Correlates of age at menopause and osteoporosis in Saudi women

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Summary

Objective: To evaluate the age of menopause among Saudi Arabian women and to predict the local trend in the prevalence of osteoporosis.

Material & Method: All menopausal women who had bone mineral density studies at King Khaled University Hospital, Riyadh, Saudi Arabia, between 1999 to 2003. Correspondence and logistic regression analysis were conducted to identify variables that were positively associated with age of menopause.

Results: 935 postmenopausal females were included. The mean age of menopause was 48.1 ± 5.9 years. Early and late onset of menopause were associated with osteoporosis, while normal onset of menopause was associated with osteopenia or remained normal. There was no association between age of menopause and parity or body mass index.

Conclusion: The age of menopause among Saudi women is lower than in Western countries but similar to other Arabic countries. In addition to cultural differences genetics play a role in determining the age of menopause and the development of osteoporosis.

Key words: Menopause; Osteoporosis; Osteopenia.

Introduction

The occurrence and timing of reproduction related events such as menarche, first birth and menopause play a major role in a woman's life. The age of the final natural menstrual period is an important risk indicator for subsequent morbidities and mortalities. Hormonal changes at menopause are associated with the onset of a number of medical conditions namely osteopenia and osteoporosis. However, the age of menopause and the frequency of the various menopausal conditions, differ in different societies and can indicate how disease prevalence changes with age. The concept of local biologies has been put forward to account for such inter- and intrasocietal differences [1].

This study was conducted to evaluate the age of menopause among Saudi Arabian women and its correlates. A unique correspondence analysis and logistic regression analysis were applied to predict the local trend in the prevalence of osteoporosis.

Material and Method

The study population included all menopausal Saudi Arabian women who had bone mineral density (BMD) studies at King Khaled University Hospital (KKUH), Riyadh, Saudi Arabia between the years 1999 and 2003. The data base included women's age, age at natural menopause, parity, body mass index (BMI), medical history and BMD result. BMD was performed using DXA (Lunar Radiate Corp., WI) measuring BMD of the lumbar spine (L2-L4) and was entered as normal, osteopenia (BMD of 1 and 2.5 SD below that of young adults, t-score - 1 to 2.5) or osteoporosis (BMD of more than 2.5 SD below that of young adults; t-score - 2.5 or more).

Statistical method:

The data were analyzed using the chi-square test, correspondence analysis (CA), and logistic regression analysis. Age of menopause was arbitrarily grouped into the intervals 16-39, 40-49, and 50-65 years to facilitate threshold analysis aimed at discovering variables that were associated with early, normal, or late age of menopause. The chi-square test was used to investigate the association between two categorical variables. Correspondence analysis was used to transform data arranged in the form of an γ x c contingency table into a graph. Logistic regression analysis was used to identify variables that were positively correlated with the various thresholds of age of menopause. Correspondence analysis and logistic regression analysis were conducted using programs CA and LR, respectively, from the BMDP Statistical Package.

Results

Nine hundred and thirty-five postmenopausal women were included in the study. The mean age of menopause was 48.1 ± 5.9 years, median 49 years (range 16-65years) (Figure 1).

Results pertaining to the association between age at menopause and the incidence of osteopenia and osteoporosis are presented in Table 1. Out of the 935 women, 120 (12.8%) were found to have normal BMD findings, 416 (44.5%) had osteopenia and 399 (42.7%) had osteoporosis. There was a statistically significant association between age of menopause and prevalence of these two conditions (p = 0.003). To show in better perspective the association between the row and column categories in Table 1, we used CA and transformed the results into a graphic presentation shown in Figure 2. Within the context of correspondence analysis, the graph in Figure 2 appropriately depicts the associations inherent in the results in Table 1 as indicated by the 99.7% of total inertia printed at the bottom of the figure. In CA, the

Table 1. — *The incidence of osteopenia and osteoporosis in relation to age at menopause in 935 Saudi women.*

Age at menopause	Normal No. (%)	Osteopenia No. (%)	Osteoporosis No. (%)	Total No. (%)
16-39 years	6 (10.9%)	22 (40.0%)	27 (49.1%)	55 (100%)
40-49 years	64 (13.9%)	230 (50.0%)	166 (36.1%)	460 (100%)
50-65 years	50 (11.9%)	164 (39.0%)	206 (49.1%)	420 (100%)
Total	120 (12.8%)	416 (44.5%)	399 (42.7%)	935 (100%)
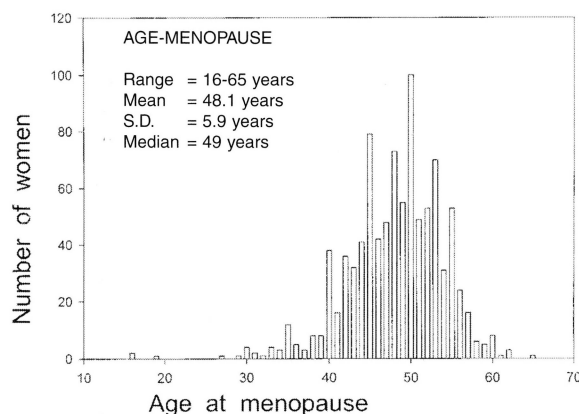
Figure 1. — Distribution of age at menopause for 935 Saudi Women.

interpretation of association is based on proximity of a row and column category. Therefore, early onset of menopause (age 16-39 years) as well as late onset of menopause (age 50-65 years) were associated with osteoporosis. On the other hand, normal onset of menopause (age 40-49 years) was associated with the occurrence of osteopenia or remained normal.

We also used logistic regression analysis to identify variables that were positively associated with age at menopause. The variables used in the analysis included parity, BMI and a collection of data on a variety of variables relating to medical history for all the women in the study. The diagnosis (normal, osteopenia, and osteoporosis) was also included among the independent variables. Binary logistic regression analysis was used rather than polytomous logistic regression for ordered categories. Therefore, three separate runs of the logistic regression analysis program were done using each one of the age groups for age at menopause as the groups of interest for the dependent variable. Secondly, logistic regression analysis was conducted using the marginal analysis option whereby there is no reference group for each one of the independent variables. Therefore, we reported odds rather than ratio as the estimate of risk. Results from the logistic regression analysis are presented in Table 2.

History of hysterectomy was associated with both early onset (16-39 years) and normal onset (40-49 years) of menopause, but the association was statistically significant only for early onset of menopause. Age of menopause of 40-49 years was associated with low blood pressure, osteoarthritis and osteopenia. A medical history of diabetes (DM) and asthma, and a diagnosis of osteoporosis were associated with late age (50-65 years) of menopause.

Table 2. — *Results from logistic regression analysis showing variables that correlated with age at menopause in 935 Saudi women.*

Age at menopause	Associated variables	Regression coefficient	Coefficient (SE)	Odds	95% C.I.
16-39 years	Hysterectomy	0.6662	2.30	1.95	1.10-3044*
40-49years	- Low BP	0.3971	1.70	1.49	0.94-2.35
	- Hysterectomy	0.4768	1.94	1.61	0.993-2.61
	- Osteoarthritis	0.6158	2.33	1.85	1.10-3.11*
	- Osteopenia	0.2694	2.66	1.31	1.07-1.60*
50-65 years	- Diabetes	0.2297	3.15	1.26	1.09-1.45*
	- Asthma	0.3857	1.90	1.47	0.987-2.19
	- Osteoporosis	0.2539	2.46	1.29	1.05-1.58*

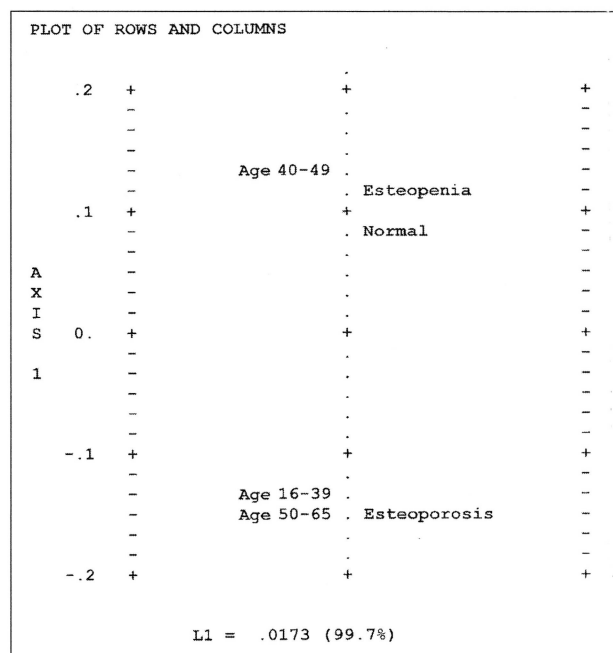* The association was statistically significant; SE = Standard error.

Figure 2. — Correspondence analysis graph showing the association between age of menopause and osteopenia and osteoporosis.

Discussion

Menopause occurs as the gradual unresponsiveness of the human ovary to gonadotrophins leading to low serum estradiol and progesterone, followed by a rise in follicle stimulating and luteinizing hormones. A number of clinical symptoms follow the hormonal changes including vasomotor, genitourinary, psychological, ischemic heart disease and bone changes (osteopenia then osteoporosis). The age of menopause varies with socioeconomic conditions, smoking, race, parity, height, skinfold thickness, lifestyle and education [2].

The median age in our study (49 years) is slightly lower than that reported for the U.S.A. (51.1 years) [3], Japan (50.54 years) [4], Lahore (50.0 years) [1], Greece (51 years) [5], and Mexico (50.0 years) [3], while it was similar to the age reported in Kenya (48.28 years) [2] and

United Arab Emirates (48 years) [6]. These findings point to the cultural differences between these societies that play an important role with regards to the age of menopause.

This study is also unique because for the first time in the literature a correspondence analysis has been applied to correlate age of menopause and appearance of bone changes (osteopenia and osteoporosis). It shows that a normal onset of menopause was associated with either osteopenia or having normal BMD findings, while early and late onset of menopause was associated with osteoporosis. Osteoporosis is a complex multifactorial disease determined by genetic and environmental factors as well as their interactions [7]. Livshits *et al.* [8] suggested the possibility of a pleiotropic genetic effect which may be controlled by a major genetic locus control of the BMD.

Early menopause has been shown previously to be associated with osteoporosis [9], but our study shows that also late age at menopause is associated with osteoporosis which has not been shown previously. This finding could also be attributed to the life style, nutritional and educational background of Saudi women as osteoporosis was shown previously to be common among post-menopausal Saudi women [10]. Identification of a major locus gene for BMD could provide new opportunities to understanding the liability and pathogenic process in which they are involved in the determination of osteoporosis risk. It would also be interesting to apply similar correspondence analyses between the age of menopause and bone changes in other similar and different societies to compare results and add to this evidence.

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