Age at menarche and its associated factors

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Abstract

Objective: The objective of this study to determine the age at menarche in girls aged 11-14 and the factors which affect it.
Method: This is a descriptive-analytic cross-sectional research. The study population 651 students were selected by cluster random sampling basis from elementary and grade one of high schools which conducted in 2014. The data were collected by a questionnaire, a tape measure, and a digital scale. The data were analyzed by descriptive and analytic tests.
Result: The mean age of menarche was 12.93±0.51. The present weight (RR= 1.037, 95% CI 1/025-1/049), breastfeeding (RR= 0.050, 95% CI 0/012-0/209), menarche age of mother (RR= 0.802, 95% CI 0/729-0/883) had a statistically significant effect as factors related on the menarche (P<0.05). The results showed statistically significantly (P<0.05) in girls using the cell phones during the week (RR= 1.028, 95% CI 1.002-1.055) and the daily use of computers (RR=1.242, 95% CI 0.977-1.578)
Conclusion: The indicator of health care planning awareness of the age of menstruation is one of the requirements for good health.
Key words: Menarche, Students, Puberty, Environmental Factors.

Introduction

As a complex temporal process in biological events, puberty leads to secondary sexual characteristics, maturity and obtaining reproductive capacity (1).

Menarche is the climax of puberty in females. It is a phase in development of maturity which is accompanied by morphological, behavioral and mental changes (2). It is also regarded as an important indicator of progress in the process of puberty in girls (3). Menstruation starts at the ages of 12-13 years(4). Undoubtedly, genetics is the main determinant factor in the onset of puberty. There is a positive relationship between the menarche age of mothers and that of their daughters and the role of genetic and familial factors is reported to be influential in this respect(5). However, it seems that a number of factors are related to the age of onset and progression of puberty; such as nutritional status, general health condition, geographic location, exposure to light and mental state (1, 5-6), the socioeconomic status, chronic illnesses, environmental stimuli, physical activities, altitude of one's living place (6-9), seasons, weight and height during puberty (10-11), height and weight at birth, obesity, high body mass index (1, 12), breastfeeding and its duration (13). It was shown that electromagnetic waves of the cell phones can adversely affect the hormonal system and the reproduction rate in both sexes, lowering ovulation as well (14).

Reportedly, there has been a reduction in the age of menarche in European countries from 16-17 in the nineteenth century to the age of 13 in the twentieth century (3, 15).

In addition, studies are indicative of a downward trend in the age of menarche in Asian countries(10). In advanced countries, such as the United States, this downward trend depends on the race, ethnicity and socioeconomic status of girls (3). One study showed that the mean age of menarche is 11.4 year in Mexico, indicating a significant difference in the age of menarche over decades. It means that the girls born in the 1990s or later had a lower menarche age than those born between the 1940s and 1980s (3). The mean ages of menarche in Iran were (6).

It seems that in countries with longer life expectancy and better nutritional levels, the age of menarche has decreased(3). In addition to the nutritional factors, it is reported that a high socioeconomic status and the use of the Internet or TV and ethnicity have a reverse relationship with puberty (4, 16).

The age of menarche is not only clinically important, but it also plays a significant role with respect to general hygiene and the community because it reflects certain aspects of health in the community(3). The early onset of puberty is associated with negative health consequences and is under the influence of internal and external factors. This is of high significance in terms of general health condition (17). These consequences include psychological problems, metabolic syndromes (18), breast cancer(19), ovarian cancer (20), poor ovarian function and fertility consequences, endometrial cancer, cardiovascular diseases, high blood lipid levels, obesity (21-22), diabetes type 2 and osteoporosis(10). Early menarche not only

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Table 1: Comparison of individual factors on the occurrence of menarche

Characteristic		N	MEAN	SD	P-Value
Menarche age of mother	Non-Occurrence of menarche	282	13.06	1.35	0.0001*
	Occurrence of menarche	313	12.57	1.25	
Menarche age of sisters	Non-Occurrence of menarche	81	13.01	1.26	0.018*
	Occurrence of menarche	88	12.53	1.13	
Number of family	Non-Occurrence of menarche	305	3.96	0.76	0.362
	Occurrence of menarche	311	4.019	0.82	
Rank of birth	Non-Occurrence of menarche	306	1.58	0.74	0.158
	Occurrence of menarche	307	1.68	0.86	
Present weight	Non-Occurrence of menarche	322	43.39	10.21	0.0001 *
	Occurrence of menarche	329	52.94	10.31	
Present height	Non-Occurrence of menarche	324	1.47	0.09	0.0001 *
	Occurrence of menarche	327	1.56	0.09	
Weight at birth	Non-Occurrence of menarche	304	3.38	2.75	0.141
	Occurrence of menarche	306	3.14	0.61	
Height at birth	Non-Occurrence of menarche	190	0.48	0.06	0.926
	Occurrence of menarche	191	0.48	0.06	
Duration of breastfeeding	Non-Occurrence of menarche	300	21.88	13.82	0.809
	Occurrence of menarche	295	21.66	7.6	
BMI	Non-Occurrence of menarche	323	20.76	18.05	0.396
	Occurrence of menarche	328	21.65	4.84	

has a negative impact on health but it also inflicts a devastating effect on society and social performance as one study has indicated that one of the four teenage girls who had experienced early menarche reported the negative effects of menstruation on social activities and also interference with their school activities(23). Puberty is a critical stage for parents and children and a period for development and changes to gain fertility power. Passing through this sensitive phase without guidance might be a challenge for girls, communities and families. Predicting the correct time of puberty in girls helps to provide them with the timely required information in this respect. It also makes them mentally prepared to cope with the changes that they experience in this period. There is no doubt that girls must be informed of when menstruation starts (24). As the earlier literature has contradictory results about the factors affecting the age of menarche (7, 13, 25), some of this factors such as the effect of birth weight and height, exclusive breastfeeding, duration of breastfeeding in infancy and effects of electromagnetic waves on menarche age have not been studied in combination with other factors. Authorities are required to make a program for teenagers to lead a happy healthy life in order to mentally prepare them to deal with changes.

Method:

The current study is a descriptive-analytic cross-sectional research. The study population was 700 students from elementary schools and grade one of high schools in Guilan province, Iran conducted in 2014. The inclusion criteria for the study population involved having no symptoms for chronic mental disorders and chronic physical diseases such as thyroid disease, diabetes, convulsion in addition to not being on drug.

The sampling method was conducted on at two-stage cluster random sampling basis. Following, the study population was chosen from among students aged 11-14, who were studying at the elementary and first grade of high schools both in public and private schools. The sample randomly included 30 clusters (classes) i.e. one class from each school. Sampling took two months in 2014. The data were collected by means of a self-designed questionnaire, a tape measure, and a digital scale) personal scale brand). The questionnaire was prepared on the basis of similar related studies (6, 26-28), and contained three parts: In the first part, the demographic information included such variables as the type of school, grade, the date of birth, and socioeconomic status of the students based on the education and occupation of their parents and the status of housing. The second section of the questionnaire asked about their menarche, the time when they started using the cell

phones and computer and how often (per week) and how long (minute per day) they used them. In addition, the questionnaire asked about the respondents' sport activities in a week, its type and its anthropometric characteristics.

The first two sections of the questionnaire were filled out by the students and then the schools asked their mothers to fill out the remaining parts which covered such items as the economic status of the family, the age of their own menarche as well as that of other daughters (if any), and it also included questions about the subjects 'weight and height at birth and duration of their breastfeeding. The researcher attended the data collection point and employed the face to face method for data collection. The questionnaire was checked for validity by means of content validity and then it was reviewed by 11 academic members of the School of Nursing and Midwifery, Guilan. When the comments and suggestions were received, the required modifications were applied and then the final version was prepared. This study has permission (No. 902125) from the Research Department and Ethics Committee of Guilan University of Medical Science. The researcher referred to the Education Organization of Rasht and provided the requisite information to obtain their consent for the administration of the sampling in schools.

For data collection, the questionnaires with the letters of consent were given to the students who were entitled to take part in the study, but before the distribution of the questionnaires, the subjects were informed of the issue of the confidentiality of their responses, and voluntary participation in the research, and they were given directions for filling out the questionnaires. About 700 students took home the questionnaires and the letters of consent and if their parents consented, they would fill out all the three parts and return them the following day. There were only 651 questionnaires returned.

The students, having the least clothes on and no shoes were weighed on a scale whose accuracy was checked every day and was 0.1 kg accurate. The information was recorded on the questionnaires. The height of the subjects was measured with a standard measuring tape while they were standing upright on a flat surface, legs side by side

Table 2: Multiple regression coefficients related to individual factors associated with age at menarche.

Characteristic		Coefficient	Standard error	P- Value	OR	95 % CI	
Initial model	Number of family	-0.141	0.266	0.595	0.868	1.462	0.516
		-0.071	0.119	0.551	0.932	1.175	0.732
Final model	Rank of birth	-0.029	0.118	0.806	0.972	1.224	0.771
	Live with family	-0.036	0.341	0.917	0.965	1.883	0.495
	Present weight	-0.049	0.02	0.016	1.05	1.093	1.009
	Present height	-0.211	1.532	0.891	0.81	1.312	0.04
	Menarche age of mother	-0.226	0.05	0.0001	0.798	0.88	0.723
	Weight at birth	-0.145	0.114	0.202	0.865	1.081	0.692
	Breast feeding	-2.853	0.747	0.0001	0.058	0.249	0.013
	Duration time of breast feeding	-0.004	0.006	0.453	0.996	1.007	0.984
	BMI	-0.032	0.047	0.411	0.962	1.055	0.877
	Present weight	0.036	0.006	0.0001*	1.037	1.049	1.025
	Menarche age of mothers	-0.22	0.049	0.0001*	0.802	0.883	0.729
	Breast feeding	-3.03	0.733	0.0001*	0.05	0.209	0.012

and arms on the either side of the body. The knees, hips, shoulders and the back of the head were aligned on one line. A set square was positioned on the top of the head to measure the height with 0.5 accuracy. The BMI was obtained by dividing weight (in kilograms) by height squared (in meters). The data were analyzed by means of the SPSS software (version 20) and other descriptive and inferential methods such as t-test, chi-square, cox regression and logistic regression.

Result:
The participants were 700 students, 49 of them left the research as their parents did not express their consent, making the study population 651 students. The results indicated that the mean age at menarche was.   year.
 With respect to qualitative factors related to the age at menarche a statistically significant relationship between the variables of exclusive breastfeeding (P=0.0001) and school grade with menarche (P=0.0001), while the chance of the occurrence of menarche decreased by exclusive breastfeeding only. Present height and weight and menarche age of mothers and siblings showed a statistically significant relationship with the occurrence of menarche. Results showed with an increase in height and weight, the chance of occurrence of menarche increased. On the other hand, late age of menarche in mothers

and siblings led to being late menarche in girls (Table 1).
In the modeling process, all variables related to the age of menarche that were reviewed in univariate analysis were entered into the initial model in order to determine the predictors. The final model was made to determine the predictive variables of menarche age on the basis of back ward stepwise likelihood ratio(LR) at the rates of entery= 0. 05, removal=0.1.
Variables such as the present weight (RR= 1.37, 95% CI 1/025-1/049), breastfeeding (RR= 0.050, 95% CI 0/012-0/209) and the age of mother menarche (RR= 0.802, 95% CI 0/729-0/883) had a statistically significant effect on the occurrence of menarche (Table 2).
Regarding the socioeconomic factors related to the age of menarche, the father's job was statistically significant. A comparison made between the median and the mean of menarche age in girls with fathers employed indicated a lower mean (11/99± 0/09) compared with (12/30±0/11) in fathers unemployment, worker and farmer (figur1). As the statistical result of cox regression shows, among the environmental factors predicting the time of menarche, the frequency of the weekly use of cell phones has (RR= 1.028, 95% CI 1.002-1.055) and the daily use of computers has (RR=1.242,95% CI 0.977-1.578) for girl to have a higher chance for menarche (figure2).

With regard to the amount of physical exercises result shows that doing sport activities even professionally has no statistically significant relationship with the menarche age. Only the type of the exercise can have a significant relationship with the time of occurrence of menarche (P<0.05). For example, menarche occurs more often in people involved in handball, aerobics, and basketball.
Season was another parameter in the occurrence and frequency of menarche as it was found that in spring, menarche has the highest and in winter it has the lowest frequency (Table 3).

Discussion:
In this study, the mean age at menarche was year. In Colombia, it was reported that the mean of menarche was 12.6 years with a 0.54 reduction in the age at menarche per decade (16). The mean age at menarche in the north of Iran was reported to be (27) year. Studies reported that the age of menarche is 11-13 years (3-4, 26) which is in line with the findings of the present research.
This study indicates that among the individual factors examined, the school grade of the students had a significant relationship with the age at menarche and the highest occurrence was in grade one of high school aged 12-13 years. This is in line with a some of studies(4, 28).
There was also a significant relationship

Table 2: Multiple regression coefficients related to individual factors associated with age at menarche.

Environmental factors						
		Occurrence of menarche		Non-Occurrence of menarche		p-value a
		Percent	N	Percent	N	
Duration of life in Rasht	Since birth	50.4	209	49.6	206	0.522
	From 5 years ago	53.8	43	46.2	37	
	5-10 years	45.1	23	54.9	28	
	More than 10 years	44.2	46	55.8	58	
Using the cell phones	YES	37.8	84	62.2	138	0.0001*
	No	55.5	238	44.5	191	
Using the computers	Yes	38.2	68	61.8	110	
	No	53.7	254	46.3	219	
Type of the exercise	Gymnastics	65.5	12	45.5	10	0.0001*
	Volleyball	38.8	47	61.2	74	
	Basketball	31.4	16	68.6	35	
	Walking	84.6	33	15.4	6	
	Sports-ups	71.4	20	28.6	8	
	badminton	34.8	8	65.2	15	
	Fitness	49.2	93	50.8	96	0.0001*
	swim	58.6	17	41.4	12	
	Martial arts	46.4	26	53.6	30	
	Dance	45	9	55	11	
	Tennis	70.8	17	29.2	7	
	Aerobics	23.1	3	76.9	10	
	Handball	22.2	2	77.8	7	
Seasons	Spring	0	0	35.6	110	
	Summer	0	0	29.4	91	
	Autumn	0	0	23	71	
	winter	0	0	12	37	

between the age of menarche in mothers as well as siblings and that of the subjects studied in the research. The mean for the age of menarche in daughters was six months less than that in their mothers. This was in line with the study reported by Terry , indicating the age of menarche in daughters was five months less than that in their mothers (28). There is a strong relationship between the age of menarche in mothers and their daughters.

Furthermore, it has been stated that genetics and familial factors can affect the age of menarche (5, 10). The findings indicated no significant relationship between the family size and the birth order. The lower the number of children causes the lower the age of menarche (7). It seems that this difference is due to a difference population.

In this study found a significant relationship between the weight of the girls

and the time of the occurrence of menarche. This is in line with the results achieved by Delvarianzadeh (26). Some studies reported that obesity and weight gain are risk factors for early puberty in girls (1, 12, 21) For the occurrence of menarche, it is more important to gain a certain level of fat and physical mixtures than gain a certain level of weight (1, 17).

The present study indicated a significant relationship between height of girls and
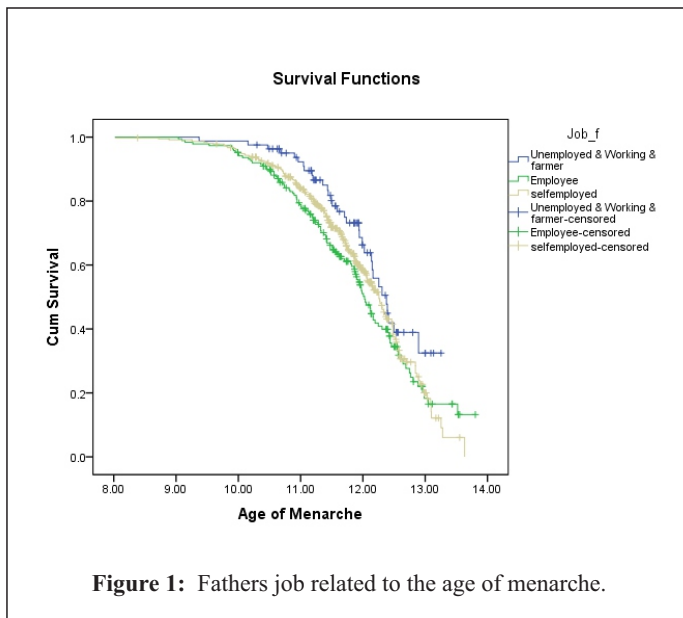
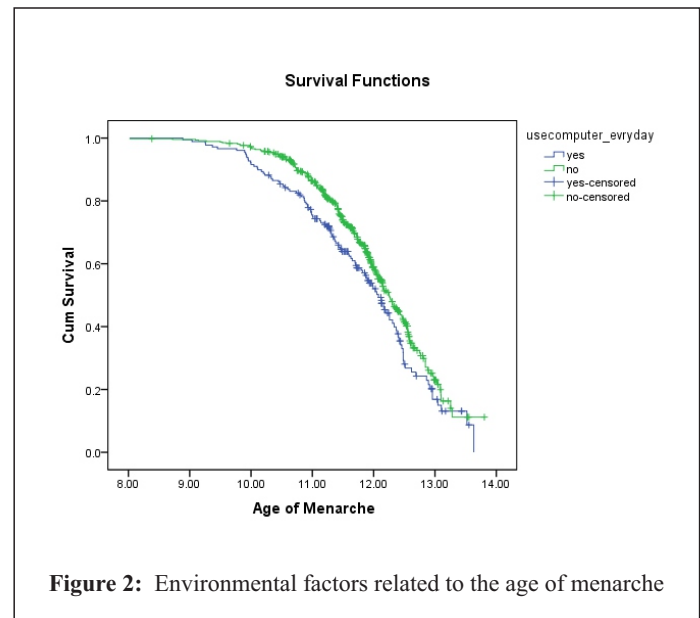**Figure 1:** Fathers job related to the age of menarche.

Figure 2: Environmental factors related to the age of menarche

their menarche occurrence. Similar results were reported in other studies (12, 16). The present research showed that breastfeeding can affect the time of occurrence of menarche and exclusive breastfeeding can reduce the chance of the occurrence of menarche. However, no significant relationship was found between the duration time of breastfeeding and the age of occurrence of menarche. Reports show that there is no statistically significant relationship between nutrition on breastfeeding and the age of menarche (4, 13). Nonetheless, the duration of breastfeeding can affect the developmental programs of the child in the future and the time of puberty (13). This difference in the results is, perhaps, due to the proximity between the means of duration of breastfeeding in both groups that experienced or did not experience menarche in the current study, because nutrition on breastfeeding was 21 months in both of them.

With respect to the socioeconomic factors examined in this study, there was a statistically significant relationship between the variable of the father's job in the subjects under study and the age of menarche in such a way that the percentage of the occurrence of menarche in girls with fathers employment was higher than those girls whose fathers were workers, unemployed and farmers (that are classified as low income jobs). Similar to the present findings, the results of recent studies conducted in Nigeria and Bangladesh where girls from families with a

higher social, economic and occupational status and with highly educated parents had a lower age of menarche in comparison with those families with a low social and economic status (29-30). one study reported that the income of the family had a reverse relationship with the age of menarche (16). This difference may be attributed to the mean of income in different countries.

Regarding the environmental factors , results indicate that the use and the frequency of using cell phones per week, and per day and the duration of using them during a day has a direct relationship with the age of occurrence of menarche. As one study shows that for the reduction of the side effects of electromagnetic waves, the body cells use protective measures like an increase in the concentration of epinephrine and melatonin(31). In addition, melatonin directly controls the ovarian activity and stimulates the synthesis of progesterone. The concentration and duration of melatonin production is high in women suffering from cessation of monthly hypothalamic menstruation because melatonin prevents the concentration of the hormones which are required for ovulation (32). In a study, it was also stated that electromagnetic waves caused by cell phones can affect the rate of productivity in both sexes and reduce the amount of ovulation (14). Furthermore, a study conducted in Karachi shows a significant relationship between using a variety of media (TV and the Internet) and the age of

menarche(4).These are in line with the findings of the current study.

The results show that only the type of sports activities has a significant relationship with the age of menarche. This is, however, in contrast to the study that was conducted on girls participating in Sports Olympiad. Also, it was shown no statistical difference between the occurrence of menarche and different sport activities (25). It seems that the difference is due to the fact that in the current study, sport was considered generally and many of the subjects studied were not professional athletes.

Seasons as an environmental factor on the time of the occurrence of the menarche, revealing that the highest frequency of menarche occurs in spring (35. 6%). In other studies, it was reported that season can affect the onset of puberty in females and that the highest frequency of menarche was in summer (11, 26).These differences are justifiable considering the different amount of sunlight in different geographical locations throughout the year. In fact, the indicator of health care planning awareness of the age of menstruation is one of the requirements for good health in puberty and fertility. In addition, it is necessary for the youth to have the basic knowledge on time in such a local context with religious and cultural beliefs. Therefore, the findings of this research project can help the managers and planners to run in-service training classes for the health workers in schools to provide the students with the timely proper

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