table 2. Anthropometric and social data for the premenopausal,

perimenopausal and postmenopausal women in Zuturung are in table 3. The educational status of the postmenopausal women is displayed in figure 1.

Table 1: Mean Age of the Premenopausal, Perimenopausal and Postmenopausal subjects in Zuturung District.

Parameter	Premenopausal (n=38)	Perimenopausal (n=22)	Postmenopausal (n=75)
Age (years)	33.60 \pm 4.59	46.00 \pm 5.80*	57.67 \pm 9.19*

p < 0.05 = * All values indicated are as mean \pm SD.

Depicting the mean ages of the premenopausal, perimenopausal and postmenopausal subjects.

Table 2: Mean and Median Age at Menopause for the Postmenopausal subjects in Zuturung District

Parameters	Postmenopausal (n=75)
Age at menopause (mean years)	44.23 \pm 2.74
Age at menopause (median years)	44.00
Minimum age at menopause (years)	38.00
Maximum age at menopause (years)	56.00

p < 0.05* All data indicated are mean \pm SD.

Depicting the age at menopause characteristics of the postmenopausal women in Zuturung district.

Table 3: The Anthropometric and Lifestyle Characteristics of the Premenopausal,

Parameters	Premenopausal (n= 3)	Perimenopausal (n=22)	Postmenopausal (n=75)
BMI (kg/m ²)	25.18 \pm 3.48	26.42 \pm 7.27	26.07 \pm 5.99
Waist circ. (cm)	83.73 \pm 8.00	92.19 \pm 11.91*	89.63 \pm 10.66*
Smoking currently(%)	0%	0%	0%
Drink alcohol (%)	18.31%	22.72%	36.99%

*=*p* < 0.05 All data indicated are mean \pm SD. BMI-Body mass index, WC-Waist circumference.

There was a statistically significant increase in waist circumference (*p*=0.000) and waist hip ratio in the perimenopausal and postmenopausal subjects as compared to the premenopausal group. However, their BMI (*p*=0.120) was not significantly different from that of the premenopausal group. No subject reported a history of smoking while all the 3 groups reported a history of consumption of alcohol in increasing proportion.

Majority of the women had no form of education (48.5%) while only about 8.8% had attained tertiary education.

There was no significant difference in the age at menopause for the rural women irrespective of their educational status (Figure 2)

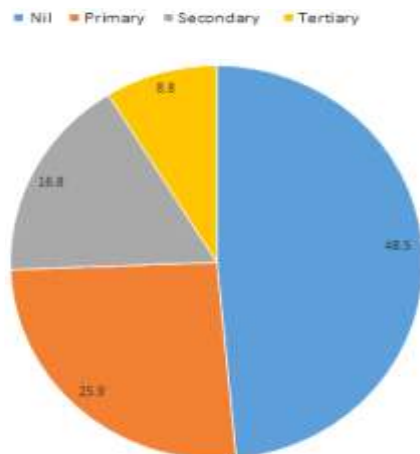


Figure 1. The educational status of the postmenopausal subjects in Zuturung district.

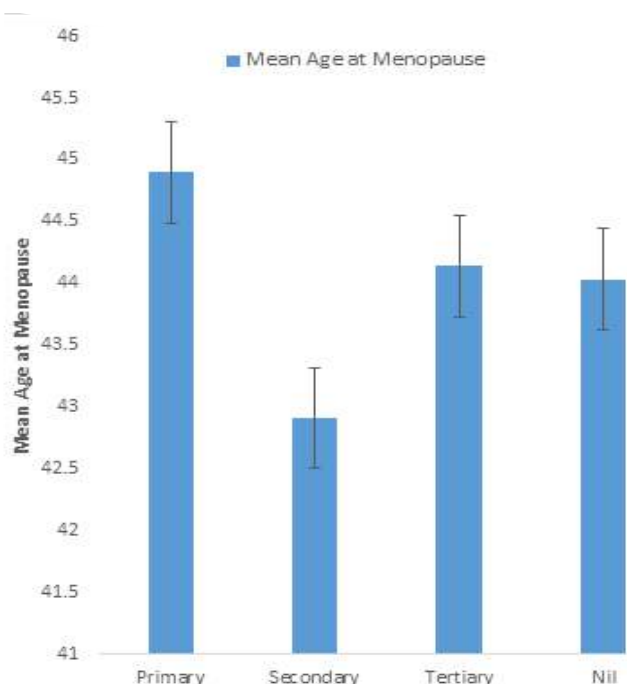


Figure 2. The age at natural menopause for the different educational status of rural postmenopausal women in Zuturung district.

Representing the correlation matrix. The weight of the postmenopausal women showed significant positive association with their BMI, waist circumference and height. ($p < 0.05$). While their HC correlated with the weight, height and WC of the subjects significantly. However, all the anthropometric parameters showed no significant association with their ages nor their age at menopause.

Table 4: A correlation matrix of the age, age at menopause and some anthropometric parameters of the postmenopausal women in Zuturung district.

Variables	Age	Age at M	BMI	WC	Ht	Wt	HC
Age	1						
Age at M	.267	1					
BMI	-0.04	.047	1				
WC	-.005	.134	.285*	1			
Ht	.170	.178	.134	.133	1		
Wt	.05	.090	.963*	.283*	.391*	1	
HC	.121	.223	.207	.780*	.269*	.239*	1

*= $p < 0.05$ BMI-Body mass index, WC-Waist circumference, Ht- Height, Wt- weight, HC- Hip circumference, Age at M- Age at menopause.

DISCUSSION

The mean age of the perimenopausal and menopausal women was significantly higher than that of the premenopausal control (Table 1). That is understandably so because women attain those former phases with advancing age.

The mean and median age at menopause for the women was 44.23 ± 2.74 years and 44 years respectively (Table 2). These findings are similar to the previous study by Achie *et al.*,^[6] where they reported a mean and median age at menopause for Nigerian women in Zaria as 46.16 ± 0.37 and 46 years respectively. These ages fall below the values reported in other regions in Nigeria.

A study of postmenopausal women in Sagamu, southwest Nigeria revealed a mean and median age at menopause of 48 ± 2.58 and 49 years.^[14] They belong to a different ethnic group (predominantly Yoruba ethnic group) with differing sociocultural backgrounds. Similarly, Okonofua *et al.*,^[15] had previously elicited a similar mean and median age of menopause in women of Yoruba descent too, 48.4 and 48 years respectively. Another study of urban Yoruba women in Ibadan, in the southwest of Nigeria, by OlaOlorun and Lawoyin,^[16] showed a mean and median age at menopause of 48 ± 5.9 and 48 years respectively too.

The mean age at menopause for women from Orlu in Eastern Nigeria was reported to be 47 ± 4.2 years.^[17] His study incorporated administering questionnaires to 13 communities from the Eastern Nigeria region. Even though their study was similarly on rural women they still presented with a slightly higher age at natural menopause as compared to our study in Northern Nigeria. Implying that the menopause experience of women in rural areas as well as women in other regions of Nigeria might differ. This finding is true in developing as well as in developed countries.^[18]

The age at menopause is said to show significant

association with the year of birth.^[19] They observed ages of menopause in their study for earlier years were lower implying that there was a time-related trend of age at menopause. The earlier study in women in Northern Nigeria gave the mean age at menopause for postmenopausal women in Zaria as 46.2 ± 0.37 as at 2011.^[6] Our recent study in the same region eight years later is producing the mean age at menopause of 44.23 ± 2.74 in rural women. By inference, this mean age at menopause would have been lower for this same rural community then. These results suggest that certain factors involved with socio-demographic, lifestyle, dietary and reproductive characteristics are related to the age at natural menopause in Nigerian women.

The existence of genetic variance in menopausal age was already suggested by a case-control study^[20] and a cross-sectional study^[21] in which early menopause tended to cluster in families. Heritability studies of menopausal age of twins and siblings showed substantial genetic variance^[22,21,23] This confirms that age at natural menopause is also determined by “heritable” components. Both comparisons among sisters and twin-sisters as well as between mothers and daughters found indications for genetic variance. This explains the variance across ethnic groups found in different regions of Nigeria.

Unraveling the genetic determinants involved in menopausal age opens the way to identify which women are at risk of premature ovarian aging and who can afford delaying having their families without fear of infertility. Since (genetic) tests are lacking to predict the age at menopause, an important indication may be family history on menopausal age components.^[24,21] Analyses of candidate genes indicated that the steroid hormone metabolism and biosynthesis pathways were associated with age at natural menopause and that genes involved in premature ovarian failure were also significantly

associated with age at menopause.^[25] Two single nucleotide polymorphisms of the tumor necrosis factor receptor family have also been shown to be significantly associated with age at natural menopause.^[26] However, heritability estimates cannot effectively distinguish between genetic factors and the early shared environmental influences that are more similar among twins. Up to the present, linkage has been more successful as there are now two regions exhibiting suggestive linkage on chromosome 9 and the X-chromosome.^[23]

None of the women interviewed were smoking cigarettes (table 3). This is a finding that should result in a later age at menopause. Early menopause has been shown to correlate with a history of smoking.^[27]

The effect is usually greatest in current smokers while the results from a past history of smoking is mixed.^[28] Further, exposure to smoke both prenatally and around the time of menopause is reported to accelerate ovarian aging.^[29] One possible mechanism is that tobacco smoke constituents such as polycyclic hydrocarbons destroy primordial oocytes or may contribute to degeneration of follicles through lowered estrogen levels thereby causing early natural menopause among smokers.^[27] Further, drug metabolism is reported to be enhanced in smokers.^[30] Hence, estrogen also may be more rapidly metabolized in the livers of smokers, which could lead to an earlier reduction of estrogen levels. Smoking has also been reported to have antiestrogenic effects. An Indian study in rural women showed the earlier onset of age at menopause experienced correlated with tobacco smoking. The prevalence of smoking among them (rural) was more than five times that of their urban counterparts.^[31] Contrary to the Indian picture more current smokers are found among Nigeria's urban population as compared to the rural population especially in adolescents.^[32]

The BMI of the perimenopausal and postmenopausal

women showed no significant difference with that of the premenopausal women (table 3). However, the waist circumference showed significant difference among the control (premenopausal) as compared with the perimenopausal and postmenopausal women. Obesity is defined by both increased BMI and ethnic specific waist circumference.^[33]

The higher waist circumference in postmenopausal subjects as compared with the perimenopausal and premenopausal subjects is caused by the effects of depleting estrogen levels in the menopausal period. These depleting levels are associated with hyperphagia in rats, decreased energy expenditure and increase in visceral fat (alteration in fat distribution in menopause) in humans.^[34,35]

Obesity has been associated with inadequate ovarian function, which could result in fewer ovulatory cycles and less depletion of follicles. In addition, the production of estrone in the adipose tissue of obese women may result in higher estrogen levels, which may lead to less follicular degeneration. There is no universal consensus on the relationship between body mass index (BMI) and age at natural menopause (ANM). However, a primary bias was by cigarette smoking because smoking was a strong confounding factor related to lower BMI and earlier menopause.^[36]

BMI across the reproductive lifespan was reported not to influence age at menopause to an extent that would be clinically relevant for postmenopausal health. Lower BMI at all ages and underweight trajectory were related to an earlier start of HT. Further studies are required to understand whether such relationships are due to underweight women experiencing menopause earlier (and because of menopausal symptoms starting HT earlier) than heavier women, or having behavioral characteristics related to earlier HT use, independent of menopause.^[37]

Some previous studies found an earlier age at

menopause among women with a low body mass index,^[38,39] but a study by Hardy *et al.*, did not.^[37] In Zhu *et al.*^[38] a higher menopausal age was observed among the overweight/obese women as compared to their normal weight counterparts. There is a report of BMI at a critical age being associated with the age at menopause.^[40] There is a report that BMI at the age of 18 is associated with age at menopause,^[3] hence the critical age may be younger than 39 y old. The critical age needs to be studied further.^[41] However, there appears to be a paucity of studies comparing correlation of age at menopause with a higher waist circumference.

High physical activity, and lower socioeconomic status and nutritional status in rural women has been reported to be associated with a lower age for the onset of natural menopause as well as a higher age at menarche.^[42,43] In contrast with the Asian study, a lower menopausal age in the urban area compared to the rural area of South African women was observed.^[44,45] A similar observation was made for Spain as less physical activity seemed to correlate with a lower natural menopausal age.^[46] Compared to their urban counterparts, the semi-rural women in Spain who were reported to be engaged in higher physical activity registered the highest age at natural menopause. In general, there is a strong indication of physical activity contributing to the difference observed in the onset of age at natural menopause between urban and rural populations.^[31,47] In another study, by Harlow and Signorello,^[48] major depression was associated with earlier menopause. Implying that psychosocial stress activates the hypothalamic-pituitary-adrenal axis, leading to increased secretion of glucocorticoids with inhibition of release of gonadotropin releasing hormone and suppression of ovulation.^[49] This mechanism linking between stress and hypothalamic amenorrhea might lead to an earlier menopause; especially in our subjects who live in a rural area with the attendant stress needed

for daily life survival.^[50] Findings also suggests that even early life stressors may also be related to early menopause.^[51] They include, malnutrition (acting prenatally through maternal under nutrition or post natal through poor childhood growth) and parental divorce during childhood.

All the 3 groups reported a history of consumption of alcohol in increasing proportion across the groups (Table 3). Although alcohol intake has been suggested to affect the age at which natural menopause occurs, results from observational studies are not consistent. The findings of a review indicate that alcohol consumption, particularly low and moderate alcohol intake, might be associated with later onset of menopause although the magnitude of the association was low. They also suggest further studies to corroborate their findings, clarify the level of alcohol intake at which menopause is delayed and identify the potential mechanisms behind this association.^[52] Reasons for the later age at menopause in alcohol consuming women suggested by another study are observed increasing concentrations of parent oestrogens with increasing alcohol intake among both never/former and current hormone replacement users, consistent with prior studies. There was also an observed trends of increased 2-hydroxylation pathway oestrogen metabolites with increasing alcohol intake (2-, 4-, and 16-pathway oestrogen metabolites)^[53] Another observation was that moderate drinkers were distinguished from abstainers by lower testosterone levels. This, it is suggested, reflects an increased rate of aromatization of testosterone stimulated by ethanol. Torgerson *et al.*,^[54] concluded that the onset of the menopause is delayed by moderate alcohol consumption. Alcohol consumption was significantly correlated with oestradiol levels and was found to be independently associated with menopausal status.^[55] Implying that further categorization and assessment of the drinking levels of our subjects could be carried out to verify

this association of alcohol consumption with age at natural menopause.

We found no association between the anthropometric parameters with the ages of the menopausal subjects nor with their age at menopause (Table 4). However, studies have shown many factors to affect the age at menopause, such as the mother's age at menopause, the age at menarche, body mass index, use of tobacco and alcohol, physical activity, socioeconomic status and educational level.^[34,52,38] We observed only a weak association of the anthropometrical parameters with themselves. The data in our study were collected as a cross-sectional study. That exposes us to the potential for recall bias and uncertainty about the timing of factors of in relation to the occurrence of menopause.

We conclude a finding of an earlier onset of natural menopause among rural African women in Zuturung District which was not significantly associated with their anthropometrical parameters.

We recommend longitudinal/prospective population based national studies on the age at natural menopause among rural women. So there will be less distortion of the true picture of the timing of the final natural menstrual period, particularly for understanding factors that precede and may affect the timing of menopause. Studies involving supplementation with zinc, vitamin B6 and higher intake of fish oils and fresh legumes portion in rural women and its effect on the age at natural menopause are also recommended.

Acknowledgements

We wish to acknowledge and appreciate the women of Zuturung district, the District Head of Zuturung and the research assistants who participated in the study.

REFERENCES

1. Gold, E. B. The Timing of the age at which menopause occurs. *Obstetrics and Gynecology Clinics of North America*, 2011 Sep 38(3): 425 – 440.
2. Gold EB, Bromberger J, Crawford S, Steve S, Greendale G.A, Harlow SD, Skurnick J. Factors Associated with Age at Natural Menopause in a Multiethnic Sample of Midlife Women. *American Journal of Epidemiology*, 2001 May 153(9): 865–874.
3. Mcknight KK, Wellons MF, Sites CK, Roth DL, Szychowski JM, Halanych JH, Cushman M, Safford MM. Racial and Regional Differences in age at menopause in the United States: Findings from the reasons for geographic and racial differences in stroke (REGARDS) study. *American Journal of Obstetrics and Gynecology*. 2011 Oct 205(4): 353.e1–353.e8
4. Sowers MR, Zheng H, Greendale GA, Neer RM, Cauley JA, Ellis J, Johnson S, Finkelstein JS. Changes in Bone Resorption Across the Menopause Transition: Effects of Reproductive Hormones, Body Size, and Ethnicity. *Journal of Clinical Endocrinology and Metabolism*, 2013 Jul 98(7): 2854–2863.
5. Bello FA, Daramola OO. "Attitude to the menopause and sex amongst middle-aged women in a family medicine clinic in Ibadan, Nigeria", *Obstetrics and Gynecology International*. 2016 Jul <https://doi.org/10.1155/2016/2031056>.
6. Achie LN, Olorunshola KV, Mabrouk M. Age at Natural Menopause among Nigerian Women in Zaria, Nigeria. *Asian Journal of Medical Sciences* 2011 3(8): 151-153
7. WHO Scientific Group on Research on the Menopause in the 1990s. WHO Technical Report Series Geneva, Switzerland. 1996 ; 866.
8. Norton K, Whittingham N, Carter L, Kerr D, Gore C, Marfell-Jone M. Measurement techniques in anthropometry, chapter 2. In:

- Norton K, Olds T (eds) *Anthropometrica*. University of New South Wales Press, Sydney, Australia, 1996 :25–75.
9. Frankel HM. Determination of Body Mass Index. *JAMA.*, 1986 Mar 255(10):1292.
 10. Visscher TLS, Seidell JC, Molarius A, van der Kuip D, Hofman A, Witteman, JCM. A comparison of body mass index, waist-hip ratio and waist circumference as predictors of all-cause mortality among the elderly: the Rotterdam study. *International Journal of Obesity*, 2001 Nov 25 (11): 1730 – 1735.
 11. WHO. Waist Circumference and Waist–Hip Ratio: Report of a WHO Expert Consultation, Geneva, 2008 Dec 8–11.
 12. Frese EM, Fick A, Sadowsky HS. Blood Pressure Measurement Guidelines for Physical Therapists. *Cardiopulmonary Physical Therapy*, 2011 Jun 22 (2): 5- 12.
 13. Pickering TG, Hall JE, Appel LJ, Falkner BE, Graves J, Hill MN, et al. Recommendations for blood pressure measurement in humans and experimental animals. Part 1: Blood pressure measurement in humans: A statement for Professionals from the subcommittee of professional and public education of the American Heart Association Council on high blood pressure research. *Circulation*. 2005 Feb 111:697–716.
 14. Adefuye PO, Adefuye BO, Lamina MA, Shorunmu TO, Akindele RA. Menopause in Sagamu, southwest Nigeria. *East African Medical Journal*, 2017 94 (12): 986-997.
 15. Okonofua FE, Lawal A, Bamgbose JK. (1990). Features of menopause and menopausal age in Nigerian women. *International Journal of Gynecology & Obstetrics*, 1990 Apr 31(4): 341 – 345.
 16. OlaOlorun F, Lawoyin, T. (2009). Experience of menopausal symptoms by women in an urban community in Ibadan, Nigeria. *Menopause*, 2009 Jul-Aug 16(4): 822-830.
 17. Anolue FC, Dike E, Adogu P, Ebirim C. Women's experience of menopause in rural communities in Orlu, Eastern Nigeria. *International Journal of Gynaecology and Obstetrics*. 2012 Jul 118(1):31-3. doi: 10.1016/j.ijgo.2012.02.014.
 18. Price S. L, Storey S, Lake, M. Menopause experiences of women in rural areas. *Journal of Advanced Nursing*, 2008 Feb 61(5): 503-511.
 19. Kalichman L, Malkin I, Kobylansky, E. Time-related trends of age at menopause and reproductive period of women in Chuvashian rural population. *Menopause* 2007 Jan-Feb 14(1):135 -40.
 20. Cramer DW, Xu H, Harlow BL. (1995). Family history as a predictor of early menopause. *Fertil Steril*. 1995 Oct 64:740–5.
 21. van Asselt KM, Kok HS, Pearson PL, Dubas JS, Peeters PHM, te Velde ER, van Noord PAH, *Fertil Steril*, 2004 Nov 82 (5): 1348–1351.
 22. Xiaoyi F, Hongyan W, Xiaojin Z. Genetic aspects of early menopause. *Journal of Bio-X Research*: 2019 Sep 2(3): 105-111.
 23. Kok HS, Asselt KM, Schouw1 YT, Peeters PHM, Wijmenga C. Genetic studies to identify genes underlying menopausal age. *Human Reproduction Update*, 2005 Sep/Oct 11(5): 483–493.
 24. Murabito JM, Yang O, Fox C, Wilson PWF, Cupples AL. Heritability of age at natural menopause in the Framingham Heart Study, *The Journal of Clinical Endocrinology & etabolism*, 2005 Jun 90(6):3427–3430.
 25. He C, Kraft P, Chasman DI, Buring JE, Chen C, Hankinson SE, Paré G, Chanock, S, Ridker PM, Hunter, DJ. (2010). A large-scale candidate gene association study of age at menarche and age at natural menopause. *Human Genetics*,

- 2010 Nov 128(5):515-27.
26. Lu Y, Liu P, Recker RR, Deng H, Dvornyk V. *TNFRSF11A* and *TNFSF11* are associated with age at menarche and natural menopause in white women. *Menopause*. 2010 Sep 17(5): 1048–1054.
27. Yang HJ, Suh PS, Kim SJ, Lee SY. Effects of smoking on menopausal age: Results from the Korea national health and nutrition examination survey, 2007 to 2012. *J. Prev. Med. Public Health*. 2015 Jul 48(4): 216–224.
28. Mikkelsen TF, Graff-Iversen S, Sundby J, and Bjertness E. Early menopause, association with tobacco smoking, coffee consumption and other lifestyle factors: a cross-sectional study. *BMC Public Health*, 2007 Jul 7:149.
29. Tawfik H, Kline J, Jacobson J, Tehranifar P, Protacio A, Flom JD et al., (2015). Life course Exposure to Smoke and Early Menopause and Menopausal Transition. *Menopause*. 2015 Oct 22(10):1076–1083. Oct
30. Hart P, Farrell GC, Cooksley WG, Powell LW. Enhanced drug metabolism in cigarette smokers. *Br Med J*. 1976 Jul 2(6028):147–149. doi: [10.1136/bmj.2.6028.147](https://doi.org/10.1136/bmj.2.6028.147)
31. Saw OM, Resni M. Rural-Urban Difference in Natural Menopausal Age and the Correlating Factors. *International Journal of Women's Health and Reproduction Sciences*, 2020 Apr 8(2): 112–118. DOI: [10.15296/ijwhr.2020.18](https://doi.org/10.15296/ijwhr.2020.18)
32. Oyewole BK, Animasahun VJ, Chapman HJ, Wang W. Tobacco use in Nigerian youth: A systematic review. *PLoS One*. 2016 May 13(5): e0196362.
33. Lear SA, James PT, Kumanyika S. Appropriateness of waist circumference and waist-to-hip ratio cutoffs for different ethnic groups. *European Journal of Clinical Nutrition*, 2009 Jan 64:42–61.
34. Donato GB, Fuchs SC, Oppermann K, Bastos C, Spritzer PM. (2006). Association between menopause status and central adiposity measured at different cutoffs of waist circumference and waist-to-hip ratio. *Menopause*, 2006 13(2):280-5.
35. Poehlman ET, Toth MJ, Gardner AW. (1995). Changes in energy balance and body composition at menopause: a controlled longitudinal study. *Annals of Internal Medicine*. 1995 Nov 123: 673-675.
36. Tao X, Jiang A, Yin L, Li Y, Bradbury J. Mechanism found for smoking-induced early menopause. *Menopause (New York, N.Y)* 2014 Sep 23(4) DOI:[10.1097/GME.0000000000000324](https://doi.org/10.1097/GME.0000000000000324)
37. Hardy R, Mishra GD, Kuh D. Body mass index trajectories and age at menopause in a British birth cohort. *Maturitas*. 2008 Apr 59(4): 304 - 314
38. Zhu D, Chung H, Pandeya N, Dobson AJ, Kuh D, Crawford SL, et al. Body mass index and age at natural menopause: an international pooled analysis of 11 prospective studies; Meta-Analysis. *European Journal of Epidemiology*, 2018 Feb 33(8):699-710.
39. Akahoshi M, Soda M, Nakashima E, Tominaga T, Ichimaru S, Seto S, Yano K. The effects of body mass index on age at menopause. *International Journal of Obesity*, 2002 Jun 26:961–968.
40. Morris DH, Jones ME, Schoemaker MJ, McFadden E, Ashworth A. Body mass index, exercise and other lifestyle factors in relation to age at natural menopause: analyses from the breakthrough generations study. *American Journal of Epidemiology* 2012 May 175(10):998-1005.
41. Szegda KL, Whicomb BW, Purdue-Smithe AC, Boutot ME, Manson JE, Hankinson SE, Rosner BA, Bertone-Johnson ER. Adult adiposity and

- risk of early menopause. *Human Reproduction*. 2017 Dec 32(12):2522-2531
42. Wang M, Wei-wei G, Hu R, Wang, H, Guo Y, Bian Z, et al Age at natural menopause and associated factors in adult women: Findings from the China Kadoorie Biobank study in Zhejiang rural area. *PLOS ONE* 13(4): 0195658
43. Sharma K, Bansal M. Association of age at menopause with post-menopausal symptoms, menarche age and other reproductive factors among rural females in Shimla, Himachal Pradesh. *Journal of biosocial Science*. 2018 Jan 50(1): 19-25.
44. Peer N, Bradshaw D, Laubscher R, Steyn N, Steyn K. Urban-rural and gender differences in tobacco and alcohol use, diet and physical activity among young black South Africans between 1998 and 2003. *Glob Health Action*. 2013 Jan 6(1): 19216.
45. Walker AR, Walker BF, Ncongwane J, Tshabalala EN. Age of menopause in black women in South Africa. *Comparative Study: British Journal of Obstetrics and Gynaecology*, 1984 Aug 91(8):797-801. <https://doi.org/10.1111/j.14710528.1984.tb04853.x>
46. Mielgo-Ayuso J, Aparicio-Ugarriza R, Castillo A, Ruiz E, Ávila M, Aranceta-Batrina J, et al. Physical activity patterns of the Spanish population are mostly determined by sex and age: findings in the ANIBES Study. *PLoS One*, 2016 Feb 11(2):e0149969. doi:10.1371/journal.pone.0149969.
47. Dasgupta D, Ray S. Menopausal Problems among rural and urban women from Eastern India. *Journal of Social, Behavioral, and Health Sciences*. 2009 3 (1): 20–33
48. Harlow, B. L. and Signorello, S. L. (2000). Factors associated with early menopause. *Maturitas*, 28;35(1):3-9. April
49. Mikhael S, Punjala-Patel A, Gavrilova-Jordan L. Hypothalamic-pituitary-Ovarian axis disorders impacting female fertility. 2019 Jan 7(1):5 doi: [10.3390/biomedicines7010005](https://doi.org/10.3390/biomedicines7010005)
50. Choi B, Lee Y, Choi J, Cho W, Im H, An J. The Association between Stress Level in Daily Life and Age at Natural Menopause in Korean Women: Outcomes of the Korean National Health and Nutrition Examination Survey in 2010-2012. *Korean J. Fam. Med.* 2015 Nov 36(6):305–309. doi:[10.4082/kjfm.2015.36.6.305](https://doi.org/10.4082/kjfm.2015.36.6.305)
51. Mishra GD, Cooper R, Tom SE, Kuh D. Early life circumstances and their impact on menarche and menopause. *Womens Health (Lond Engl)*. 2009 Mar 5:175-90. doi: [10.2217/17455057.5.2.175](https://doi.org/10.2217/17455057.5.2.175)
52. Taneri PE, Kiefte-de Jong JC, Bramer WM, Daan NMP, Franco OH, Muka T. Association of alcohol consumption with the onset of natural menopause: a systematic review and meta-analysis. *Human Reproduction Update*, 2016 Jul/Aug 22(4): 516–528.
53. Playdon MC, Coburn SB, Moore SC, Brinton LA, Wentzensen N, Anderson G. et al. alcohol and oestrogen metabolites in postmenopausal women in the Women's Health Initiative Observational Study. *British Journal of Cancer*, 2018 Dec 118(3):448–457.
54. Torgerson DJ, Thomas RE, Reid DM. Mothers and daughters menopausal ages: is there a link? *Eur J Obstet Gynecol Reprod Biol*, 1997 Jul 74(1):63–6.
55. Gill J. The effects of moderate alcohol consumption on female hormone levels and reproductive function. *Alcohol Alcohol*, 2000 Sep 35(5):417-23. <https://doi.org/10.1093/alcalc/35.5.417>