BACKGROUND

That menopause in the human female typically precedes death prompts the hypothesis that some evolutionary advantage must be gained by an individual’s premature cessation of reproduction. A number of hypotheses for the existence of this species-wide characteristic have been proposed, the most prominent of which include the mechanistic hypothesis1, the Grandmother Hypothesis2,3, and the Mother Hypothesis4. In a mechanistic approach to understanding the cessation of human reproduction, it is argued that once a woman’s ovarian reserve drops below a minimum level necessary to produce sufficient estradiol to drive the hypothalamic-pituitary-ovarian axis, ovarian functioning begins to decline, prompting the perimenopausal transition.

Conversely, proposed explanations for an advantage to ceasing reproductive investment include the Grandmother Hypothesis and the Mother Hypothesis, both of which draw on Life History Theory, particularly the argument that adult mortality schedules are a primary driver in life history strategies. The Grandmother Hypothesis proposes that late in life a woman can gain a greater fitness advantage by foregoing reproduction in her own reproduction in favor of investment in the maintenance of her lineage (i.e. caretaking of grandchildren). The Mother Hypothesis posits that a woman’s Lifetime Reproductive Success (LRS) depends upon the likelihood that she will survive until her youngest child has a high probability of reaching reproductive maturity. These two hypotheses are not mutually exclusive and selection may well be acting simultaneously in the ways described in each model. Although the focus differs in the two hypotheses, they share the argument that in a population with high adult mortality, one expects an earlier onset of menopause than in populations with relatively low adult mortality. Comparisons across populations tend to support this prediction (see Table 1).

RESULTS & DISCUSSION

A logistic regression of current age and current cycling status estimated the median age at menopause to be 48.0 years (p<0.001, CI: 46.78 - 49.56 years; see Fig. 1; all analyses used SPSS v. 18.0). This estimate falls on the lower end of the range of reported age at menopause in different populations (see Table 1). This finding is consistent with the prediction that a population characterized by high mortality is expected to have an earlier age at menopause.

We then conducted factor analysis to generate a composite indicator of socioeconomic status and ran logistic regression on current age, SES, and age at menarche. In our logistic regression model, a lower age at menarche predicts a lower age at menopause (p=0.053; see Fig. 2). As age of menopause on average, suggesting that the reproductive lifespan remains relatively constant among the members of this population, regardless of specific ages of initiation and cessation. This model also predicts that as socioeconomic status increases within a given age of menarche, a woman will have an earlier onset of menopause (Fig. 3), but this effect is very small.

PROJECT REPA

Reproduction and Ecology in Provincia Aroma (REPA) is a multidisciplinary longitudinal study of reproductive functioning and health in rural Bolivia. The first phase of Project REPA took place in 1995 to 1997; women aged 22-38 years were recruited from an agropastoral region in the Bolivian altiplano. This population is characterized by high mortality, a consequence of the harsh environment. During a private interview conducted in the participant’s native language (Spanish or Aymara), women were asked to report reproductive status and history. Indicators of socioeconomic status were also collected. Anthropometry was carried out by a single trained observer (VJV) and included measurements of height, weight, and skinfolds.

In the second phase of Project REPA, carried out from June to December 2010, women who had participated in the earlier study were recruited. Participants were asked to self-report reproductive status and updated histories in a private interview, also conducted in her native language.