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# Intra-population age variation at natural menopause and underlying past reproductive events: a case of Polish women

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**Introduction**. Menopause in the human female is a developmental stage that should be understood within the context of normal aging. This paper describes the intrapopulation variation in the age of natural menopause among Polish women and identifies the female reproductive characteristics associated with the menopause. **Materials and Methods**. Data from 2147 naturally postmenopausal women, participants of a cross-sectional population-based survey conducted in 2000–2003 in all but Eastern parts of Poland, were analyzed to determine the mean and median ages at natural menopause. **Results**. The mean recalled age of natural menopause among Polish women was 49.90 years and the median age obtained by probit estimate was 50.92 years. Women from small towns were likely to experience menopause earlier compared to women from the cities. The timing of menopause among rural women was very close to their counterparts from the cities (median age 50.91 and 50.98 years, respectively). The positive education gradient of the age at menopause showed the 0.87 year difference in median menopausal age between women having high and low levels of education. Moreover, rural women having the primary/vocational level of education were distinguished from their urban counterparts by a later age at menarche (13.96 and 13.44 years, respectively), earlier age at the first child-birth (21.45 years *vs.* 25.59 years) and earlier age at the last birth (28.96 years *vs.* 31.05 years). The multivariate explanatory model of a stepwise multiple regression with forward elimination revealed that the age at menarche and the length of menstrual cycle were significantly associated with the age at menopause. Along with these variables, age at first birth and the number of days of bleeding as well as the urbanization factor contributed to the variation of age at menopause. **Conclusions**. Age at menarche, peculiarities of menstrual cycle, age of women at first child-birth, also the education and urbanization factors could influence the variation of the age at menopause.

**Key words**: menopause, menarche, menstrual cycle, parity, age at child-birth, childbearing years, education, urbanization.

## INTRODUCTION

Menopause in the human female is a developmental stage that should be understood within the context of normal aging. It is defined as a complex biosocial and biocultural phenomenon, which occurs in women's midlife either spontaneously (naturally) or can be induced through a medical intervention (e.g., surgery, chemotherapy, or pelvic radiation therapy). Whatever the character of the menopause, its standardized definition is used to refer to the permanent cessation of menses resulting from the loss of ovarian follicular function (1). Thereby, menopause means a crucial point in the transition from female reproductive to postreproductive life. A natural menopause is recognized to have occurred after 12 consecutive months of amenorrhea, for which there is no other obvious pathological or physiological causes (2). Although there is a strong central tendency in the age at menopause, with medians clustering around 50 years, a considerable variation exists both within and between populations. The medians range from 47 to 52 years in developed countries and between 41 and 47 years in less developed countries (3). Reports of the age at menopause among Polish women range from 49.2 to 50.01 years (4–7). However, comparisons of the

age at menopause are difficult because of the different methodologies applied across studies.

Many attempts have recently been made to identify the environmental and life-history factors essential for variations in the age at menopause, including heredity, marital status, age at menarche and at first child-birth, parity, life style and socioeconomic status, though the findings are still inconclusive (8). Contradictory findings as to the factors associated with age at menopause and a search for updated records for Polish women have stimulated interest in this question. Therefore, the purpose of the present study was to describe the distribution of the age at menopause among Polish women in relation to the reproductive and social variables, using an approach designed to avoid the problems that may account for the inconsistent results of prior studies.

## MATERIALS AND METHODS

This study was designed as a cross-sectional population-based one and conducted in 2000-2003 in all but the far Eastern part of Poland. Women were defined eligible for the study if they were healthy, over 35 years of age and expressed cooperativeness. They were selected by stratified random sampling from registered lists obtained from communal or municipal offices. The total sample consisted of 7042 out of a potential 8100 participants yielding a 86.9% final response rate. Of 3268 postmenopausal women, 2147 (66%) had natural menopause, and these women were investigated in the present study. They were classed by age, marital status, level of education and category of urbanization.

Women were administered a Menopause-Specific Questionnaire (MSQ) by fully-trained graduate student interviewers. Some inquiries recalled the past, either three months back (midlife health symptoms) or the entire life span. In the scaling procedure, a binary yes/no option was used for quantitative statistics and for the evaluative purpose an item was rated on a seven-point scale.

For the purposes of the present study the demographic, socio-economic and life-history aspects of the questionnaire were conducted. The reproductive capacity was characterized by the pattern of menstrual cycle (length cycle, length of bleeding) and life-history traits (age at menarche, age at first childbirth, age at last birth). The onset of the reproductive period was dated by the age at menarche. The interval of time between the age at menarche and at menopause was used for estimating the maximum length of the potential childbearing period. The length of the total childbearing period was obtained from the difference between the age at the first and last birth. Parity was defined as a number of livebirths ever given.

The individual age at menopause was obtained by asking postmenopausal women to recall their age at the last menstrual period (LMP). The accuracy of the replies usually depended on the time interval since menopause (the older the women the more marked tendency to round off the dating of the onset and end of the menstruating period). The status-quo method is thought to be more reliable compared to the retrospective one, since data can be determined on the basis of each woman's yes or not reply on the events that occurred within only a previous year. In the mentioned approach, women were asked to determine their menstruating status as either menstruating or not. Each age-specific prevalence of the postmenopausal state was transformed to a probit scale and median age was calculated from these transformed data. Two-way ANOVA models were applied to evaluate the effects of both education and urbanization categories. All computations were run using the Statistica 6.0 programme package (9).

## RESULTS

Table 1 displays the demographic, social and reproductive characteristics of the study cohort. The mean age of the women was 49.87 years (SD 3.38) with a skewness of –0.56 and a kurtosis of 0.47, indicating a fairly symmetric distribution slightly skewed toward older ages (the left of the age distribution). The majority of women were married (79.9%) or widowed (9.3%) at the time of the survey. A quarter of women came from rural and three quarters from urban communities. Slightly less than half of women (45.8%) had completed secondary school and almost one quarter (22.3%) had completed higher school, labelled as the academic level of education. Characteristics of the menstrual cycle indicated that 61.7% of women had the normal length (28–32 days) of the menstrual cycle and 30.4% shorter than 28 days. Almost half of women reported that their menstrual bleeding had lasted 5–6 days, and those who reported shorter duration (less than 5 days) of menstrual bleeding constituted 34.2%. Almost half of women (42.3%) had two children. They followed the most common pattern of parity among Polish women. Women having three children constituted of 20.7% of the total sample. Nulliparous women (7%) and women having more than five children (4.3%) constituted minorities in the total sample. The most common age at the first birth was between 21 and 25 years (54.4%). Women giving the first delivery at an age under 21 and over 25 constituted 21.5% and 24.1%, respectively. Slightly more than half of the women (58.2%) gave the last delivery at the age range 26–33 and those who were older than 33 years at the last delivery constituted 26.5%. The total numbers

Table 1. **Percentage distribution of selected characteristics of the sample (n = 2147)**

| Variable | % | Variable | % |
|---|---|---|---|
| Age range (years) | | Length of menstrual cycle (days) | |
| 35–40 | 0.2 | < 28 | 30.4 |
| 40–45 | 1.9 | 28–32 | 61.7 |
| 45–50 | 14.4 | > 32 | 7.9 |
| 50–55 | 46.1 | Days of menstrual bleeding | |
| 55–60 | 37.4 | < 5 | 34.2 |
| Marital status | | 5 – 6 | 47.4 |
| Married | 79.9 | > = 7 | 18.4 |
| Single never married | 5.1 | Parity | |
| Widowed | 9.3 | Nulliparous | 7.0 |
| Divorced | 5.7 | 1 | 17.7 |
| Place of residence | | 2 | 42.3 |
| Village | 21.2 | 3 | 20.7 |
| Small town up to 20 000 inh. | 29.8 | 4 | 8.0 |
| Medium to large town 20 000 to 500 000 inhabitants | 27.5 | > = 5 | 4.3 |
| City over 500 000 inhab. | 21.5 | Age at first child-birth (years) | |
| Educational level | | <21 | 21.5 |
| Primary | 11.4 | 21–25 | 54.4 |
| Vocational | 20.5 | >25 | 24.1 |
| Secondary | 45.8 | Age at last child-birth (years) | |
| High school graduate | 22.3 | <26 | 15.4 |
| | | 26–33 | 58.2 |
| | | > 33 | 26.5 |
| Age at menarche (years) | | Numbers of childbearing years | |
| < 13 | 17.7 | <10 | 70.0 |
| 13–15 | 69.3 | 10–20 | 29.1 |
| > 15 | 12.9 | > 20 | 0.9 |

of childbearing years ranged from 1 year to 25 years, with the majority (70%) of women that had given delivery within 10 years. Women with a number of total childbearing years ranging from 10 to 20 constituted 29.1%.

The age of the last menstrual period (LMP) reported by 1879 women ranged from 37 to 58 years, with the mean value yielding 49.90 years and SD 3.47 years. Its frequency distribution over age classes is displayed in Fig. 1.

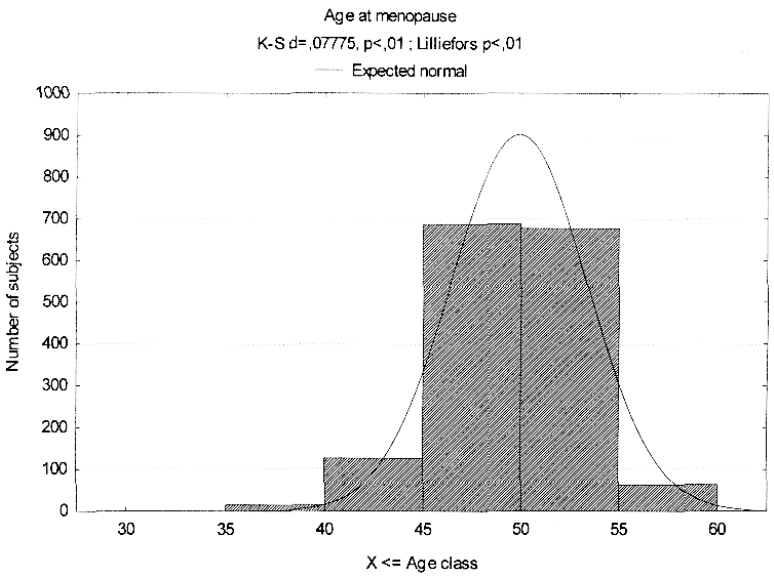


**Figure.** Percentage distribution of age at natural menopause over age classes in a sample of Polish women

Women who experienced earlier menopause (before 45 years of age) constituted 8.9% of the total sample and those who experienced later menopause after 55 years of age, constituted 4% of the total sample. The median age of natural menopause calculated by probit estimate for 6130 subjects was 50.92 years with SE = 0.33 years. Mean and median ages at natural menopause in relation to urbanization and education factors are presented in Table 2.

Figures in Table 2 show the urbanization and education gradients in the age at natural menopause among Polish women. Considering the urbanization factor, one may see that the larger the category of urbanization the later age at menopause (49.55 years, 49.95 years and 50.38 years, respectively).

Table 2. **Mean (recalled) and median (probit estimate) age at natural menopause among Polish women by urbanization and education factors**

| Variable | N | Mean | SD | N | Median | SE |
|---|---|---|---|---|---|---|
| Urbanization | | | | | | |
| Village | 358 | 50.05 | 3.39 | 1115 | 50.91 | 0.79 |
| Small town | 492 | 49.55 | 3.42 | 1739 | 50.75 | 0.64 |
| Medium to large town | 483 | 49.95 | 3.49 | 1538 | 50.89 | 0.53 |
| City | 212 | 50.38 | 3.62 | 1222 | 50.98 | 0.92 |
| Education | | | | | | |
| Primary/Vocational | 714 | 49.89 | 3.39 | 1870 | 50.46 | 0.64 |
| Secondary | 595 | 49.81 | 3.55 | 2562 | 51.05 | 0.48 |
| Academic | 227 | 49.96 | 3.47 | 1197 | 51.35 | 0.73 |

Table 3. **Two-way ANOVA models for age at menarche, age at first and last child-birth and parity with urbanization and education as predictive factors**

| Trait | Predictive factors | df | *F* value |
|---|---|---|---|
| Age at menarche | Urbanization | 3 | 14.0** |
| | Education | 2 | 3.7* |
| | Urbanization × Education | 6 | ns |
| Age at first birth | Urbanization | 3 | 11.9** |
| | Education | 2 | 275.8** |
| | Urbanization × Education | 6 | ns |
| Age at last birth | Urbanization | 3 | 0.2 |
| | Education | 2 | 27.8** |
| | Urbanization × Education | 6 | ns |
| Parity | Urbanization | 3 | 8.9** |
| | Education | 2 | 16.6** |
| | Urbanization × Education | 6 | ns |

* $P < 0.05$; ** $P < 0.01$.

Women living in the cities (the highest category of urbanization) tend to have menopause at the oldest age compared to their peers from towns and villages. Bivariate analysis (one-way ANOVA) indicates that the urbanization factor significantly contributes to age variation at menopause ($F = 3.07$ and $P < 0.05$). Considering the education factor, its highest level corresponds to the latest timing of menopause. Women having the primary/vocational level of education and those with the secondary educational level experienced menopause at the same time (49.89 years and 49.81 years, respectively) and slightly earlier compared to women having with a high (academic) level of education (at 49.96 years). However, minute differences in age at menopause in relation to the education factor are not significant ($F = 0.33$ and $P > 0.05$) implying means that the level of education is not the main factor of variation in age at menopause. On the other hand, the effect of urbanization on age at menopause, consistent in the bivariate model, disappears in the multivariate model which includes urbanization and education ($F$ for education = 0.2; $P > 0.05$ and $F$ for urbanization = 1.4; $P > 0.05$ interaction between urbanization and education insignificant).

Considering the other life history traits, such as age at menarche, age at the first and last birth and parity, they reveal a diversity in relation to urbanization and education factors. Table 3 displays results of two-way ANOVA for the characteristics mentioned above and predictive urbanization and education factors.

The results of two-way ANOVA reveal a different reproductive pattern in women from urban and rural settings, namely in relation to such characteristics as age at menarche, age at the first and last birth and the parity. Education and urbanization factors appear to effect separately the variation in the reproductive characteristics, as no interaction between them was found in any combination of the variables. Rural women with a low level of education were likely to be older at the onset of menstruation (mean age at menarche 13.96 years) and younger at first birth (mean age 21.45 years) compared to urban women having a high level of education (mean age at menarche 13.44 years and mean age at first birth 25.59 years). *Post hoc* tests showed that both age at menarche and age at first birth were significantly different among four categories of urbanization and three levels of education. Considering the age at last birth, only educational level contributed to its variation. Women having a high level of education, irrespective of their place of residence, were likely to give the last delivery at a significantly later age (mean 31.05 years) compared to women educated to a lower level (mean age 28.96 years). As far as parity is concerned, rural women having a lower educational level were likely to give more live births compared to urban well educated women (for urbanization factor $\chi^2 = 69.60$, $df = 9$, $P = 0$ and for education factor $\chi^2 = 68.27$, $df = 6$, $P = 0$). Two-way ANOVA revealed a significant influence of both factors (urbanization and education) on the parity without significant interaction between the predictive factors.

The association of age at menopause with social and life history traits as predictive factors is shown in one-way ANOVA models in Table 4.

The content of the table indicates a significant association between age at menopause and age at menarche ($F = 11.9$; $P < 0.01$), length of menstrual period ($F = 9.4$; $P < 0.01$), urbanization ($F$

Table 4. **One-way ANOVA models for age at natural menopause with social and reproductive history variables as predictive factors**

| Factor | df1 | df2 | *F* value |
|---|---|---|---|
| Urbanization | 3 | 2125 | 3.2* |
| Education | 2 | 2147 | 0.3 |
| Age at menarche | 2 | 2100 | 11.9** |
| Length of menstrual cycle | 2 | 2109 | 9.4** |
| Days of menstrual bleeding | 2 | 2107 | 4.5 |
| Parity | 3 | 2097 | 0.4 |
| Age at first child-birth | 2 | 2098 | 2.9* |
| Age at last child-birth | 2 | 2109 | 1.6 |
| Childbearing years | 2 | 2018 | 0.2 |

* $P < 0.05$; ** $P < 0.01$.

= 3.2; $P < 0.05$) and age at first child-birth ($F$ = 2.9; $P < 0.05$). The association between age at menopause and age at menarche was positive. Women that had an earlier menarche tended to have earlier menopause (menarche before 13 years of age; menopause at the mean age of 49.31 years) compared to women with menarche at age 13–15 (mean age at menopause 49.93 years) and women with late menarche, after 15 years of age (mean age 50.57 years). The association between age at menopause and length of menstrual cycle had also a positive direction: the longer the menstrual cycle, the later the menopause. Women with a menstrual cycle shorter than 28 days had earlier menopause (mean age at menopause 49.31 years) compared to women with a menstrual cycle longer than 32 days (mean age at menopause 51.05 years). Age at first child-birth was significantly associated with the age at menopause in the way that the younger were women at first birth the later was the timing of menopause. Thus, women younger than 21 years at the first child-birth had a later menopause (mean age at menopause 50.34 years) compared to women that gave the first delivery after 25 years of age (mean age at menopause 49.77 years). The category of urbanization was significantly associated with the age at menopause in the way described above. Of all factors bivariately studied, the age at menarche is consistent for variation with the age at menopause in the two-variate model including the length of menstrual cycle or the length of menstrual bleeding, age at menarche ($F$ value yields 6.5; $P < 0.01$ and $F$ value yields 3.4; $P < 0.05$ with $F = 0.6$ for insignificant interaction between predictive variables). Significant effects of the age at menarche and the length of menstrual cycle indicate that the earlier the age at menarche and shorter menstrual cycle, the earlier the age at menopause. In women who began to menstruate earlier than at 13 years of age and had a normal length of menstrual cycle (28–32 days) menopause occurred earlier (49.08 years) compared to women who began menstruate later than at 15 years of age and had a normal length of menstrual cycle (menopause at 50.71 years).

The multivariate model of stepwise multiple regression analysis with forward elimination, calculated for 1894 subjects, included all the predictive variables studied: urbanization, education, menarche, length of menstrual cycle and length of menstrual bleeding (in days), parity, age at first and last child-birth and total childbearing years. The results indicate the age at menarche ($b = 0.29$, $SE = 0.09$, $P < 0.01$) and the length of menstrual cycle ($b = 0.72$, $SE = 0.24$, $P < 0.01$) to be significantly associated with the age at menopause. The length of menstrual bleeding, age at first birth and urbanization factor are additional predictive variables for the age at menopause of all variables taken to the model. Although the age at menarche and the length of menstrual cycle explain 4% of the total variation in the age at menopause, their influence is significant.

## DISCUSSION

There is a general agreement that menopause occurs around 50 years of age, though a number of studies in a variety of populations have demonstrated a wide variation in its timing. As McKinley (10) claims, an important source of this variation has to be referred to the methodological background. It includes biased sample selection, various definitions of menopause, retrospective recall errors and innapriopriate statistical analyses. One should bear it in mind when drawing conclusions upon the data.

The mean recalled age at menopause among the study women was 49.9 years. Moreover, there was a clear evidence of the effect of the urbanization gradient on the timing of natural menopause ranging from 50.05 years for rural women through 49.55 years for women living in small towns and 49.95 years for women from towns of medium to large numbers of inhabitants, and finally to 50.38 years for women, inhabitants of large cities. The timing of natural menopause reveals also the educational gradient, indicating that menopause occurred significantly later among women who had a completed academic education (49.96 years) compared to women having primary/vocational levels of education (49.89 years). The mean recalled age at menopause among women being studied was 49.9 years. This figure is slightly higher compared to 49.2 years calculated by Baron (5) for women from the entire Poland. The differences in mean ages at menopause between 358 rural women from this study (50.05 years) and 341 rural women investigated forty years ago by Bielicki and Welon (49.33 years) appear

to be significant (4). Considering urban women, a significant difference in the age of menopause was found between the present data calculated for 212 women from the city (50.38 years) and 1655 women from urban settings (49.66 years) investigated by Koniarek and Ýukowski (7). The difference disappears when the medians are compared (50.98 years for the present sample versus 50.66 years for urban women reported by Koniarek and Ýukowski). Thereby, it is difficult to judge to what extent those discrepancies between findings might refer to the methodological background. The phenomenon of delayed menopause among rural women might be explained by the different reproductive pattern (higher parity, longer childbearing period), higher strength for physical activity, rare anticonception use. It has been known that the reproductive pattern varies according to the biological and sociocultural determinants. Every society has its own expectations as to the norms regarding the timing of marriage, family formation and childbearing as well as cultural values regarding the role of motherhood, or fitness of parents with age. The present study provides readers with some quantitative clue to the understanding of reproductive determinants of menopausal age in Polish women. The findings provide a quantitative evidence that the majority of life history traits of the reproductive period are not associated with the age at menopause.

A significant association was found between the age at menarche and at menopause, indicating that the earlier menarche, the earlier menopause. This finding corroborates well the results obtained by Cramer et al. (11), unlike those of Parazzini et al. (12) who claimed that a significant association between age at menarche and age at menopause has a reverse direction: the earlier age at menarche the later age at menopause.

A statistically significant relationship between the length of the menstrual cycle and the age at menopause revealed that the earlier age at menopause was related to short menstrual cycles (less than 28 days), whereas long menstrual cycles were related to later menopause. This finding is in agreement with the results obtained by Cramer et al. (11). They found that women whose menses were regular before 25 years of age or before the first pregnancy were likely to experience menopause around 2 years earlier than women whose menstrual cycles were irregular.

Findings concerning association between the age at the first and the last child-birth with the age at menopause have still been inconclusive. There are indications regarding the lack of association between those variables, contrary to Whelan et al. (13) who noticed that women giving first delivery before the age of 30 years used to experience earlier menopause.

The association between parity and menopausal age seems to be controversial as well. It has been suggested that the conditions causing long anovulatory periods during reproductive years may be associated with delayed menopause (12); others found a consistent relation between the number of births and earlier menopause [findings of BCDDP project cited after (13)]. In the present work, no significant relation between those variables was found.

It is supposed that childbearing and the weaning period might stop the atresion of ovum because of the anovulatory menses. Therefore the expactation of a relation between the number of parities and the age at menopause seems to be reasonable. The present findings do not support these expectations. The onset of childbearing capacity in women can be dated by menarche, the beginning of menstrual cycles. Although, the age at menarche does not mean a real fecundity, as the latter is determined by the first ovulation, still it is rather well used for practical purposes. The end of childbearing is less clear. One of the possible sources that one allows to date the end of childbearing comes from data on women's menopausal status relative to age. However, by observation, fecundity generally ceases some time before the menopause (14). Gray estimates the difference between the median age of infecundity and the median age of menopause to be around 8 years (15).

## CONCLUSIONS

The results of the present study indicate that the median age of Polish women at natural menopause yields 50.92 years. The structured timing of menopause reveals the urbanization and education gradients in the age at natural menopause in Poland.

Of all reproductive characteristics, the age at menarche and the length of menstrual cycle appear to exert most effects on the age variation at menopause. The earlier menarche the earlier menopause. The predictive value of the age at menarche for the age at menopause is consistent both in bivariate and multivariate models. The length of menstrual bleeding and the timing of the first and last child-birth appear to be the variables that strengthen the main effects of the age at menarche and the length of the menstrual cycle.

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**NATÛRALIOS MENOPAUZËS AMÞIAUS INTRAPOPULIACINË ÁVAIROVË IR SÀSAJOS SU ANKSTESNE REPRODUKCINE SVEIKATA: LENKIJOS MOTERØ ATVEJIS**

S a n t r a u k a

Moters menopauzë – tai raidos etapas, kurá reikëtø nagrinëti normalaus senëjimo kontekste. Ðiame darbe nagrinëjama Lenkijos moterø menopauzës amþiaus ávairovë populiacijos viduje, taip pat moters reprodukcinës sveikatos ypatumai, turintys sàsajø su menopauze. 2000–2003 m. atliktas Lenkijos visos rytinës dalies 2147 moterø po menopauzës tyrimas populiacijos skerspjûvio metodu, nustatytas natûralios menopauzës amþiaus vidurkis ir mediana. Vidutinis Lenkijos moterø menopauzës amþius, apskaièiuotas retrospektyviniu metodu, siekia 49,90 metø, *status quo* metodu – 50,92 metø. Maþø miesteliø moterø menopauzë buvo ankstesnë nei didþiøjø miestø moterø. Kaimo moterø menopauzës amþius buvo labai panaðus á didþiøjø miestø moterø menopauzës amþiø (mediana – 50,91 ir 50, 98 metø atitinkamai). Nustatytas teigiamas iðsilavinimo ir menopauzës ryðio gradientas: menopauzës amþiaus skirtumas tarp moterø su aukðtuoju ir þemesniu iðsilavinimu buvo 0,87 metø. Be to, palyginus su miesto moterø menarche, kaimo moterø su pradiniu/profesiniu iðsilavinimu menarchës amþius buvo vëlesnis (mediana – 13,96 ir 13,44 metø atitinkamai), kaimo moterø amþius per pirmàjá (21,45 ir 25,59 metø) ir per paskutinájá gimdymà – jaunesnis (28,95 ir 31,05 metø atitinkamai). Daugiamatë regresinë duomenø analizë parodë ir menstruacinio ciklo ypatumø bei menopauzës amþiaus patikimà sàsajà. Be viso to, ávairiam menopauzës amþiui átakos turëjo ir moters amþius per pirmàjá gimdymà bei kraujavimo per mënesines trukmë, taip pat urbanizacija. Menarchës amþius, menstruacinio ciklo ypatumai, moters amþius per pirmàjá gimdymà, taip pat iðsilavinimas ir urbanizacija gali turëti reikðmës menopauzës amþiaus ávairovei.