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The influence of climate on age at menarche: Augmented with the influence of ancestry

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ABSTRACT

Samples representative of South Korea, Indonesia, and Peninsular Malaysia were analyzed and the influence of climate on age at menarche was investigated. The sample size was 24,651 for Korea (birth years 1941–1992), for Indonesia 8331 (birth years 1944–1988) plus 20,519 (birth years 1978–1997), and 2842 for Peninsular Malaysia (birth years 1927–1968). Respondents recalled their age at menarche. The mean age at menarche was calculated for each birth year by country, and for Malaysia, additionally by ancestry. It has been found that mean ages at menarche for the early birth years were much younger in Indonesia than in Korea despite similar levels of socioeconomic conditions (proxied by GDP per capita). For example, for the birth year 1944, the mean age at menarche was 14.45 years for Indonesia and 16.19 years for Korea—a difference of 1.74 years. It was necessary to double the Korean GDP per capita to make the Korean mean age at menarche the same as the Indonesian one. Chinese and Malay women in Peninsular Malaysia were further analyzed, and the results provided indirect evidence that the difference between Korea and Indonesia was not due to ancestry differences. Results in multivariate settings provided consistent results. It has been concluded that climate exerts a significant influence on age at menarche because the relatively easy availability of food in the tropics increases energy intake while the absence of cold weather decreases energy expenditure on maintenance and activity.

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Introduction

Many factors determine age at menarche (Ellis, 2004). Among them, climate had been long believed to influence menarche before Roberton (1832) challenged this belief in the 1830s and 1840s. For example, he concluded, "in warm climates it [menarche] occurs often as early as the eighth or ninth year; in temperate climates it is usually postponed to the thirteenth or fourteenth year; and in the arctic regions to the nineteenth or twentieth. This opinion, which is general, appears to me to be in a great measure, if not entirely, erroneous (Roberton, 1832:227)." He derived this conclusion by observing that age at menarche was similar regardless of climates. Approximately one and a half centuries later, Bojlen and Bentzon (1968) objected this conclusion, saying that Roberton did not hold other factors constant and thus could not isolate the influence of climate. They considered types of nutrients that were particularly important and hypothesized that, "In the arctic, the climate may have a puberty-retarding effect, which is counteracted by the protein-rich nutrition of the Eskimos, while in the tropics, the puberty-accelerating climate is assumed to be counteracted by a protein-poor, carbohydrate-rich nutrition." (Bojlen and Bentzon, 1968:81). Immediately after this review, Zacharias and Wurtman (1969) reviewed the literature on the determinants of age at menarche and reached the opposite conclusion: "recent research has not supported the belief, once widely held, that sexual development occurs at an earlier age in the tropics than in temperate zones" (Zacharias and Wurtman, 1969:868). These conflicting conclusions notwithstanding, few attempts have since been made to assess which side was better informed.

In this debate, no evidence was based on nationally representative samples. If a sample is not representative, it is difficult to ascertain whether the results are related to the population or to a special group in the population. This practice must have increased the confusion in the literature. It is also unclear what metrological factor was referred to. The context suggests that it referred to the mean annual temperature, and we adopted this reference point in his study. Nationally representative samples for South Korea and Indonesia were analysed and the importance of climate in determining age at menarche has been examined. These two countries are relevant because Korea is located in a temperate zone while Indonesia is located in the tropics. In addition, these samples contained birth cohorts that experienced similar levels of socioeconomic conditions, making it possible to isolate the influence of socioeconomic conditions on age at menarche at the population level. Furthermore, both countries witnessed economic development during the period. This fact enabled us to demonstrate that the populations in this study were sensitive to socioeconomic conditions, indicating that they are typical populations as far as age at menarche is concerned. After presenting evidence of the importance of climate in determining age at menarche, arguments were supported by drawing on another sample representative of Peninsular Malaysia. This sample is attractive because it contained Chinese, who are ethnically similar to Koreans, as well as Malays and Indians, who are ethnically similar to Indonesians. Using this sample, we further isolated the influence of ancestry on age at menarche. Finally, the arguments were reinforced in multivariate settings.

Materials and methods

The Korean National Health and Nutrition Examination Survey (KNHANES), a cross-sectional survey, provided data for Korea. We pooled the KNHANES for the years 2001, 2005, and 2007–2013, i.e., all survey years that have the variable of age at menarche. Women aged 20–60 were selected to allow late ages at menarche (for 20 years of age) and to remove survival bias (for 60 years of age). If healthier women experience menarche earlier and live longer, the surviving women would report earlier ages at menarche than the population in the same birth years. Then, the mean age at menarche would be biased downward.

The Indonesian Family Life Survey (IFLS) and the Young Adult Productive Health Survey (YAPHS) provided data for Indonesia. The IFLS is a longitudinal survey that was carried out in 1993, 1997, 2000, and 2007 (a survey for 1998 is an ad hoc survey for a quarter of the original sample and is publicly unavailable). Ever-married women aged 15–49 recalled their ages at menarche. Thus, we first selected all women aged 15–49 with valid information in IFLS1 and then added new members with valid