Age at menarche among rural school youth in west-central Poland: variation with weight status and population growth

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ABSTRACT: Studies of age at menarche in Poland have a long history and consistently show an urban-rural gradient. The objectives of the study were to to estimate the age at menarche among school girls resident in ten rural communities of the Greater Poland province in 2016 and to compare ages at menarche by weight status and by population growth. The sample included 1146 girls, 7–16 years of age, resident in ten rural communities. Menarcheal status was obtained via interview. Heights and weights were measured; the BMI was calculated. Based on the latter, the girls were classified as thin, normal weight and overweight (including the obese) relative to IOTF criteria. Population growth between 1986 and 2016 in each community was estimated from local records. Ages at menarche were estimated with the probit regression protocol (SPSS) using the logistic model with log 10 transformation for the total sample and for the subsamples by weight status and population growth. The median age at menarche for the total sample of rural girls was 13.25 ± 0.20 years. Menarche was earlier among Overweight (13.06 ± 0.32 years) compared to Normal Weight (13.25 ± 0.37 years) and Thin (13.81 ± 0.41 years), and among girls resident in communities with Major population growth (12.58 ± 0.44 years) compared to Little/No growth (13.65 ± 0.14 years). Results of the present survey were generally consistent with recent surveys of age at menarche among rural girls in Poland and among girls classified by weight status. Corresponding comparative data relating menarche to population growth are lacking.

KEY WORDS: puberty, thinness, overweight, BMI, population growth

Introduction

Age at menarche is a commonly used indicator of maturity among adolescent girls and women. It is a relatively late indicator in the sequence of pubertal events and occurs, on average, after peak height (Malina et al. 2004). There is also a relatively long tradition of reporting ages at menarche in Europe and North America. In Europe, for example, mean ages at menarche in the late 19th century were about of 16–17 years, and evidence from several European countries suggests a decline in age at menarche by about 3.6 months per decade (Ong et al. 2006). The secular decline was generally related to improvements in health and nutritional conditions over time associated with conditions of living and improvements in socioeconomic conditions (Nieczuja-Dwojacka et al. 2018). In the context of the recent leveling of secular changes in age at menarche in many populations, it has been suggested that mean age at menarche in some populations may be approaching a "genetic limit" given reduced associations with socioeconomic and environmental factors (Golding et al. 2001).

Corresponding data from the end of the 19th century for the Polish population indicate a median age at menarche of 15.2 years (Kowalska 1966). Consistent with data for Europe, age at menarche in Polish girls has also declined over time, allowing for variation associated with the two world wars and major political transformation in the 1980s. Although based on retrospective data, mean age at menarche among college women born before WWII, 14.2±1.2 years, was slightly earlier than among women born during the war, 14.4±1.3 years, and both were later than that of women born after the war, 13.9±1.3 years (Liczbińska et al. 2018).

A review of three large scale surveys in different regions of Poland spanning 1967 through 2007 noted secular declines and persistence of the urban-rural contrast in ages at menarche in national and regional samples, and also noted corresponding contrasts between rural girls who were from farming and non-farming families (Łaska-Mierzejewska et al. 2016). More recently, a summary of national surveys in Poland noted secular declines and persistence of urban-rural contrasts in means ages at menarche between 1966 and 2012 (Gomula and Kozieł 2018). Overall, several studies noted that ages at menarche of girls resident in rural areas were consistently later, on average, than in urban girls, while daughters of rural non-farming families attained menarche earlier than girls from farming families.

Studies in Poland and other countries have noted a variety of factors associated with or that are correlates of age at menarche including, for example, nutritional status, socioeconomic status, family size, parental education, ethnicity, area of residence, psychological and emotional factors, and others (Łaska-Mierzejewska et al. 2016; Malina et al. 2004). In addition, weight status defined by weight *per se* and weight-for-height indices such as the ponderal index and the BMI, is also related to age at menarche (Hillman et al. 1970; Himes et al. 2009; MacMahon 1973; Merzenich et al. 1993).

Current studies on the age at menarche of girls resident in the Greater Poland voivodship are largely limited to urban samples (Durda 2011; Durda-Masny et al. 2019; Kaczmarek 2001, 2002). The purpose of the present study is to estimate the age at menarche among girls 7–16-years of age resident in ten rural communities of the Greater Poland province in 2016. Age at menarche is ad-

dressed from three perspectives: in the total sample, among girls classified by weight status as thin, normal weight or overweight, and among girls resident in communities which have experienced major population growth compared to those in communities with little or no population growth over 30 years (1986–2016).

Material and Methods

Background

The growth status of rural school children and adolescents in 10 rural communities in the Greater Poland province (Wielkopolskie) in west central Poland was surveyed in four decennial surveys spanning 1986 and 2016 (Bartkowiak et al. 2020). The communities were located between 19 and 75 kilometers of the city of Poznań, the capital of the voivodeship. The communities were initially selected in 1986 in cooperation with the provincial Board of Education and Development in Poznań and with the approval of the respective community authorities to represent different regions of the province. Subsequent surveys in 1996, 2006 and 2016 were also conducted with the approval of provincial and respective community authorities. The present study is limited to the 2016 survey during which information on the menarcheal status of girls was surveyed. Earlier surveys did not include menarcheal information.

Ethics

The 2016 survey was approved by the Human Ethics Research Committee of the Karol Marcinkowski Medical University in Poznań (No. 907/16) and educational authorities of each community. Parents or legal guardians provided written informed consent for their child or children to participate, while the latter provided assent for their participation. The surveys were conducted by faculty and staff of the University of Physical Education in Poznań in cooperation with teachers at each school.

Sample

The study included 1146 girls 7–16 years of age from the ten communities. Chronological age (CA) groups spanned one year with the whole year as the midpoint of the interval (7 years = 6.50 to 7.49, etc.).

Age at menarche

Menarcheal status was obtained via interview. Each girl was individually interviewed by a female member of the research staff as to whether menarche had occurred (yes) or had not yet occurred (no).

Anthropometry

Height (0.1 cm) and weight (0.1 kg) were measured during the school day in the gymnasium of each community. Experienced staff of the Department of Anthropology and Biometry of the Poznań University of Physical Education made all measurements using established procedures (Bartkowiak et al. 2020).

Weight status

The BMI (kg/m^2) was calculated and used to classify the girls by weight status using age- and sex-specific IOTF criteria (Cole et al. 2000, 2007). Given limited numbers of girls classified as severely (n=9) and moderately (n=26) thin, they

were combined with girls classified as mildly thin (n=100) into a single group labeled as Thin (n=135, 11.8%). Similarly, relatively few girls were classified as obese (n=79), and they were combined with those classified as overweight (n=201) into a single group labeled as Overweight (n=280, 24.4%).

Population growth

After the fourth survey was completed, the population records of the 10 communities were extracted from locally available archives (Supplementary Table 1). Between 1986 and 2016, five communities increased in population size, +1236 to +7436 individuals compared to the other five communities which increased to a lesser extent or decreased in population, +546 to -1920 individuals (Statistical yearbook of the Poznań voivodeship 1987; Wielkopolskie Voivodship. Subregions – Powiats – Gminas 2017). The two groups were labeled, respectively, as having experienced Major or Little/No population growth across the interval of the four surveys. The distributions of girls by weight status in communities with major growth (Thin = 12.3%, Normal = 65.4%, Overweight = 22.3%) versus little/no growth (Thin = 11.4%, Normal = 62.6%, Overweight = 26.0%) did not differ (Kappa = 0.03, Chi square = 2.08).

Analysis

Ages at menarche were estimated with the probit regression protocol of IBM SPSS Statistics 19. The logit model with log 10 transformation was used. Four separate analyses were calculated, first for the total sample; for the subsamples of girls classified as Thin, Normal Weight, and Overweight; for samples of girls from the communities which experienced Major and Little/No growth; and for samples of Thin and Overweight girls from communities with Major and Little/No growth; numbers of Thin girls by age groups were too small for analysis. Median ages, 95% confidence intervals, standard errors and standard deviations are reported. The significance of differences between pairs of ages at menarche was estimated with standard errors calculated from the median and 95% confidence intervals.

Results

The median age at menarche for the total sample of rural girls in 2016 was 13.25±0.20 years with 95% confidence intervals of 12.91 to 13.64 years. Corresponding estimates for the girls classified by weight status are summarized in Table 1. Menarche occurred earliest, on average, among Overweight girls (13.06±0.32 years), followed by Normal Weight girls (13.25±0.37 years) and Thin girls (13.81±0.41 years). The range of the 95% confidence intervals was smaller among Overweight girls (1.1 years) compared to Normal Weight and Thin girls (1.3 and 1.4 years, respectively). The difference in ages at menarche between Overweight and Thin girls approached significance; other pairwise comparisons were not significant.

Estimated ages at menarche among girls resident in communities which experienced Major and Little/No population growth are summarized in Table 2. Age at menarche among girls in the former communities was, on average, significantly earlier than that among girls resident in communities Little/No population growth, 12.58±0.44 and 13.65±0.14 years, respectively. Corre-

Table 1. Samples sizes and descriptive statistics for chronological age and estimated age at menarche among rural girls classified by weight status

Weight status	Age (yrs)			Age at Menarche (yrs)				
	N	M	SD	Median	95%	CI	SE	SD
Thin	135	10.3	2.4	13.81	13.34	14.73	0.47	1.49
Normal	731	11.2	2.6	13.25	12.65	13.98	0.37	1.17
Overweight	280	10.2	2.4	13.06	12.59	13.68	0.32	1.01

Table 2. Samples sizes and descriptive statistics for chronological age and estimated age at menarche among rural girls from communities experiencing Major and Little/No population growth between 1986 and 2016

Population growth	Age (yrs)			Age at Menarche (yrs)				
	N	M	SD	Median	95%	CI	SE	SD
Major	480	10.6	2.6	12.58	11.93	13.45	0.44	1.40
Little/no	666	11.0	2.6	13.65	13.39	13.93	0.14	0.45

sponding 95% confidence intervals indicated relatively little overlap in the estimated ages at menarche between groups.

Among girls from the communities with Major growth, median ages at menarche were 12.12±0.49 years (95% CI 11.48–13.09 years) in Overweight and 12.54±0.15 years (95% CI 12.25–12.84 years) in Normal Weight girls. Corresponding estimates for the communities with Little/No growth were 13.46±0.40 years (95% CI 12.92–14.25 years) in Overweight and 13.62±0.18 years (95% CI 13.30–13.97 years) in Normal Weight girls. Differences in median ages at menarche in girls from communities which experienced Major or Little/No growth within each weight status group were significant.

Discussion

Age at menarche in the total sample of rural girls 7–16 years in west-central Poland in 2016 was 13.25years (95% CI 12.91–13.64 years), and was similar to ages at menarche in rural girls from families of farmers (13.32±1.98 years), of farm-workers (13.19±1.67 years) and of non-farmers (13.17±1.96 years) resident in four geographic regions of Poland in 2001 (Łaska-Mierzejewska and Olszewska 2007). The age at menarche of the 2016 sample of rural girls in the present study was slightly later than ages at menarche noted among girls 7–18 years resident in small towns 13.11 years (95% CI 12.88–13.35 years, n=664) and in rural villages, 13.11 years (95% CI 12.91–13.32 years, n=802) in a 2012 survey of seven districts in Poland (Gomula and Kozieł 2018).

The prevalence of Thinness among rural girls in the present survey was 11.8%, which was similar to that recently reported for rural girls 7–12 years in southern Poland in 2009–2011, 13.3% (Suder et al. 2020). The prevalence of Overweight (i.e. overweight + obesity) in the present sample, 24.4%, was within the range estimates for recent samples of Polish girls 7–15 years; however, overweight rather than obesity was somewhat more prevalent in younger girls 7–12 years in the present study (Bartkowiak et al., under review).

The earlier estimated age at menarche in the sample of overweight and obese

girls compared to normal weight and thin girls was consistent with observations in Poland. In a longitudinal series of urban girls in Poznań, ages at menarche were 12.33±1.46 years among 38 overweight girls, 12.48±0.92 years among 172 normal weight girls, and 13.90±0.13 years among 33 underweight girls (Durda-Masny et al. 2019). The mean age at menarche for urban underweight girls was similar to that for rural thin girls in the present study (13.81±1.49 years), while those for overweight and normal weight girls were earlier than overweight (13.06±1.01 years) and normal weight (13.25±1.17 years) rural girls in the present survey (Table 1). Nevertheless, results of the studies were also consistent with observations in other countries, specifically earlier ages at menarche among overweight and obese girls (Anderson and Must 2005; Biro et al. 2018; Bratke et al. 2017; Himes et al. 2009; Lazzeri et al. 2018).

The contrast in ages at menarche in the total samples of girls and also in the samples of Overweight and Normal Weight girls resident in the rural communities that experienced Major compared to Little/No population growth between 1986 and 2016 merits attention. The data suggested a difference of about one year in age menarche in the respective total samples and subsamples by weight status. The communities which experienced a major population increase were located relatively close to Poznań, 19 to 37 km, while those which experienced little or no population increase were located a bit further from Poznań, 37 to 75 km. The population increase in the former was perhaps related to in-migration from Poznań as the communities were now suburbs of the major city. Of potential relevance, only one of the five communities which experienced major growth showed an increase in birth rates, while among the remaining nine communities, changes in estimated birth rates were negligible in three and declined in the other six communities.

Conclusions

The median age at menarche in the total sample of rural girls resident in the Greater Poland province in 2016 was 13.25±0.20 years, and was generally consistent with recent surveys of rural Polish girls. Age at menarche was earlier among Overweight (13.06±0.32 years) compared to Normal Weight (13.25±0.37 years) and Thin (13.81±0.41 years), which was generally consistent with ages reported for overweight and underweight urban girls in the city of Poznań. Of interest, girls resident in communities which experienced Major population growth between 1986 and 2016 attained menarche earlier, 12.58±0.44 years, compared to girls resident in communities with Little/No population growth, 13.65±0.14 years. The population increase in the former, which were now suburbs of a major city, was perhaps related to in-migration from Poznań. The distribution of girls by weight status did not differ between communities classified by population growth, but estimated ages at menarche in Overweight and Normal Weight girls in the communities with Major growth were earlier than the corresponding groups of girls in the communities with Little/No population growth.

The Authors' contributions

The study was designed and conceived by SB, JJ, MK, RS. Field work was carried out by SB, JMK, JJ, MK, RS. Analysis and interpretation of the results were conducted by SB, JMK, RMM. The manuscript was written by SB, JMK, RMM

Conflict of interest

The authors declare that there is no conflict of interest.

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Supplementary Table 1. The ten rural communities ranked by population growth between 1986 and 2016[1]

	Distance to Poznań (km)	1986	2016	Population change
Major growth				
Biedrusko	19	9307	16743	+7436
Strykowo	31	12395	14973	+2578
Pamiątkowo	24	27530	29828	+2298
Wojnowice	35	14861	16391	+1530
Nekla	37	6215	7451	+1236
Little/no growth:				
Kłecko	75	7046	7592	+546
Kwilcz	62	6002	6395	+393
Granowo	37	4676	5051	+375
Kołaczkowo	59	6110	6084	−26
Obrzycko	46	6444	4524	−1920

[1]Extracted from Statistical yearbook of the Poznań Voivodeship (1987) and Wielkopolskie Voivodship. Subregions–Powiats–Gminas (2017).