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Ages at Menopause and Menarche in a High Altitude Himalayan Population

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1. Introduction

The paucity of published information on factors influencing age at menopause contrasts with the abundance of information on factors influencing age at menarche. Indeed the similar ages at menopause among various Western populations surveyed to date is noteworthy in reflecting an apparent lack of cultural, biological and environmental influences (e.g. Goodman et al, 1978; Gray, 1976; Malina, 1979). The results of a study at middle altitude (2300m) in the Indian Himalayas suggest that altitude is a geographic factor which may accelerate menopause (Flint, 1974). The purpose of this report is to further explore this relationship by presenting information on age at menopause and menarche in a high altitude Himalayan population.

2. Materials and Methods

The sample is drawn from the population of Upper Chumik, Mustang District, Dhaulagiri Zone, Nepal, a high altitude valley inhabited by native Tibetan speaking Buddhists living in six villages ranging in altitude from 3250 to 3560m. A 1977 census counted 1260 Tibetan residents. 689 volunteers of all ages and health statuses participated in a study of high altitude adaptation conducted from June through September 1981. Each participant received a thorough medical exam (collection of current medical complaints, a review of systems and a physical exam) enabling diagnosis of acute and chronic illness.

Age at menarche and menopause are assessed using the status quo and the recall techniques. During the course of the medical examination, each female was asked if she were menstruating. If the answer was no, then it was ascertained whether she was premenarcheal, pregnant, lactating, or postmenopausal. If menstruation had ceased for 6 months or more and the woman was not lactating or pregnant then she was classified as postmenopausal. Each female was classed as present/absent with respect to the experience of menarche and menopause and if yes for either then a recalled age of occurrence was requested. The length of the biological reproductive lifespan was calculated by subtracting recalled age at menarche from recalled age at menopause.

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Age was assessed by transforming two Tibetan systems into the Western system. One Tibetan system of reckoning age is based on a sixty year cycle of named years. Individuals know the name of their birthyear and this is easily translated into a Western calendar year and an accurate age in years obtained. Tibetans also count age in years in a numerical system that overestimates age by an average of 18 months compared with the Western system (Beall, 1981). Women in this study were asked the name of their birthyear as well as their present age, ages at menopause and/or menarche in Tibetan years. Subtracting birthyear from year of measurement (1981) yielded a chronological age in the Western system that nearly always agreed within two years of the individual's stated age using the Tibetan system, as expected given the average discrepancy between the two systems. To convert age at menarche and menopause recalled from the Tibetan numerical system into the Western system, one year was subtracted from the ages recalled in the Tibetan numerical system. This yields the age at the birthday subsequent to menarche or menopause and as such overestimates the age by an average of six months. In the final tabular analysis an additional half year is subtracted from the calculated means in order to report data comparable to samples reported in the Western manner (where recalled age is usually the birthday prior to the event and six months generally added in the final analysis (Garn, 1980:128).

Analyses of five subsamples are presented. The first is a status quo subsample of 80 females aged 12-25 for whom a median and standard deviation of age at menarche are calculated using probit analysis. The second subsample consists of all women aged 20-79 past menarche who are further classed into decennia (20-29, etc.). The mean and standard deviation of recalled age at menarche is calculated for the total sample and an analysis of variance is conducted comparing recalled age at menarche among the six decennia. The third is a status quo subsample of 49 females aged 39-53 for whom a median and standard deviation of age at menopause are calculated using probit analysis. The fourth and fifth subsamples consist of all women past menopause and women aged 50-79 past menopause. A mean and standard deviation of recalled age at menopause and length of the biological reproductive span (recalled age at menopause less recalled age at menarche) is calculated for each. For all women past menopause, three correlations coefficients are calculated: between recalled age at menarche and menopause, recalled age at menarche and length of the biological reproductive span and recalled age at menopause and length of the biological reproductive span. In addition, women 50-79 are classed into three decennia (50-59, etc.) and analysis of variance is conducted comparing recalled age at menopause among the three decennia. The reason for analyzing two postmenopausal subsamples is that the sample of all women past menopause tends to underestimate the population age at menopause because women who are still menstruating are not included since their later age at menopause is not known. Presenting a separate analysis of a group of women aged roughly three standard deviations above the median age at menopause substantially decreases the possibility of such a bias toward underestimation since virtually all these women have experienced menopause.

3. Results

The median age at menarche among Upper Chumik females estimated by probit analysis of the status quo subsample is 16.2 ± 1.1 years. The average recalled age of menarche among females twenty and older is 16.9 ± 2.0 years (N = 182) and agrees closely. The mean recalled ages at menarche of the six decennia presented in Table 1 range from 16.5 to 17.6 years. Although the oldest women recall an age at menarche 0.9 years later than the youngest, analysis of variance reveals that the trend is not statistically significant (F = 1.1, df = 5/176, p=.36).

Table 1

AGE (yrs)	Recalled Age at Menarche		
	$\bar{X}$	S.D.	N
20-29	16.7	1.5	52
30-39	16.9	2.4	40
40-49	16.5	1.5	37
50-59	17.1	1.7	25
60-69	17.6	2.4	20
70-79	17.6	3.1	8
ALL	16.9	2.0	182

Mean Recalled Age at Menarche Among Upper Chumik Women Aged 20-79 in 6 Decennia.

The median age at menopause estimated by probit analysis of the status quo subsample is 46.8 ± 1.1 years. The average recalled age at menopause among females fifty and older is 45.9 ± 5.7 years (N = 52). The mean recalled ages at menopause of the decennia 50-57 range from 44.2 to 47.4 years (refer to Table 2). Although the youngest (50-59) postmenopausal decennium reports the highest recalled age at menopause, analysis of variance indicates that the trend is not statistically significant (F = 1.46, df = 2/49, p = .24). The average length of the biological reproductive span is 28.5 ± 6.1 years (N = 51). Ages at menarche and menopause are not correlated (r = .10, p = .23, N = 58). Age at menarche correlates weakly negatively (r = -.29, $p < .02$, N = 57) and age at menopause correlates strongly positively (r=.93, $p < .001$, N=57) with length of the biological reproductive span.

Table 2

AGE (yrs)	Recalled Age at Menopause		N
	$\bar{X}$	S.D.	
50-59	47.4	5.3	23
60-69	45.0	5.6	20
70-79	44.2	6.6	9
Overall	45.9	5.7	52

Mean Recalled Age at Menopause Among Upper Chumik Women Aged 50-79 in 3 Decennia.

4. Discussion

The internal consistency of the status quo and the recall assessments provide evidence of the accuracy of the retrospectively obtained data. The recalled age at menopause and menarche in each decennia lie within two standard deviations of the median estimated from the status quo subsamples. The single exception to this is the average age at menopause of 44.2 years recalled by women aged 70-79. It is not unthinkable that recall be less accurate in this oldest group of women, though there seems little reason to suspect that it be less accurate for menopause than menarche and these women do recall an age at menarche well within normal limits for this population. Possibly this low average is due rounding off to age 45 in the Tibetan numerical age system which when transformed into the Western and then further corrected would yield an age of 43.5. Another possibility is random fluctuation due to the small sample size in this decennium. And there is the possibility of a true secular trend toward later age at menopause. However, analysis of variance revealed no statistical trend toward later age at menopause or earlier age at menarche, a finding in accord with unpublished data from this sample indicating no secular trend in growth of the long bones. This indicates that the timing of these developmental events as well as the biological characteristics influencing them are similarly experienced by women currently and in the recent past.

The median age at menopause of 46.8 years is accelerated compared with the medians around 50 reported for Western industrial populations (Gray, 1976; Malina, 1979). By the age of 50 when nearly all Upper Chumik women are post-menopausal, only half of U.S. women are naturally postmenopausal (MachMahon and Worcester, 1966). The present sample is also accelerated relative to a Rajput sample at 2300m in India whose average age at menopause of 47.3 compared with 48.9 for a sample of Rajput women at 300m (Flint, 1974). Apart from two very low medians of 43.6 and 44.0 years reported for a New Guinea and an Indian sample, respectively (Gray, 1976), published medians are higher than that calculated for Upper Chumik. Data on non-European, non-industrial populations are scarce for this parameter. While the present data confirm the finding of accelerated age at menopause at high altitude, the lack of comparable low altitude Tibetan populations, obviates attributing this to any particular factor associated with altitude or some other aspect of the biological or social environment or to a population characteristic.

The median age at menarche of 16.2 years in Upper Chumik is relatively late in the context of the worldwide range of variation from 12.3 to 18.4 (Eveleth and Tanner, 1978) and confirms earlier studies documenting slow growth and delayed development prior to maturity among Himalayan high altitude residents (Frisancho, 1978). The present data also confirm other studies reporting the independence of ages at menopause and menarche (Goodman et al, 1978; Flint, 1976; Treloar, 1974). The Upper Chumik biological reproductive span of 28.9 years is shorter than that in a longitudinal sample of Minnesota women whose span of 35.9 years is 24% longer due both to earlier menarche and later menopause (Treloar, 1974). A positive correlation between length of the

reproductive span and age at menopause is common to both studies, while the correlation between age at menarche and length of the reproductive span is found in the present sample.

Among experimental animals delayed achievement of adult body size and long growing periods are associated with later onset of degenerative processes of aging and long lifespans (Goodrick et al, 1978; Sacher, 1976; Yu et al, 1982). High altitude Himalayan populations provide a somewhat analagous natural experimental setting in which to consider whether the phenomenon of delayed development prior to maturity continues through adulthood in humans. (The commonality of slow growth and delayed maturity results from different sets of conditions experienced by the laboratory animal and human populations). The data presented here indicate that, in this Himalayan high altitude population, delayed achievement of mature function of the female reproductive system, measured by age at menopause. There appears to be no "compensation" for the delayed menarche and the result is a relatively short biological reproductive span. In this population, the factors delaying maturity of the female reproductive system appear to have no or a different influence on its subsequent biological changes.

Presently, there is little information on variation in and factors influencing age at menopause in any population, although there are compelling reasons to study this. One is that the length of the female reproductive lifespan is theoretically an important source of differential fertility, and thus of interest to students of natural selection. The event marking its termination is relatively unstudied compared with that marking its onset, although the present data suggest that age at menopause may be a greater determinant than age at menarche. In addition, age at menopause is an indicator of senescence of the reproductive system and may prove a useful marker in studies of biological development after maturity just as age at menarche often has been assessed as an indicator of biological development prior to maturity. These data from Upper Chumik add to our knowledge of the range of population variation in this poorly understood parameter of biological aging in women.

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