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Menopause in Blackfeet Women – A Life Span Perspective

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A B S T R A C T

A lifespan perspective, combining quantitative and qualitative approaches, is used to examine factors related to the timing of menopause in Blackfeet women of northern Montana (USA). Cross-sectional survey data demonstrate a median age at menopause using a status quo method of 51.6 years, and a mean age of 47.0±5.0 years among those women who had already experienced menopause. Age at menopause is inversely associated with age at menarche and having been breastfed, and positively associated with use of contraceptives, household income, and current or recent employment. Household income and age at menarche influence menopause age jointly in multivariate models. These and other patterns are examined in the lives of two women with very divergent ages at menopause. Although these data support an effect of early life influences on shaping reproductive trajectories that culminate in menopause, environmental factors and human agency during adult life may play a modifying role.

Key words: *menopause, aging, Native American, nutrition*

Introduction

Menopause, defined as the last menstrual period, is an important marker in the biological aging process for women. In a life span approach, menopause becomes part of a trajectory of reproductive function in women's lives that begins before birth[1]. Along this biological trajectory are earlier events including the formation of ova, menarche, menstrual cycling, and reproduction. At all of these earlier stages, developmental and environmental factors may influence timing or outcomes. As a result, each individual's progression along this path during her life span has unique characteristics[2].

However, the environmental influences upon ovarian development and reproductive function are shaped by a variety of social realities, including structural ones, at given points in time[3]. For example, a secular trend to earlier age at menarche has been described for many of the world's societies[4]. The timing of menarche appears to be influenced by energy

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balance during critical periods of growth[5], and age at menarche has declined as societies have undergone economic modernization processes that have improved energy balance. Thus, entire cohorts of women of a given age are exposed to particular social and economic forces acting in their locales, filtered through social class and other structures. These social realities interact with biology to affect the course of individual reproductive trajectories.

Certainly, women's experience of the menopause transition, including associated symptoms and meanings, varies among societies[6]. It is less clear how environmental factors influence the timing of this biological event across human populations. Researchers have been divided on the question of whether there is a species-specific age at natural menopause, i.e., a biologically-programmed time of cessation of ovarian function. There appears to be a fairly limited range of median ages at natural menopause, 50.1–51.5 years, among industrialized populations[7]. However, median age at natural menopause occurs earlier in less developed or poorly nourished populations than in more developed ones[8–11]. Researchers also are divided as to whether there has been an upward secular trend in age at menopause, perhaps related to improvements in nutrition or living standards[7,10,12–15]. One concern in this area of research is that methodology for estimating age at menopause has been inconsistent. Estimates of mean age based on recall result in a downward bias; prospective or cross-sectional methods are preferred[7,9].

Age at menopause clearly varies within populations: women have different lifespan trajectories. A number of environmental factors have been linked with variation in age at menopause. The most consistent is the finding of earlier age at menopause in smokers[7,16–19]. Nutritional status has been associated in some but not all studies[20–23]. Age at menarche has been inversely associated with menopause age in some less developed populations[14,15,24]. Other research does not support this link[8,11,18,25–28]. Additional reproductive associations with younger age at menopause have included lower parity, non-use of oral contraceptives, and shorter menstrual cycle length or irregular cycles[17,18,21,28]. Lower income, education, or manual occupation have been correlated with earlier age at menopause in some analyses[18,21,25]. Thus, it would appear that studies support some effect of environment, possibly including structural factors such as socioeconomic status, throughout individual women's reproductive trajectories, including on the timing of menopause.

Reproductive characteristics, especially those involving later life, are not well-studied in Native Americans. Many of these populations live under Fourth World[29] social and economic conditions that developed over the late 19th and the early 20th centuries and have persisted into the present. Severe economic underdevelopment is a hallmark of many Indian reservations. At the same time, Native American populations have undergone rapid lifestyle change over recent decades. As part of a larger study of lifestyle change and health in 1995–1996, reproductive characteristics, including menopause, were examined among Blackfeet Indian women living on the Blackfeet Reservation in northern Montana. The present paper examines factors related to the timing of natural menopause in these women using a lifespan approach. Cross-sectional data are further illustrated by case studies.

Material and Methods

An age-stratified, probability sample of 321 women was drawn from the tribal

enrollment list of 2,425 eligible women 18 years and older with reservation addresses. Of these, 150 women aged 18–93 years agreed to participate in the study. Additional details of sample selection and methods are presented elsewhere[30].

In-person interviews were conducted by a trained, female Blackfeet interviewers or the researcher. Complete reproductive histories were elicited by recall, including characteristics of the reproductive span, menstrual cycle regularity and average cycle length, data on all pregnancies and their outcomes, contraceptive histories, and breastfeeding. Age at natural menopause was defined as the age at last menstrual period after 12 months of amenorrhea. Additional data were obtained on socioeconomic status and lifestyle, home environment, food intake and habits, nutritional status (anthropometric measures) and health.

Data in the larger study were analyzed by four age cohorts to look at time trends. Only the two oldest cohorts (50–69 and ≥70) included women who had experienced natural menopause at a known age by time of interview (n=33). Because of censored observations, median age at menopause for the entire sample was estimated using a status quo method. The relationship between recalled age at natural menopause and independent variables was examined using regression and analysis of variance (ANOVA). Qualitative data concerning the life histories of two of the women from the sample are presented as case studies to further illustrate the range of variation in lifespan experience potentially relevant to menopause.

Results

Median age at natural menopause by the status quo method was 51.2 years (95% CI 50.0–53.2 yrs), n=86. The mean recalled age among the women in the sample who already had experienced natural menopause was 47.0 ± 5.0, median 47.0 years (n=33). Descriptive statistics for these women are presented in Table 1.

In this postmenopausal sample, bivariate analyses indicated age at natural menopause was associated inversely with age at menarche (p=0.07) (Table 2). In this regression there was one influential case (DFBeta=0.63) with later menarche and later menopause which, when removed, resulted in a statistically significant inverse relationship between ages at menarche and menopause at p=0.02. Age at menopause also was associated inversely with having been breastfed by one's mother (p=0.02). Menopause age was associated positively with current household income (p=0.01), ever-use of any form of birth control (p=0.008), ever-use of oral contraceptives (p=0.007), and current or recent employment (p=0.02). Women in the latest tertile of menopause had significantly more education than women in the earliest tertile (t= –2.06, p=0.05, not shown). Age at natural menopause was not associated with current age, parity, age at first live birth, menstrual cycle length, subject's breastfeeding history, smoking, anthropometric variables reflecting nutritional status (height, body mass index, skinfolds, arm muscle area and centripetal fat ratio), or other socio-demographic variables such as language spoken in childhood or current home, and marital status.

In multivariate analysis using stepwise regression, a model including oral contraceptives, age at menarche, and household income explained the most variance (n=29, F=5.81, p=0.004, R^2=0.41). However, significance levels of the household income and age at menarche variables in this regression suggested some collinearity, which was evaluated further with an analysis of joint effects (Table 3). Women with later menarche and lower household income had significantly ear-

TABLE 1
SELECTED DESCRIPTIVE STATISTICS FOR SAMPLE

Variable	N	X (SD)	Median
Age (yrs.)	33	67.4 (10.6)	64.4
Age at menarche (yrs.)	31	13.0 (1.9)	13.0
Live births (N)	33	5.3 (3.8)	5.0
Age first live birth (yrs.)	28	22.0 (5.8)	20.4
Menstrual cycle length (days)	28	27.3 (1.7)	28.0
BMI (kg/m^2)	30	29.6 (6.1)	29.3
Education (yrs.)	33	11.0 (3.2)	12.0

	N	Category	N	%
Current or recent employment (past yr.)	33	yes	7	21.2
		no	26	78.8
Household income ($)	31	1,250–2,499	1	3.2
		2,500–4,999	4	12.9
		5,000–9,999	11	35.5
		10,000–19,999	8	25.8
		20,000–39,999	5	16.1
		40,000–79,999	2	6.5
Ever used birth control (any method)	33	yes	14	42.4
		no	19	57.6
Ever used oral contraceptives	33	yes	7	21.2
		no	26	78.8
Breastfed by own mother	23	yes	20	87.0
		no	3	13.0
Ever smoked	33	yes	22	66.7
		no	11	33.3

lier age at menopause (p=0.04). That women with later menarche and higher income also were younger at menopause (although not significantly) suggests that the main effect on age at menopause in this sample may be age at menarche, but its effect is modified in some way by household income.

The following two cases are presented to illustrate in greater detail the patterns noted above and to enrich the lifespan perspective. Case 1 is the individual with the earliest age at menopause, and Case 2 the latest. Both women were members of the 50–69 cohort.

Case 1

Ms. A was born in 1941 and was 55.0 years of age at the time of interview. She reported experiencing natural menopause at age 35 and menarche at 16.5 years. Her menstrual cycles were regular and, on average, 28 days in length. Ms. A had never married or been pregnant and had never used any form of contraception or hormone therapy. She was unsure whether she had been breastfed by her mother.

Ms. A reported a 7/8 Blackfeet blood quantum and stated that during her childhood both Blackfoot and English were

TABLE 2
REGRESSION OF AGE AT NATURAL MENOPAUSE ON SELECTED VARIABLES

Variable	N	β	(SE)	p
Age	33	–0.03	(0.08)	0.74
Age at menarche	31	–0.83	(0.44)	0.07
Number of live births	33	0.21	(0.23)	0.36
Age first live birth	28	–0.10	(0.16)	0.55
Average cycle length	28	–1.00	(0.56)	0.09
Ever used birth control[1]	33	4.52	(1.58)	0.008
Ever used oral contraceptives[1]	33	5.48	(1.91)	0.007
Breastfed by own mother[1]	23	–6.93	(2.67)	0.02
Household income (6 categories)	31	1.85	(0.71)	0.01
Current or recent employment[1]	33	4.75	(1.97)	0.02
Ever smoked[1]	33	–0.45	(1.86)	0.81
BMI	30	0.18	(0.16)	0.26

[1] Dichotomous variable

TABLE 3
JOINT EFFECT OF MENARCHEAL AGE AND HOUSEHOLD INCOME ON AGE AT NATURAL MENOPAUSE

	N	Mean age (SD)	β (SE)	p
Early menarche/ high income[1]	10	48.8 (5.4)	–	
Early menarche/ low income	9	48.3 (3.0)	–0.4 (2.2)	0.51
Late menarche/ high income	3	46.7 (7.2)	–2.1 (3.2)	0.85
Late menarche/ low income	7	43.6 (4.8)	–5.2 (2.4)	0.04

[1]Age at menarche and household income were divided at the 50th percentile (late menarche = <14 yrs; early menarche = ≥14 yrs; low income = <$10,000; high income = ≥$10,000) to construct four dummy variables representing each possible combination. Natural menopause was regressed on these variables with the reference group being early menarche/high income.

spoken at home. During at least 10 years of her childhood, her family lived about 80 miles from the reservation in a two-room house, without plumbing, that was heated with wood. She attended government boarding schools on the Blackfeet Reservation and in South Dakota for 11 years, nine months per year. At the time of the interview, she was living with a sister and five nieces and nephews in Browning, the main reservation town, and English was the only language in use at home.

Ms. A had attained two years of post-secondary education. She was not working outside the home but had done so episodically in the past. She reported annual household income of between $1,250 and $2,499 from general assistance. The household rented the home they lived in and none of the members owned land on the reservation. Ms. A reported that the household possessed a microwave oven, a radio, a color television, a clothes washer and dryer, and one working vehicle. There was no telephone service.

This household receives government commodity foods (Food Distribution Program on Indian Reservations of the U.S.

Department of Agriculture) and obtains other food items at local and regional supermarkets. Ms. A described her childhood diet as more »balanced« and more plentiful in quantity than her diet at the time of interview. She was an active cigarette smoker and had been smoking for about 33 years, up to 1/2 pack per day. Ms. A's height was 169.1 cm, BMI 21.9 kg/m^2, triceps skinfold 16.5 mm, and subscapular 18 mm.

Case 2

Mrs. B was born in 1932 and was 64.0 years of age at the time of interview. She reported natural menopause at age 58, menarche at age 11, and menstrual cycles of 25–28 days in length. She listed eight pregnancies, with the first live birth at age 17. Two of these pregnancies ended in stillbirths and one in a premature delivery of live twins who died within hours. Five deliveries were singleton live births. She breastfed all of her children for varying lengths of time and reported she was not breastfed by her own mother. She recalled having used several forms of contraception, including rhythm, oral contraceptives, and finally tubal ligation, although her husband, whom she described as older than she, »did not believe in birth control.« At the time of interview she was on hormone replacement therapy with estrogen and progestin, which she had begun after menopause.

Mrs. B stated her Blackfeet blood quantum was 13/32 and the language spoken in her childhood home was English. She was raised by her grandparents and lived mostly on or near another Indian reservation about 200 miles east of Browning in north central Montana. The home she lived in for six years, the longest at that time, had two rooms, no plumbing or electrical service, was heated with wood, and was located near the Missouri River, which was their water source. She went to boarding school in Great Falls for five years, nine months per year. She completed 10 years of school and got married at age 16. At the time of interview she had been widowed for about six months and lived alone in Browning throughout most of the year; in the summer some of her family would join her. She reported working full time during the school year and stated her annual income, from wages, land lease, and summertime unemployment benefits, was in the $40,000 and $79,999 category. She owned her home and also individual trust land on the reservation. The home included a microwave oven, two radios, two color televisions, a clothes washer and dryer, two working vehicles, and telephone service.

Mrs. B said most of the household food during her childhood came from a supermarket in a nearby town or was home raised (beef cattle, milk cows, vegetable garden); some food was wild (deer). She described her childhood diet as nutritious, and said she ate better then than at present (fewer »fast foods« in the past). At the time of interview, she was getting most of her food from a supermarket off the reservation and also utilized local markets, the Hutterites for seasonal fresh vegetables, and wild foods (deer, elk, berries). Mrs. B stated she was a cigarette smoker at the time of the interview, smoking one pack per day on the weekends and two cigarettes a day during the week; she had smoked intermittently since age 10 or 11. Mrs. B's height was 161.4 cm, BMI 30.7 kg/m^2, biceps skinfold 9 mm, and subscapular 29.5 mm.

Discussion

Among Blackfeet women who have experienced menopause, several factors are predictive of the timing of this event. Earlier menopause is associated with later menarche, lower adult income, and nonuse of oral contraceptives in a multivariate model that explains almost half of

the variance in age at menopause. Other associations include non-employment, lower education, and having been breastfed in infancy. Unlike many studies, this one found no association with smoking.

One interpretation of these data is that present day low income and unemployment are markers of a lifelong trajectory of poverty. This fits with the economic and social history of the reservation and other observations made during this study[31]. In this view, whatever mediates the relationship between menarcheal age and income for this group could have occurred in childhood. Having been breastfed may be a marker of traditionalism, holding to longstanding indigenous customs and beliefs. Historically, the more traditional Blackfeet have tended to be poorer[32].

The stories of these two women illustrate, although not precisely, some of the findings in the cross-sectional data (as well as being consistent with associations noted in other studies cited earlier). Ms. A experienced the earliest age at menopause in the sample, as well as the latest menarche. She reported being of nearly full Blackfeet blood quantum and was somewhat unusual for her generation in that Blackfoot was spoken in her childhood home, both facts that suggest traditionalism. That home's structural characteristics imply rural austerity, if not poverty. She had never married, was nulliparous, and had never used contraceptives or hormones. At the time of the interview she was unemployed, her household had very low income, and it also was not well-off in terms of possessions, home or land ownership, and diet. Lack of telephone service is an indicator of lower economic status on the reservation. Ms. A was relatively lean compared with the rest of the post-menopausal sample (median BMI = 29.3 kg/m^2).

In contrast, Mrs. B experienced the latest age at menopause and one of the youngest ages at menarche. She reported less than half Blackfeet blood quantum and was not exposed to Blackfoot or another native language in her childhood home. She was raised by her grandparents, sometimes considered a traditional custom for a favorite grandchild, although it may have been of necessity. Her childhood home characteristics also suggest austerity, although because of the availability of home-raised and wild foods, diet appeared more than adequate. She had married, had high parity with a first birth relatively young at 17 years, and had used oral contraceptives. She was not breastfed by her mother. At the time of interview she was employed and had one of the highest incomes in the sample. Her household possessions, home, and land ownership indicated a comfortable lifestyle. Mrs. B's BMI was above the median for the sample.

There was only nine years difference in age between these two women, and they were treated in the cross-sectional study as members of the same cohort; however, their lives as portrayed in the information they provided during the survey were very different. Ms. A's history is suggestive of lifelong poverty, while Mrs. B's appears to have been more economically secure. Ms. A never married or had children and had a relatively short reproductive span, while Mrs. B married, had children, and experienced a long reproductive period. They had in common that they both had long histories of smoking and were active smokers at the time of menopause, and that they both spent at least part of their childhood away from the Blackfeet Reservation.

The process of later-life aging, including the event of menopause, must be understood in the context of the earlier life course[33]. A lifespan perspective emphasizes not only the early historical, social, and environmental contexts that shape an individual's biological developmental

trajectory, but also the ways individual trajectories interact with changing environments through lifetimes, in part through human agency. In the stories of these two women, one born during the Depression and one during World War II, we can read what appear to be individual developmental trajectories in the apparent internal consistencies over the entire reproductive and early post-reproductive lifespans. These continuities include such divergent influences as hormonal exposure, both endogenous and exogenous, diet, and socioeconomic status.

Human biologists have long recognized the effect of early life influences on adult form and function. The lengthy human developmental period permits environmental effects that may shape physiological processes for the duration of the lifespan. Reproductive function, including the timing of menarche, regularity of menstrual cycling, and pregnancy outcomes, can be affected by a range of ecological, behavioral, and constitutional factors, including nutrition, intensive exercise, and hypoxia during development[11,34–38]. In the context of the cross- sectional findings in the present study, having an impoverished childhood might affect ovarian function through a number of mechanisms: diet, energy balance, workloads, and disease stress. The apparent relationship between late menarche and low income may be mediated through inadequate dietary resources in childhood that slowed growth and delayed reproductive maturation. Ovarian function throughout the reproductive years may be affected by the timing of reproductive maturation[5].

In a lifespan perspective, adult life environment and behavior also must be considered. The effect of smoking on the timing of menopause, when one has been detected, represents such a later-life behavioral influence. Proposed mechanisms for a smoking effect include an influence on estrogen metabolism or binding, or a direct, toxic effect on oocytes, among others[39–41]. The fact that no smoking effect was detected in the present study is curious, since many Blackfeet women smoke[42]. Perhaps the key variable to assess, if possible, would be smoking at the time of menopause, which was not evaluated here. In the present study, it might be suggested that earlier menopause is associated with lower household income through its effects on adult diet, nutritional status, or other covariates. However, these data did not support an association of menopause age with anthropometric indicators of nutritional status, although the relevant component of body size or composition, e.g., weight change or weight at menopause, may not have been measured[23].

Before concluding, a few methodological caveats are in order. The postmenopausal sample size was small and thus the results potentially susceptible to strong influence from the experience of a few women. Also, those who are in the sample, particularly in the older cohort, represent survivorship, and they may be different from their deceased cohort members in ways that relate to the menopause experience. Recall was an important methodological tool in this study, introducing the possibility of errors of me-mory. Unfortunately, this is the most feasible way to obtain these kinds of far-ranging data from a community-based sample of women in their middle and older years. Recall is standard practice in studies like the World Fertility Survey[43] and the U.S. Survey of Family Growth[44]. Also, there is no evidence of clustering of menarcheal ages in the present study.

The current findings, pointing as they do to some effect of early life influences on the timing of menopause in this population, underscore the utility of a lifespan approach to understanding this aspect of human aging. That other studies have suggested an effect of later life experi-

ences, such as pregnancy history, smoking behavior, and nutritional status, on age at menopause only serves to further reinforce the importance of including the full lifespan in attempting to understand variability in age at menopause. Individual trajectories are shaped by historically molded social and economic environments during early development and are contextualized throughout a human life by changing environments and the effect of human agency; this process may be best understood through a combination of quantitative and qualitative data. In the present analysis, comparing the lives of two women with very different reproductive trajectories provides richer insight into ways individual trajectories may be set off on a particular žtrack' and shaped during a lifetime. Age at natural menopause appears to be somewhat malleable to environmental influences occurring throughout the lifespan leading up to that event. Further research is needed to confirm both early- and later-life effects and to evaluate apparent population differences in factors affecting menopause age.

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MENOPAUZA U BLACKFEET ŽENA: PERSPEKTIVA DULJINE ŽIVOTA

S A Ž E T A K

Perspektiva duljine života, koja uključuje i kvantitativni i kvalitativni pristup, korištena je kako bi se ispitali čimbenici koji su povezani s dobi menopauze u Blackfeet žena iz sjeverne Montane (SAD). Podaci transverzalne studije pokazali su da srednja dob menopauze korištenjem »status quo« metode iznosi 51,6 godina uz prosječnu dob od 47,0 ± 5,0 godina među ovim ženama koje su već doživjele menopauzu. Dob menopauze je obrnuto proporcionalno povezana s dobi menarhe i s prehranom majčinim mlijekom u dojenačkoj dobi, te pozitivno povezana s korištenjem kontracepcije, prihodima domaćinstva, te s trenutačnom ili nedavnom zaposlenošću. U multivarijatnom modelu, prihod domaćinstva i dob menarhe zajednički utječu na dob menopauze. Ovaj kao i drugi uzorci proučavani su u životima dviju žena s vrlo različitom dobi menopauze. Premda ovi podaci podupiru učinak utjecaja rane dobi na oblikovanje reproduktivnih trajektorija koji kulminiraju u menopauzi, čimbenici okoliša i djelatnost čovjeka tijekom odrasle dobi mogu odigrati modificirajuću ulogu.