Social and economic factors influencing the age of menarche of female students at the Faculty of Medicine and Health Sciences at the Jan Kochanowski University in Kielce compared to developmental norms

Wpływ czynników społeczno-ekonomicznych na wiek menarche studentek Wydziału Lekarskiego i Nauk o Zdrowiu Uniwersytetu Jana Kochanowskiego w Kielcach w porównaniu z normami rozwojowymi

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Abstract

Introduction: The age of menarche is the beginning of the final puberty phase. It is used as an assessment criterion for girls' sexual maturation. Despite much research in the area, the issue is still valid because, along with improvement of the quality of life and socio-economic conditions, a tendency has been observed for girls go through puberty earlier.
Aim of the research: To analyse the menarche age of female students at the Faculty of Medicine and Health Sciences Jan Kochanowski University (JKU) in Kielce with respect to socio-economic conditions and developmental norms.
Material and methods: An anonymous retrospective questionnaire was applied and filled out by a total of 132 female students (70 from urban areas, 62 from rural areas). The questions concerned menarche age, socio-economic conditions, health, height, and weight. From the obtained data, mean values and standard deviations were calculated, and Student's *t*-test analysis was performed.
Results: Among the female students from urban areas, the majority of them, i.e. 18.57%, achieved sexual maturity at the age of 12.0 years. Among the girls from rural areas, the majority of them (19.37%) had their first menstruation at the age of 13.0. The mean menarche age of female students from cities is 12 years and 10 months, from the countryside – 13 years and 1 month. The mean puberty age of the JKU female students is similar to the corresponding age in other regions of Poland.
Conclusions: It cannot be unequivocally stated that socio-economic conditions have a crucial impact on the age of menarche. The differences between urban and rural standard of living conditions are blurring.

Streszczenie

Wprowadzenie: Wiek *menarche* (pierwszej miesiączki) jest początkiem końcowej fazy dojrzewania. Stosowany jest jako kryterium oceny dojrzewania płciowego dziewcząt. Mimo licznych badań zagadnienie to jest ciągle aktualne, gdyż wraz z poprawą jakości życia i warunków społeczno-ekonomicznych obserwuje się pewną tendencję do wcześniejszego dojrzewania dziewcząt.
Cel pracy: Analiza wieku *menarche* u studentek Wydziału Lekarskiego i Nauk o Zdrowiu Uniwersytetu Jana Kochanowskiego (UJK) w Kielcach na tle uwarunkowań społeczno-ekonomicznych oraz norm rozwojowych.
Materiał i metody: W badaniu użyto anonimowej ankiety retrospektywnej, którą zgodziły się wypełnić 132 studentki (70 pochodziło z miasta, 62 ze wsi). Pytania dotyczyły wieku pierwszej menstruacji, warunków społeczno-ekonomicznych, wiedzy na temat dojrzewania oraz wysokości i masy ciała. Z uzyskanych danych obliczano średnie i odchylenia standardowe oraz przeprowadzono analizę statystyczną testem *t*-Studenta.
Wyniki: Wśród studentek pochodzących z miasta najwięcej (18,57%), dojrzewało w wieku 12 lat. Spośród dziewcząt pochodzących ze wsi najwięcej (19,37%) miało pierwszą menstruację w wieku 13 lat. Średnia wieku *menarche* studentek z miasta to 12 lat i 10 miesięcy, a ze wsi – 13 lat i 1 miesiąc. Średni wiek dojrzewania studentek UJK jest zbliżony do wieku dziewcząt z innych regionów Polski.
Wnioski: Nie można jednoznacznie stwierdzić, że warunki społeczno-ekonomiczne istotnie wpływają na wiek pierwszej miesiączki. Zacierają się różnice pomiędzy warunkami życia w środowisku miejskim i wiejskim.

Social and economic factors influencing the age of menarche of female students at the Faculty of Medicine and Health Sciences at the Jan Kochanowski University in Kielce compared to developmental norms

211

Introduction

The age of first menstruation (menarche, i.e. the beginning of the final stage of puberty) [1, 2] is an important and yet the simplest criterion to assess girls' sexual maturity. For this reason, many authors undertake research in this area [3–9]. The age of the first menstruation is a result of multiple overlapping factors, both endogenous and exogenous. It is believed that girls' age of menarche is correlated with the corresponding age of their mothers [2]. On the other hand, external factors include somatotype, diet, physical activity, biogeographic environment, and socio-economic situation [10–12].

Many authors of recent studies point to the successive lowering of the menarche age as a consequence of the secular trend [10]. This is due to the general improvement of living standards, including material conditions and social and health awareness. However, the authors of various studies have reported that early puberty timing is associated with higher risks for type 2 diabetes, obesity, and cardiovascular disease in women as a consequence of the hormonal imbalances [4, 13]. Here we analyse the age of first menstruation in female students of the Faculty of Medicine and Health Sciences Jan Kochanowski University (JKU) Kielce and compare these findings to other regions, as well as to the whole of Poland, which provides a great deal of information about the biological development of girls. The Świętokrzyskie Province, from which the students participating in this study were recruited, is a dynamically growing region of our country.

Aim of the research

Therefore, this paper aimed to analyse the menarche age of the JKU female students depending on their socio-economic factors.

Material and methods

The study was made using an anonymous retrospective questionnaire that was completed by a total of 132 female students of the Faculty of Medicine and Health Sciences JKU, Kielce; 70 of the students were from cities, and 62 were from the countryside. In the survey, the urban origin was divided into two subcategories: cities with up to 50,000 residents (27 girls) and cities with greater than 50,000 residents (43 students). The research tool was the author's questionnaire; the questions concerned menarche age, education of parents, number of siblings, socio-economic conditions, health, body height, and body weight. The student's responses were categorised. The students were not weighed and measured, and that the given results are declarative, and body mass index (BMI) index was calculated based on those values. Relevant consent was obtained to perform the study from the Bioethical Commission of the Faculty of Medicine and Health Sciences JKU in Kielce (No. 14/2017). The obtained data were processed statistically.

Statistical analysis

Mean values were calculated ($\bar{x}$) along with standard deviations (s) and significance of differences between the average Student's t-test, using Statistica 12 software. The assumed level of significance was $p \leq 0.05$. The study results were compared with the results reported by other authors.

Results

Menarche age

The age range of menarche in the studied students was broad: from 10 years 5 months (one person from a rural area) to 16 years 1 month (1 person from a village). In general, the majority of girls from urban areas commenced puberty at 12 (18.57%) and 13 (11.43%) years old. In the case of girls from the countryside, the most matured were 13.0 and 12.0 years old (19.37% and 12.9%, respectively). Detailed data on this can be found in Table 1 and Figure 1. The mean age at first menstruation in girls from rural areas was 13.23 years (i.e. 13 years and 3 months, s = 1.165).

In the case of girls from urban areas, $\bar{x}$ = 12.81 (12 years 10 months) and s = 1.149. An analysis of the mean values of the age at first menstruation for the two social groups using Student's t-test showed the differences to be not statistically significant.

In some studies, the results obtained were compared across three categories of puberty: early (up to 11 years of age), average (11–14 years of age), and late (over 14 years of age). The timing of the first menstruation in the vast majority of the surveyed girls was "average" (75.81% of girls from rural areas and 77.14% of girls from urban areas). In small towns the average age of puberty reached 42.1% of female students, while in large cities as much as 90.19% (Table 2).

Living conditions

The socio-economic conditions of the students, the place of residence, parents' education, number of siblings, diet, sources of knowledge about puberty, and BMI were taken into consideration.

The majority of the surveyed girls (96.8% and 91.4% from villages and cities, respectively) grew up in a full family with both parents.

Considering the education of parents, it should be noted that about one-third of the parents completed higher education, one-third secondary education, and one-third vocational education. There were no statistically significant differences in parents' education when comparing the studied social groups with regard to higher and secondary education but differences were found concerning vocational education

Table 1. Puberty age of female students from urban and rural areas

Puberty age [years and months]	Village		City	
	N	%	N	%
10.5	1	1.61		
11.0	1	1.61	3	4.29
11.4			1	1.43
11.5			1	1.43
11.6	2	3.23	3	4.28
11.7	1	1.61	2	2.86
11.8	1	1.61		
11.10			3	4.28
11.11			1	1.43
12.0	8	12.9	13	18.57
12.1	2	3.23	1	1.43
12.2	2	3.23	1	1.43
12.3			1	1.43
12.4			1	1.43
12.5	2	3.23	3	4.28
12.6	2	3.23	2	2.86
12.7	1	1.61		
12.9			1	1.43
12.10	1	1.61		
13.0	12	19.36	8	11.43
13.1			3	4.28
13.2	2	3.23	2	2.86
13.3	2	3.23		
13.4	1	1.61	1	1.43
13.5	2	3.23		
13.6	1	1.61	1	1.43
13.7	1	1.61	1	1.43
13.9	2	3.23		
13.10	1	1.61		
13.11			1	1.43
14.0	5	8.06	4	5.71
14.1			1	1.43
14.2			3	4.28
14.3	2	3.23	1	1.43
14.4	1	1.61	1	1.43
14.6	1	1.61		
14.9			1	1.43
14.10			1	1.43
15.0			2	2.86
15.1	1	1.61		
15.2	1	1.61		
15.4			1	1.43
16.0	2	3.23	1	1.43
16.1	1	1.61		
Σ	62	100	70	100
13.07258 = 13.1	Average value ($\overline{x}\ \overline{x}$)		12.81057 = 12.10	
1.164884	s		1.148905	
1.356954	Variance		1.319982	
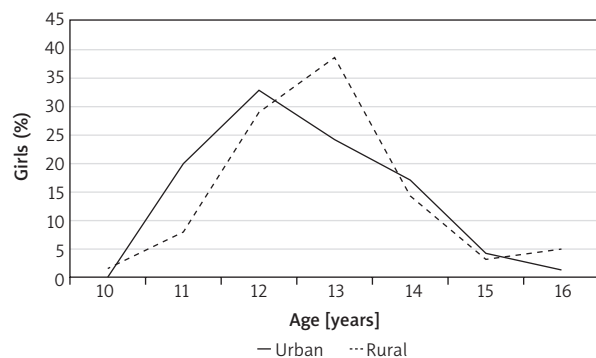
Figure 1. Puberty age of female students of JKU from urban (solid line) and rural areas (dotted line)

($p = 0.005$). Also, no differences were found concerning the number of siblings. However, we did detect some differences concerning the student's declarations regarding living conditions. Most (68.6%) of the students from urban areas indicated very good living conditions, while this proportion was only 9.7% among students from rural areas. Most of the girls from rural areas (79.0%) indicated good living conditions.

A vast majority of female students were eating regularly before the onset of their first menstrual period; while only 9.8% were eating irregularly (more in the case of female students from urban areas). Nearly all of the surveyed girls were not dieting, while only 3.8% were on a short-term diet that lasted between one and several months (84.3% of female students from urban and 96.8% from rural areas).

The girls' eating habits were different: the diet of 33.3% was dominated by carbohydrates and fruit and vegetables. Only one-fifth of the surveyed students indicated meat (including fish) as the main element of their diet, while 11.4% indicated dairy products. Significant differences between the nutrition of students from rural and urban areas were not disturbed (Table 3). Most (92.4%) of the surveyed students claimed they were eating the same way at menarche age.

Regarding the students' proportions of body structure at the age of the first menstrual period, 45% declared the same proportions, 54% were slightly slimmer, and 33% were more obese. When analysing the mean values of the BMI ratio of girls from urban and rural areas, it should be noted that they were very similar (21.33 and 21.77 kg/m², respectively). The majority (88.7%) of girls from rural areas had a correct body build (BMI in the range of 18.5–24.99 kg/m²). Only 4.84% were underweight (BMI < 18.5 kg/m²): two girls from the group of 13-year-olds and one from the group of 12-year-olds. Similarly, only 6.45% were overweight: three people from the group of 12-year-olds and one from the group of 13-year-olds. Among the girls from urban areas, the situation was similar: 82.9% were of proper body build, and 5.7% were un-

Social and economic factors influencing the age of menarche of female students at the Faculty of Medicine and Health Sciences
at the Jan Kochanowski University in Kielce compared to developmental norms

213

Table 2. The menarche age of the UJK female students with division into early, average, and late puberty

Social origin		Early puberty		Average puberty		Late puberty	
		N	% in group	N	% in group	N	% in group
Village (n = 62)		1	1.61	47	75.81	14	22.58
City (n = 70)		0	0	54	77.14	16	22.86
City with division into small and big	< 50,000 inhabitants (n = 19)	0	0	8	42.1	11	57.9
	> 50,000 inhabitants (n = 51)	0	0	46	90.19	5	9.81

derweight (two 11-year-olds and two 12-year-olds). Overweight girls accounted for 11.4% (two 11-year-olds and three in each group of 12- and 13-year-olds Table 3.

Only a few of the surveyed female students were chronically ill (1.5%). As far as people from the students' families are concerned, in more than half of the cases (53%) no diseases were found. In 18.2% of cases, the parents were sick, in 15.9% the siblings were sick, and in 12.9% members of the extended family were sick.

Discussion

Currently, girls are starting puberty at an even younger age, which is measurable by the appearance of the first menstrual period. It is believed that this is the result of coexisting genetic factors and a broadly understood socio-economic environment. According to Olszewska *et al.* [4] and Olesen *et al.* [11], in the 20th century, the mean age of menarche in Europe was 15. It is currently 12–13 years [13, 14]. Therefore, the reduction in the age of the first menstrual period is accelerating. This is explained by, among others, improvement of living conditions, change in eating habits, and increased health awareness.

The mean menarche age of girls from various geographical regions of Poland ranges from 12 to 13 years (Table 4) – from 12 years 5 months to 12 years 11 months in the case of girls from urban areas and from 12 years 5 months to 13 years 4 months in girls from rural areas. The mean age of puberty among students of JKU in Kielce from urban areas is not dissimilar from the Polish data. In the case of the girls from rural areas, the mean age of 13 years and 1 month is similar to the mean age of girls from the Pomorze region (13 years and 4 months) and Rzeszow and Zielona Gora regions (12 years and 11 months), while it is slightly higher than the mean age of the girls from Bydgoszcz (by 7 months). The differences among these values are not large and fall within a statistical error limit. Considering the age range of the first menstrual period of the surveyed students (10 years 5 months – 16 years 1 month), it is similar to other authors from Poland (9 years 5 months – 16 years 6 months) [1–5, 8, 13–15]. Considering the division of menarche age into

early puberty (up to 11 years), average (11–14 years), and late (over 14 years), the majority of surveyed girls became mature at an "average age".

When analysing the list above, one can draw the following conclusions. The mean puberty age of female students at JKU in Kielce was attained by 75.81% of girls from rural areas and 77.14% girls from urban areas. When comparing girls from large cities (over 50,000 residents) and towns (less than 50,000 residents), the values are quite different: as many as 90.19% of girls from cities reached puberty within the average age range, while in the case of girls from urban areas more than half (57.9%) reached puberty late (over 14 years of age) and 42.1% reached puberty at the average age. However, it seems that for students from urban areas, from which only 19 female students originated, the results need to be treated carefully. Of the surveyed female students, only one person reached puberty early; interestingly, this girl came from a rural area. A surprising proportion of the girls became mature late (22.58% of girls from rural areas and 22.85% of girls from urban areas). In the case of girls from urban areas, this value was only 9.81%. When comparing these results with the data of other authors [4, 5], attention should be paid to the similar percentage distributions in particular age categories, especially with respect to the girls from the Podkarpackie region. The situation is different for the students from the Pomeranian Medical University in Szczecin, in which there was a relatively large group of girls who went through puberty earlier (14.01%).

When one compares the obtained results with the results of studies among girls from primary and secondary schools in Kielce [2], it should be stated that the mean puberty age of students from cities is similar to the results of the studies by Zięba *et al.* (i.e. 12 years and 10 months), while in the case of female students from rural areas, the mean age is 11 months older among primary and secondary school students (Table 4).

According to the literature data, girls who commence puberty earlier have a higher BMI or a tendency for obesity [2, 8, 14, 16]. In this research, this dependence was impossible to confirm because only one female student reached sexual maturity earlier

Table 3. Socio-economic conditions of the female students at JKU in Kielce

Type of socio-economic conditions		Village		City		Total		Statistical significance	
		n/62	%	*n*/70	%	*n*/132	%	χ²	*P*-value
Upbringing	Full family	60	96.8	64	91.4	124	93.9		
	Only mother	2	3.2	5	7.1	7	5.3		
	Only father			1	1.4	1	0.76		
Education	Higher mothers	26	41.9	21	30.0	47	35.6	2.0309	0.154131
	Higher fathers	16	25.8	24	34.9	40	30.3		
	Secondary mothers	21	33.9	22	31.5	43	32.6	1.72	0.185693
	Secondary fathers	15	24.2	28	40.0	43	32.6		
	Vocational mothers	13	21.0	26	37.1	39	29.5	7.929	0.004865
	Vocational fathers	30	48.4	17	24.3	47	35.6		
	Primary mothers	2	3.2	1	1.4	3	2.3		
	Primary fathers	1	1.6	1	1.4	2	1.5		
Siblings	1	26	41.9	36	51.4	62	47	1.6342	0.802626
	2	22	35.5	21	30.0	43	32.6		
	3	6	9.7	7	10.0	17	9.8		
	More	6	9.7	4	5.7	10	7.6		
	Only child	2	3.3	2	2.9	4	3.0		
Living conditions	Very good	6	9.7	48	68.6	54	40.9	47.5178	0.00001
	Good	49	79.0	18	25.7	67	50.8		
	Satisfactory	7	11.3	4	5.7	11	8.3		
Information about the first menstrual period	Conversation with parents	33	53.2	54	77.1	87	65.9		
	Biology lessons	18	29.0	29	41.4	47	35.6		
	Female friends	14	22.6	14	70	28	13.6		
	Books	10	16.1	10	14.3	20	15.2		
	The Internet	10	16.1	9	12.9	19	14.4		
	Older sisters	2	3.2	8	11.4	10	7.6		
	Other sources	6	9.7	7	10.0	13	9.8		
Eating habits	Regular	60	96.8	59	84.3	119	90.2	5.7755	0.016257
	Irregular	2	3.2	11	15.7	13	9.8		
Type of diet	Carbohydrates	20	32.3	24	34.3	44	33.3	0.8355	0.840956
	Vegetables and fruits	23	37.1	21	30.0	44	33.3		
	Meat (including fish)	12	19.4	15	21.4	27	20.5		
	Dairy products	7	11.3	10	14.3	17	11.4		
Chronic diseases	Yes	2	3.2			2	1.5		
BMI	Normal	55	88.7	58	82.9	113	85.6	1.0749	0.584226
	Underweight	3	4.8	4	5.7	7	5.3		
	Overweight	4	6.45	8	11.4	12	9.1		
	Average	21.33		21.77		21.52			

Social and economic factors influencing the age of menarche of female students at the Faculty of Medicine and Health Sciences
at the Jan Kochanowski University in Kielce compared to developmental norms

215

Table 4. The age of first menstruation of girls from various regions of Poland (as per various authors)

Region	Kielce UJK	Kielce Zięba *et al.*, 2012	Bydgoszcz Nowicki, 1996	Pomorze Zaworski, 2008	Kraków Kowal, Cichocka, 2011	Rzeszów Radochońska *et al.* 2006, Nowak, 2005*	Zielona Góra Asienkiewicz, Wandycz 2017	Końskie Umławska, Krzyżanowska 2008
Urban	12 y 10 m	12 y 3 m	12 y 8 m	12 y 11 m	12 y 5 m	12 y 7 m	12 y 7 m	12 y 5 m
Rural	13 y 1 m	12 y 2 m	12 y 4 m	13 y 4 m		12 y 6 m 12 y 11 m	12 y 9 m	12 y 5 m

(10 years 5 months). In her case, the BMI was 22.32 kg/m², which means that the body build was correct. According to Kaplowitz *et al.* [16] and Umławska and Kolasa [6], early puberty is not always related to obesity. According to the secular trend, girls are undergoing puberty earlier, but they also take on a slender figure. In the opinion of these authors, contrary to the general opinion, there is no simple cause-effect relationship between early puberty and obesity. In the mind of Wasiluk and Szczuk [17], excessive weight is more frequently observed in urban youths, and according to the data of some authors, urban girls achieve puberty earlier than their rural peers.

In girls who enter puberty at a late stage, the BMI is relatively low (e.g. 19 kg/m²) [7]. Among the surveyed JKU female students there were 30 students in this group (14 from rural areas and 16 from urban areas). In the majority of these students, the BMI values ranged from 20.0 to 24.6 kg/m², and the value was lower than 19 kg/m² in only three cases. This is compliant with the results of the studies carried out by Krawczyńska and Łukawska [18], who indicated that the majority of youths had an average body mass.

Olszewska *et al.* [4], when analysing socio-economic factors such as place of residence, the number of siblings, or parents' education, stated that none of them significantly affected the pace of puberty. Similarly, our results did not display such dependencies.

When discussing the issue of girls' puberty, one should consider all of the genetic and socio-economic conditions, including eating habits, parents' education, self-esteem, and motivation of a healthy lifestyle among girls, as indicated by multiple studies (e.g. Nowak-Starz and Zięba [19], Zając *et al.* [20], and Szczekala *et al.* [21]). It should also be noted that the current standard of living in rural areas is not very different from the urban standard, and in some cases is even better. This is due to education, increased pro-health awareness, and improved living conditions. Half of the students (50.8%) stated that their conditions were good, 40.9% very good, and 8.3% satisfactory. The majority of the surveyed students were eating regularly and were not on any diets. Their diet was dominated by carbohydrates, fruit, and vegetables, while meat was less represented. All of the surveyed students knew about puberty before their first menstrual pe-

riod. In terms of sources of such knowledge, 65.9% indicated conversations with their parents. This is undoubtedly related to the level of parents' education, their increased awareness, and trust among youths towards their relatives. The other sources indicated by students included biology classes, older female friends, books, and the Internet. It seems that the role of the Internet in obtaining information about the structure and functioning of bodies among youths is significant (14.4% of girls listed this source in our survey) [22].

Conclusions

Despite the significant span of menarche age (10 years 5 months – 16 years 1 month), the majority of female students reached puberty at the age of 12. Some influence of social and economic factors on the age of menarche was observed; the girls from urban areas become mature, on average, 5 months earlier than their peers from rural areas. The mean age of puberty among female students at JKU in Kielce is not very different from the average in other regions. The female students from the surveyed social environments possessed knowledge about puberty before their menarche age. The eating habits, BMI values, and the standard of living of girls from rural and urban areas were not significantly different.

Conflict of interest

The authors declare no conflict of interest.

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