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Reliability of retrospective assessment of the age of first menstruation

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Abstract: The age of the first menstruation is one of the indicators for assessing the course of puberty. It is also a sensitive indicator of the economic situation of individual professional groups or societies, and the low average age of menarche is widely recognized as a marker of society's well-being. The aim of the study was to analyse the reliability of the retrospective method of assessing the age at menarche by comparing the results to the age obtained from continuous research. Data regarding the age at menarche came from longitudinal somatic development and physical fitness studies conducted between 1976 and 2022. In 2022, 47 women were examined. In continuous studies, the prospective method was used in the assessment of the age of first menstruation while in the 2004 and 2022 studies a retrospective method was applied. Only in 4 out of 47 women the age of the first menstruation declared in 2004 and 2022 (the women were 32–34 and 50–52 years old, respectively) was consistent with the one found in continuous studies. In other cases, there was a discrepancy between the age found in continuous studies and self-reported in 2004 or 2022 or between the age stated in 2004 and 2022. Of those women who were present for the 2022 study, 36 had information about the age of first menstruation from continuous studies and the age of menarche in 2004 was given. For this sample the arithmetic mean and the standard deviation of the age at menarche were calculated. It was found that the retrospective method often used in the assessment of the age of the first menstruation is not fully reliable, as the average discrepancy in the assessment ranged from nearly 1 month (0.05 years) to over 2 months (0.19 years) compared to the prospective method. Women surveyed in 2004 determined the age of the first menstruation more accurately compared to statements obtained 18 years later from the same women. This study suggests that long-term memory (LTM) of a significant life event of every woman is unreliable, as indicated by the difference in the declared age of the first menstruation of women examined in 2004 and 2022, which, in individual cases, was up to 3, 4 or 5 years.

Key words: menarche, prospective method, retrospective method, continuous research.

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Introduction

The age of the first menstruation is one of the indicators for assessing the course of puberty. It is also a sensitive indicator of the economic situation of individual professional groups or societies, and the low average age of menarche is widely recognized as a marker of the well-being of society. It is sometimes included in the analysis of secular trends, acceleration or deceleration of development (Gomuła and Kozieł 2018; Brix et al. 2019; Liu et al. 2021; Pop et al. 2022; Wu et al. 2022 et other). However, regardless of the purpose of the research, the reliability of the results depends on the methods used to assess the age at menarche.

There are three main methods of assessing the age of menstruation: the status quo method (responders answer a question about the occurrence of the first menstruation of girls, most often used at the age of 9–16 years), the retrospective method (responders answer a question of when the first menstruation occurred in girls and women, most often used in participants after 16 years of age and the prospective method (based on a question when the first menstruation occurred, asked during longitudinal studies including girls from about nine years of age. The retrospective method is the most commonly used methods used to estimate the age at menarche. Girls/women are asked to provide the age of the onset of menstruation to the nearest year and month, e.g., I was 12 years and 4 months (12.33 years). It is very rare for a woman to remember the age of her first menstruation to the nearest day. To calculate the average value in the sample of adult women, potentially all study participants are considered for analyses because all of them are post-menarche. The question arises: what size of menarche age memory error can be expected in women asked about it at different stages of life? Could this error be influenced by the woman's age at the time of the examination, i.e., the temporal distance from the date of menarche? For instance, the longer period of time has passed since the time of menarche, the more the recalled (retrospective) age differs from the actual age at menarche, i.e., prospective one. This problem can only be recognized in longitudinal studies (as in this study), which there are relatively few (Livson and McNeil 1962; Damon et al. 1969; Damon and Bajema 1974; Casey et al. 1991; Must et al. 2002; Żarów and Cichocka 2008). In the available studies, the differences between prospective and retrospective age at menarche ranged from -0.50 to +0.17 years. The size of the differences is significant, which is a subject for further analysis. In continuous studies of a selected group of girls/women from Krakow, which have been ongoing since 1976, the age at menarche was obtained at 3 ontogeny points, including 2 checking long-term memory (retrospective method) in relation to the well-established actual age of menarche (prospective method).

The aim of the present study was to determine whether the date of menarche recreated in women's memory differs from the actual date determined by prospectively, in adolescence, and what are the magnitude and direction of the memory errors. This study adds to the debate regarding how reliable the retrospective age at menarche is as a measure of changes in the rate of puberty in girls when used to track successive birth cohorts in a sample. This study also aims to determine whether in the study of the inheritance of the rate of puberty between mothers and daughters, the obtained results may be distorted by the age of the individuals at the time of examination.

Material and methods

Research material consisted of data derived from a longitudinal study focused on somatic development and physical fitness of girls and boys, conducted in 1976–2022 by the Department of Anthropology of the Institute of Biomedical Sciences of the University School of Physical Education in Krakow (KBC 1976–2022). The first series of annual surveys was performed in the years 1976–1988 (age of the participants 6–18 years), and the second series in the years 1980–1990; the age of the respondents was 8–19 years. The study analysed data combined from two series examined in 2004 (age 32–34 years) and re-examined in 2022 (age 50–52 years). Sample size and age of the examined girls and women:

- I series – data collected from 455 girls at the age of 6 to 142 aged 18,
- II series – data collected from 360 girls at the age of 8 to 108 women aged 18,
- 103 women in 2004 and 47 women in 2022.

Descriptive statistics, such as mean and measures of variability were calculated. Statistical significance of the differences between the analyzed assessment methods was calculated using the Student's t-test for dependent samples. The analyses were conducted using the Statistica 13.0 software. The numerical statement shows that the number of women in subsequent studies decreased, which is the expected trend in longitudinal studies. In the first and second series of the study, information about the age of the first menstruation was collected using the prospective method. In the studies conducted in 2004 and 2022, a retrospective method was used. Of the 47 women surveyed in 2022, 25% reported secondary education, and the remaining 75% (35 people) stated higher education. All studies were conducted with the consent of the girls' parents and test subjects. The consent of the Bioethics Committee at the Regional Medical Chamber in Krakow was obtained for the examination in 2022 (consent no. 65/KBL/OIL of April 11, 2022). All procedures contributing to the study complied with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008.

Results

Table 1 shows individual data on age and menstruation according to the prospective and retrospective methods of the surveyed girls and women.

Of 47 women examined in 2022, only four cases in the age of menarche found in the longitudinal study was consisted with the one self-reported by the participants in 2004 and 2022. Ten women declared the same age of menarche while examined in 2004 and 2022 aged 32–34 and 50–52 respectively. In the remaining 33 cases, there was a discrepancy between the age found in the continuous surveys and the age declared in 2004, between the age found in the continuous tests and in 2022, or between the age stated in 2004 and in 2022. Of the 47 women who participated in the 2022 study, 36 also had information about their age of the first menstruation available in the data from continuous studies regarding the reported age of menarche in 2004. For this sample, arithmetic mean, standard deviation and range of the age of menarche were given at three points in women's ontogeny – as a teenager, at 32–34 and at 50–52 years old (Table 2).

Table 1. The age of the first menstruation data according to the prospective method and the retrospective method – age in years (KBC 1976–2022)

Serial number	Test No	Continuous tests 1976-1988 and 1978-1990	Research in 2004 Women aged 32-34	Research in 2022 Women aged 50-52	Difference between continuous testing and 2004	Difference between continuous testing and 2022	Difference between 2004 and 2022
Age of first menstruation consistent in all studies							
1	768	12	12	12	0	0	0
2	324	13	13	13	0	0	0
3	181	15	15	15	0	0	0
4	410	16	16	16	0	0	0
Age of first menstruation consistent in 2004 and 2022 surveys, and divergent in relation to continuous studies							
5	394	11.08	12	12	-0.92	-0.92	0
6	431	11.42	11	11	0.42	0.42	0
7	684	11.75	13	13	-1.25	-1.25	0
8	998	11.92	11	11	0.92	0.92	0
9	757	12.33	12	12	0.33	0.33	0
10	650	12.5	12	12	0.5	0.5	0
11	605	13.42	14	14	-0.58	-0.58	0
12	399	13.75	14	14	-0.25	-0.25	0
13	746	13.92	13.58	13.58	0.33	0.33	0
14	437	14.67	13	13	1.67	1.67	0
Age of first menstruation divergent across all studies							
15	888	10.5	10	10.08	0.5	0.42	-0.08
16	918	11.58	11.5	11.58	0.08	0	-0.08
17	60	11.58	.	10.25		1.33	
18	237	11.67	12.5	12	-0.83	-0.33	0.5
19	442	12.17	.	15		-2.83	
20	871	12.25	12.42	13	-0.17	-0.75	-0.58
21	457	12.33	.	10.25		2.08	
22	314	12.5	.	12.25		0.25	
23	313	12.58	12.5	11.83	0.08	0.75	0.67
24	785	12.58	11	10.5	1.58	2.08	0.5
25	752	12.83	12.33	14.5	0.5	-1.67	-2.17
26	659	12.83	14	12.92	-1.17	-0.08	1.08
27	214	12.92	16	11	-3.08	1.92	5
28	777	13	14	13.5	-1	-0.5	0.5

Serial number	Test No	Continuous tests 1976-1988 and 1978-1990	Research in 2004 Women aged 32-34	Research in 2022 Women aged 50-52	Difference between continuous testing and 2004	Difference between continuous testing and 2022	Difference between 2004 and 2022
29	415	13.08	14	13.92	-0.92	-0.83	-0.08
30	349	13.17	.	13.5		-0.33	
31	633	13.33	14	14.75	-0.67	-1.42	-0.75
32	671	13.5	13	17	0.5	-3.5	-4
33	173	13.5	13	14	0.5	-0.5	-1
34	523	13.58	12.67	12.08	-0.92	1.5	0.58
35	629	13.67	13.50	14.17	0.17	0.5	-0.67
36	890	13.75	13.58	12.75	0.16	1	-0.75
37	623	13.75	14	14.92	-0.25	-1.17	-0.92
38	74	13.75	.	12.83		0.92	
39	343	13.83	14.08	13.92	-0.25	-0.08	0.17
40	847	13.92	.	14.5		-0.58	
41	387	13.92	13	16	0.92	-2.08	-3
42	524	14.08	14	14.67	0.08	-0.58	-0.67
43	790	14.08	.	16.42		-2.33	
44	601	14.42	.	14.25		0.18	
45	646	14.42	15	16	-0.58	-1.58	-1
46	965	14.58	.	16		-1.42	
47	67	14.92	.	16.67		-1.75	

. did not participate in the study

Table 2. Descriptive statistics of women's age of the first menstruation; age is stated in years (KBC 1976–2022, n=36)

Parameter	Continuous testing Prospective method	2004 Women aged 32-34 Retrospective method	2022 Women aged 32-34 Retrospective method
Arithmetic mean	13.05	13.10	13.24
SD	1.15	1.36	1.68
Range	10.50 – 16.00	10.00 – 16.00	10.08 – 17.00

Table 2 shows that the average age of menarche that was self-reported in 2004 was higher by almost one month (0.05 years), and in 2022 – by more than two months (0.19 years) from the corresponding age calculated from the longitudinal data. Thus, older by 18 years women reported a later age of menarche. For the current study group, the value of the Student's T-test for dependent samples

was t=0.9875, p=0.33, the number of degrees of freedom df=35, i.e., a statistically insignificant difference between the data given in found in continuous studies and found in 2022. The differences between the arithmetic mean of the continuous surveys and the mean of the 2004 surveys (t=0.3346, p=0.74, df=35), as well as between the means in 2004 and 2022, were also not statistically significant (t=0.6269, p=0.53, df=35).

Discussion

The age of the first menstruation is influenced by both genetic factors and the external environment. The relationship of the age at menarche with body structure, diet quality, physical activity, personality type, geographical environment, socio-economic status of parents, as well as the impact of psychosocial stimuli has been reported in many studies (e.g., Rees 1995; Gonzales et al. 1996; Tahirović 1998; Chowdhury et al. 2000; Cichocka and Żarów 2002; Barkai et al. 2007; Nieczuja-Dwojacka et al. 2018; Durda-Masny et al. 2019; Karim et al. 2021; Glass et al. 2022).

As can be seen from the data presented in table 2, the results obtained using the two methods varied although differences between the data self-reported in 2004 and 2022 were statistically insignificant. These differences would potentially reach a significance level if the number of examined individuals (i.e., sample size) exceeded 140 people (i.e., with the number of n=144, the value of the t statistic=1.996, with p=0.05 [exact value - 0.048]). However, collecting so much data in such long-term continuous studies is extremely difficult. Still, the difference in arithmetic means in 2004 and 2022, amounting to 13.10 and 13.24, respectively, would be statistically significant with the sample exceeding 350 respondents (i.e., with n=360, t-statistic value =2.008 with p=0.05). Such, and larger, samples are regularly reported in comparative cross-sectional studies involving analyzes of secular trends in the age of menarche. The mean age at menarche obtained using the retrospective method was reported as later than the one determined using the prospective method (Table 2), and this difference was smaller if the examination date was closer in time, than the first menstruation. A similar tendency was observed by Koo and Rohan (1997), but the interval after the repeated questions regarding the age of menarche was much shorter – nearly 1 year and almost 2 years. With an average time interval of 323 days, 66.1% of study participants were able to recall the age at menarche correctly, while with an average interval of 649 days, only 44.8% of the subjects were able to do that. In our study, only 11% of women aged 32–34 reported the exact age of menstruation (4 out of 36 women) determined in continuous studies, and at the age of 50–52 years only 10.6% did so (5 out of 47 women) although the average error in the 2022 study was greater.

A greater overestimation of the average age of menarche may be due to a greater memory error of older women. The complicated relationship between the age of the first menstruation and the time of collecting information about this age was the subject of analyses by Mirzaei et al. (2019), who found that the more distant the studies were from the occurrence of menarche, the greater the memory error. At this stage of knowledge about the mechanisms of memory and their changes with age, it is difficult to explain why, over time, on average women con-

tinuously perceive their age at menarche as older. This tendency may be reflected in various studies, including analyses of secular changes in the age of menarche. When we examine the retrospective age of menarche (and this is the only age we have at our disposal in studies of adult women) in subsequent birth cohorts of women in the sample, we find the phenomenon of acceleration of puberty, i.e., the younger the years of birth, the earlier the age at menarche. It cannot be ruled out that this pattern of secular changes is caused by the tendency of women's memory to delay the age of menarche, i.e., the older the age of the respondents, the greater the delay. Estimating the pace of the changes per decade in such a way is subject to error. In our analysis, the average assessment error (overestimation) was 0.19 years, i.e., over 2 months. Kraków is one of the best-researched populations in Poland in terms of determining intergenerational changes in the pace of children's maturation. Between 1971 and 2010, 4 large series of cross-sectional studies have been conducted monitoring age at menarche using the status quo method (no recall bias). The decrease in the age of puberty in this period was 0.44 years, i.e., an average of 0.11 years per decade, or 1.5 months (Cichocka et al. 2012). The changes were therefore subtle and reliably determined, 1–2 months per decade. The magnitude of the trend per decade was similar to the magnitude of the age at menarche memory error in women at 50–52 years old. A question can be asked – did women in the prospective study tend to underestimate or overestimate their age at menarche compared to the age assessed prospectively? The analysis presented in Table 1 shows that in 2004 (women aged 32–34 years) 15 women underestimated the age of the first menstruation and 17 overestimated it, while in 2022 (women aged 50–52 years) women more often overstated the age of menarche; 19 women underestimated and 12 overestimated it while 1 woman reported the same age. The sample has been reduced by 4 women who reported the same age in all study series. There was also no clear difference in the assessment of the age at menarche between early and late maturing women. Out of these 36, early maturing women were conventionally defined as those whose first menstruation occurred before the age of 12.50 and those whose first menses happened after the age of 13.50 were classified as late maturing. Among the 10 early maturing women, 1 provided the exact age at menarche, 4 overestimated and 5 underestimated the age of menarche. In the group of late maturing women there were 2, 5 and 6 women in the same recall categories, respectively. Longitudinal studies in general, including ours, have weaknesses mainly because they are difficult to implement, time-consuming and expensive, and over time, an increasing rate of loss of participants (dropouts, loss to follow-up) is a common problem. This means that after several decades of collecting longitudinal data, only several dozen participants usually remain from the original sample. For these reasons there are not many such studies. Our research seems to be unique because we have 3 points in ontogeny, temporally distant, examining the age of menarche, including 2 testing long-term memory. An additional advantage of our study is that the research was largely conducted by the same people, which inspired trust among the surveyed women, helping them answer the questions, often involving personal matters, with more confidence and honestly.

Conclusions

1. The retrospective method that is often used in assessing the age of first menstruation is not fully reliable, as the average discrepancy in assessment ranges from nearly 1 month (0.05 years) to more than 2 months (0.19 years) compared to the prospective method.
2. Women aged 32–34 years more accurately stated the age of the first menstruation compared to statements obtained from the same women18 years later.
3. Long-term memory (LTM), even regarding such a significant event in the life of every woman, is often unreliable, as indicated by the difference in the declared age of the first menstruation of the same women surveyed in 2004 and 2022, in some cases amounting to 3, 4 or 5 years.

Overall, in the analysis of secular trends of the age of menarche, it is worth remembering to determine the size of the trend using the same method of assessing the age of menarche. The use of various methods can lead to unreliable results, as we have already previously shown (Żarów and Cichocka 2008; Cichocka et al. 2012), and the magnitudes of the trend can be subtle. As a result, this may cause an erroneous assessment of the conditions of intergenerational changes of the age at menarche.

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Conflict of interest

The authors declare no conflict of interest.

Author's contributions

RŻ: conceptualization, methodology, investigation, software, formal analysis, validation, interpretation of the data and results, writing of the original draft, project administration, data curation; AW: investigation, software, writing of the original draft; BS: investigation, formal analysis, validation, interpretation of the data and results, data curation; interpretation of the data; MK: investigation, software, interpretation of the data; JB: investigation, software, interpretation of the data; all authors reviewed and edited the manuscript.

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