



Age at menarche in Polish University students born before, during and after World War II: Economic effects



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ABSTRACT

Although the relationships between economic conditions and biological variables over the past two centuries in Poland are reasonably well-documented, the influence of economic and political disruptions, including nutritional privation, during the years immediately before, during and shortly after World War II (WWII) has received less attention. This paper considers the association between age at menarche and body size of university students born before, during and after WWII and father's level of education, a commonly used indicator of family economic status in Poland. Subjects were 518 university students surveyed between 1955 and 1972, birth years 1931 through 1951. The sample was divided into three birth cohorts: before ($n = 237$), during ($n = 247$) and after ($n = 34$) WWII. Age at menarche was compared among birth cohorts, and by weight status and father's level of education. Age at menarche increased slightly but significantly among women born during WWII (14.4 yrs) compared to those born before (14.2 yrs) and after (13.9 yrs) the war. Controlling for year of birth and age of the student, age at menarche was significantly earlier in overweight (13.42 ± 0.35 yrs) than in normal weight (14.33 ± 0.06 yrs) and thin (14.54 ± 0.21 yrs) women. Adjusted mean ages at menarche in small samples of overweight women did not differ by father's level of education, and were earlier than corresponding ages of thin and normal weight women. Adjusted mean ages at menarche did not differ between thin and normal weight women with fathers having primary or no education, but were slightly later in thin than in normal weight women with fathers having a vocational, secondary or higher education. Although age at menarche was associated with father's level of education, young adult weight status was a somewhat more important correlate.

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1. Introduction

Four biological characteristics are commonly used as a “barometer” of human well-being in the historical context: status of skeletal remains, life expectancy, morbidity and body height (Steckel, 1979, 1992, 1995, 2008). More recently, weight-for-height reflected in the BMI is increasingly used as indicator of well-being.

Given the political, economic and social turbulence that characterized Polish history over the past two centuries, the

country was fertile ground to evaluate the impact of these conditions on the biological characteristics of the population. The economic transition from the feudal system to a capitalist economy in the 19th century was reflected in improvements in quality of life and associated increases of body height, especially among the rural population of Poland (Czapla and Liczbińska, 2014; Kozak, 1998; Liczbińska et al., 2016). Similar changes were noted in other European countries during this transition (Komlos, 1989). Industrialization and urbanization in the 19th century, however, were associated with a deterioration of living conditions in rapidly growing cities of Poland and throughout Europe; mortality rates increased while life expectancy decreased (Bourdelaïs, 2000; Humphries and Leunig, 2007; Jaadla and Puur, 2016; Jaadla et al.,

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2017; Lee and Marschalck, 2002; Leon, 2008; Liczbińska, 2009, 2011, 2015). Conditions in the cities were exacerbated by the in-migration of a large proportion of the rural population so that the majority lived in impoverished and crowded socioeconomic conditions, which were reflected over time in a reduction in heights of urban dwellers (Komlos, 1989; Steckel, 1995). Nevertheless, as industrialization progressed over time, conditions in cities improved and were eventually reflected in greater heights of urban dwellers compared to their rural peers in the late 19th and early 20th centuries (Czapla et al., 2017; Liczbińska et al., 2016).

The situation in Poland was complicated by the partition of the country among Austria, Prussia and Russia at the close of the 18th century. The Polish lands within the Russian and Austrian sectors were economically neglected compared to lands in Prussian sector. This was reflected in heights which were taller among inhabitants of the Prussian sector (Czapla and Liczbińska, 2014; Czapla et al., 2017; Liczbińska et al., 2016; Nowak, 2011; Nowak et al., 2011). Differences in height were also noted between populations living in the poor compared to the economically advanced districts (gubernyas) of the Russian sector, named the Kingdom of Poland (Czapla and Liczbińska, 2014). Poland was not restored as a political entity until after World War I, which was soon followed by World War II and major political changes after the war.

Age at menarche is an indicator of pubertal timing; it is also a good indicator of the standard of living and a sensitive “barometer” of social stratification in a population (Bielicki, 1992; Łaska-Mierzejewska, 1983). Changes in age at menarche have received somewhat less attention historically, although there is a reasonably comprehensive literature for Europe dating to the first half of the 20th century. The early European data were generally based on the retrospective method and commonly on women attending gynaecological and obstetrical clinics/hospitals (Danker-Hopfe, 1986). It was difficult, however, to identify specific factors related to the timing of this pubertal event given the political and economic conditions at this time in Europe and of course the trauma of World War II (Danker-Hopfe, 1986; see also Bindas, 2007; Villamor et al., 2009; Akachi and Canning, 2015).

In the late 1980s and early 1990s, economic and political transformations in Central and Eastern Europe, including Poland, have contributed to an improved standard of living, reflected in the style and quality of life and nutritional habits. The improvements have contributed to recent increases in height and weight and a reduction in the age at menarche compared to earlier surveys of the Polish population (Bielicki et al., 1986, 2000, 2003; Chrzanowska et al., 2007; Kołodziej and Kozieł, 2002; Kozieł et al., 2004, 2006; Łaska-Mierzejewska and Olszewska, 2004, 2007). More recently, continued increments in weight, associated in part with decreased levels of habitual physical activity, have contributed to an increase in the body mass index (BMI), the incidence of chronic diseases (Lipowicz, 2007; Stillman, 2006), and the risk for metabolic dysregulation and an elevated stress levels (Lipowicz et al., 2016).

Although the relationship between economic conditions and biological variables in Poland over the past two centuries is reasonably well documented, there is a gap in research concerning the interwar period (1919–1939), the Second World War (WWII) and the immediate post-war interval. Conditions associated with the war negatively and drastically impacted the quality of life, health and nutrition of European populations in general (Kalichman et al., 2007; Stanner et al., 1997). Conditions in Poland were severely impacted during the war, but the influence of conditions immediately before and after WWII on the Polish population has received relatively little attention (Górny and Dobrzańska, 1981; Nowak et al., 2011; Liczbińska et al., 2017; Wokroj, 1952). Preliminary research has shown that young women born during

WWII were shorter and lighter than those born before and after the war (Liczbińska et al., 2017).

In the context of the preceding historical overview, the purposes of this study are twofold: first, to compare ages at menarche of Polish university students born before, during and shortly after WWII and second, to evaluate the association among age at menarche of the students and socioeconomic status reflected in father's level of education. The results are subsequently discussed in the economic and historical context.

2. Material and methods

The data upon which this study is based were retrieved from the archives of the Institute of Anthropology of Adam Mickiewicz University. The data were collected by anthropologists from the Department of Anthropology in the 1950s and 1960s, and included year of birth, chronological age, age at menarche, height, weight and level of father's education for 518 students attending Adam Mickiewicz University in Poznań and Nicolaus Copernicus University in Toruń between 1955 and 1972. Birth years spanned 1931 through 1951. Women were divided into three birth cohorts relative to WWII: before (1931 to September 1, 1939, $n=237$), during (September 1939 through 1945, $n=247$) and after (1946 through 1951, $n=34$). Women were asked to recall their age at menarche; all except three women recalled age at menarche as the whole year. Allowing for the tendency for women to recall age at menarche as age at the birthday preceding menarche, 0.5 year was added to the recalled ages (Livson and McNeill, 1962).

Height was measured to the nearest 0.1 cm with an anthropometer following the protocol of Martin and Saller (1957). Weight was measured to the nearest 0.1 kg. The body mass index (BMI) was calculated and used to classify the women as thin ($<18.5 \text{ kg/m}^2$), normal ($18.5\text{--}24.99 \text{ kg/m}^2$), overweight ($\geq 25.0 < 30.0 \text{ kg/m}^2$) and obese ($\geq 30.0 \text{ kg/m}^2$) (World Health Organization, 1995). BMIs ranged from 16.0 to 31.6 kg/m^2 . No women had a BMI classified as severely thin ($\text{BMI} < 16.0 \text{ kg/m}^2$) and only one was obese. Frequencies by weight status were as follows: mildly and moderately thin, 53 (10%); normal weight, 452 (87%); overweight, including the one obese woman, 13 (3%).

Father's completed level of education was recorded as primary school or none ($n=103$, 20%); vocational ($n=103$, 20%); secondary ($n=146$, 28%), and higher ($n=166$, 32%). The classification reflected educational reforms established at the 1919 National Teacher Training Congress. Compulsory primary school was introduced for all children 7–14 years of age. Secondary education consisted of gymnasium, which included four years of a unified general education curriculum, and two years of high school, which provided a path to higher education. Formal vocational education was established in 1932 (Trzebiatowski, 1934; Mauersberg, 1995). The fathers of the women were educated in the context of the preceding classification. Of relevance, level of father's education is a commonly used indicator of socioeconomic status (SES) in Poland; a higher completed level of education is associated with better jobs and higher salaries and vice versa (Bielicki, 1992; Bielicki et al., 2000; Kozieł et al., 2006).

Preliminary analyses indicated no differences in basic variables between women from Toruń and Poznań, respectively: age (21.6 ± 1.4 yrs, 21.6 ± 1.9 yrs, $F=0.09$), age at menarche (14.2 ± 1.3 yrs, 14.3 ± 1.3 yrs, $F=0.12$), height (161.8 ± 5.5 cm, 161.3 ± 5.8 cm, $F=0.64$), weight (54.9 ± 5.6 kg, 54.1 ± 6.2 kg, $F=1.53$) and BMI ($21.0 \pm 1.9 \text{ kg/cm}^2$, $20.8 \pm 2.1 \text{ kg/cm}^2$, $F=0.69$), and distributions of women by father's level of education ($\chi^2=1.60$) and weight status ($\chi^2=1.05$).

Women born before WWII were significantly older than women born during and after the war ($22.3 \pm 2.1 > 21.1 \pm 1.2 = 20.5 \pm 1.3$ years, $F=36.19$, $p < 0.001$). The distribution of women by father's

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