

# Menarche age in Iran: A meta-analysis

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## ABSTRACT

**Background:** Research shows that the age at menarche, as an essential element in the reproductive health of women, had been decreasing in the 19<sup>th</sup> and 20<sup>th</sup> centuries, and shows a huge variation across different countries. There are numerous studies performed in Iran reporting a range of age at menarche. Thus, this meta-analysis aimed to determine the overall mean age at menarche of the girls in Iran.

**Materials and Methods:** All relevant studies were reviewed using sensitive and standard keywords in the databases from 1950 to 2013. Two raters verified a total of 1088 articles based on the inclusion criteria of this study. Forty-seven studies were selected for this meta-analysis. Cochran test was used for samples' homogeneity (Tau-square). The mean age at menarche of the girls in Iran with 95% confidence interval (CI) from the random effects was reported.

**Results:** The homogeneity assumption for the 47 reviewed studies was attained (Tau-square = 0.00). The mean (95% CI) menarche age of Iranian girls from the random effects was 12.81 (95% CI: 12.56–13.06) years.

**Conclusions:** The results of this study showed that mean age at menarche was less than that of some European developed countries such as Switzerland, Sweden, and Denmark, more than that reported in some countries such as Greece and Italy, and similar to the values obtained in the United States of America and Colombia. Lower age at menarche in Iran may be largely attributed to the changes in lifestyle and diet of the children.

**Key words:** Menarche, meta-analysis, Iran

## INTRODUCTION

Menarche is one of the significant events in the lives of women. The cultural, social, and epidemiological importance of this biological incident has led many epidemiological studies to investigate this incident and the factors affecting it.<sup>[1]</sup>

A significant decrease in the age at menarche has been demonstrated in the 19<sup>th</sup> and 20<sup>th</sup> centuries.<sup>[2-4]</sup> In the 19<sup>th</sup> century, the factors that seemed to be effective on the age at menarche were climate, race, social status, urban and rural residence, physical activity, education,

sexual arousal, genetics, and health status.<sup>[5,6]</sup> Meanwhile, in the studies conducted in the 20<sup>th</sup> century, some other factors such as the season and month of birth, birth order, family income, occupation and education of the parents, and family size were considered for the occurrence of menarche.<sup>[5,7]</sup>

Other factors that lead to decrease in the age at menarche according to reports are childhood obesity,<sup>[8,9]</sup> lack of a father in the family during early childhood, disrupted and stressful family relationships, low birth weight, being a single child, non-white race, history of preeclampsia in the mother, smoking exposure, lack of breast feeding, and lack of adequate physical activity in childhood.<sup>[10]</sup>

However, other factors such as increased number of family members, warm and friendly relationship of the girl with her father, safe and stress-free atmosphere of the family, having older siblings, low education of the families and the children (because of the imposed physical work from an early age to earn money), and heavy exercises to reduce body fat are the other factors that may delay the age at menarche.<sup>[10]</sup>

Early or late onset of menarche is associated with substantial morbidity in women's lives over the coming years. For example, the effects of early menarche (before age 12) include short stature;<sup>[4,11]</sup> obesity;<sup>[12]</sup> diabetes type II; cardiovascular diseases; hypertension; breast, endometrial,

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and ovarian cancers; and increase of mental and behavioral disorders (such as depression, eating disorders, alcohol use, smoking, unsafe sex, and early pregnancy in adolescence).<sup>[5,13]</sup> Meanwhile, a late menarche (after 16 years) may lead to osteoporosis, depression, and social anxiety disorder in the coming years of life.<sup>[5]</sup>

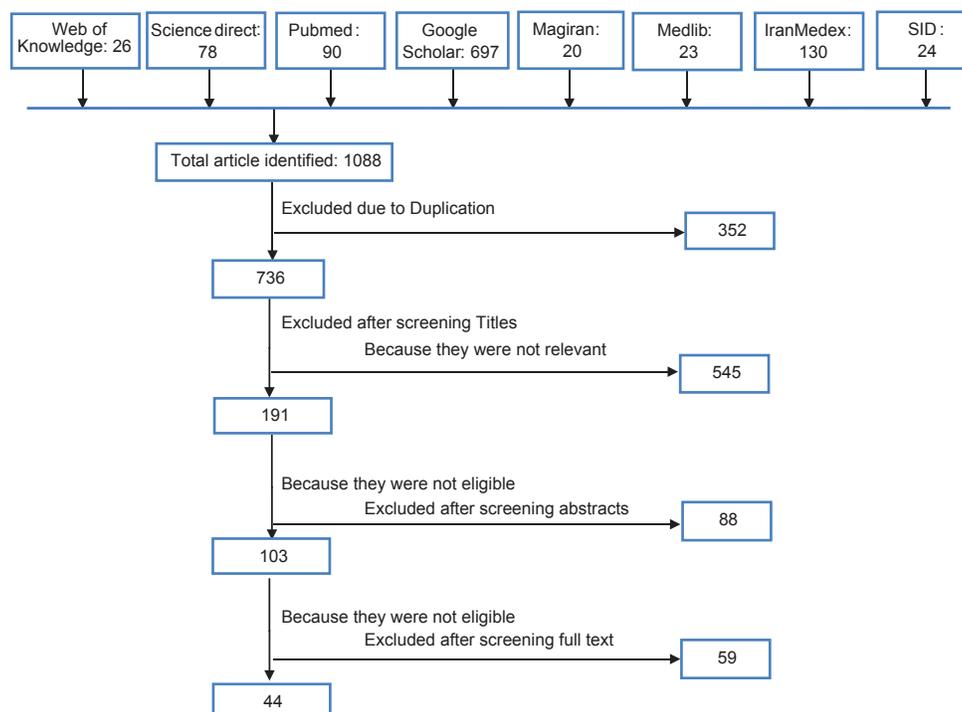
There are three ways to study the menarche age: A review of the current situation (status quo), recall or retrospective method, and prospective method. In the review of the current situation, information about the age at menarche is collected from the girls or their parents. In this method, the sample size should be large and representative of the state of population. In the recall or retrospective method, the girls or their mothers are asked about their age at menarche. This method is less reliable because it is dependent to the memory of the people. Prospective method has more accuracy although it is not easy to be conducted. In this kind of studies, the girls are asked to record their exact age at menarche every 3 months. Most of the studies have used the first method to study age at menarche.<sup>[2]</sup> Reported age at menarche varies in different parts of the world. Research conducted in different countries shows that the lowest and the highest mean ages at menarche are for Thailand (11.2) and England (13.5), respectively. This mean is 12.86 years in the United States.<sup>[14]</sup> According to the results of the studies, the mean ages at menarche are different in different cities. In Iran, the lowest and highest mean ages at menarche are reported in Sari ( $11.4 \pm 1.1$ )<sup>[15]</sup> and Birjand ( $13.8 \pm 1.6$ ), respectively.<sup>[16]</sup> There have been numerous studies

performed in Iran reporting a range of ages at menarche. Thus, this meta-analysis was conducted to determine the overall mean age at menarche of the girls in Iran.

## MATERIALS AND METHODS

This is a systematic review and meta-analysis conducted to estimate the mean age at menarche in Iranian adolescents. Review of documents was done in two ways of internet search and hand searching. To find the studies conducted on the Iranian population, the papers published in national and international journals, seminars, and dissertations available in the databases were searched for. For selecting studies, the databases (Web of Knowledge: 1 January 1990-3 June 2013), (ScienceDirect: 1 January 1950-3 June 2013), (PubMed: 1 January 1950-3 June 2013), (Google Scholar: 1 January 1950-3 June 2013), (Iran medex: 3 June 2013 and earlier), (Magiran: 3 June 2013 and earlier), (SID: 3 June 2013 and earlier), and (MEDLIB: 3 June 2013 and earlier) were searched for. Also, unpublished data (gray literature) and references of selected articles (reference of reference) were collected.

For search, the keywords of “menarche OR menarche age OR age at menarche OR menarche age OR puberty age OR age of puberty AND Iran” were used. Search strategy and the number of articles in each stage are separately given in Figure 1.



**Figure 1:** Flow diagram of the studies identified, excluded, and included in the meta-analysis

## Data selection and criteria

Data included for this study were the mean and standard deviation of age at menarche in previous studies. First, the list of titles and abstracts of all articles was searched in the database. This was done independently by two researchers. Study inclusion criteria were as follows. All cross sectional studies that examined age at menarche as mean  $\pm$  SD age at menarche or have used prospective methods were selected. Population studies on healthy adolescent girls were selected and studies on women with certain diseases such as diabetes, blind girls, and Olympic athletes were excluded. Experimental studies with a sample size of less than 100, case reports, brief reports, letters to the editor, and retrospective studies (due to recall error) were not selected in the study.

At the primary stage of investigation, articles with similarity in titles (352 articles) and irrelevancy in topics (545 articles) were excluded. Then abstracts were reviewed to find relevant studies. In this step, 88 articles were rejected due to inappropriate method of investigation and not reporting the menarche age in the form of mean and standard deviation. At the next step, the full-text articles were evaluated according to the selection criteria. The quality of the extracted articles from the databases was evaluated by two raters using checklist of the cross-sectional studies (STROBE) and the disagreements between the two raters were referred to a third person.

## RESULTS

All relevant studies were reviewed using sensitive and standard keywords in the databases from 1950 to 2013. Two raters verified a total of 1088 articles based on the inclusion criteria for this study [Figure 1]. Forty-four studies were selected for this meta-analysis [Table 1]. Cochran test for samples' homogeneity (Tau-square) was used. The mean age at menarche of girls in Iran was reported with 95% confidence interval (CI) from the random effects.

The homogeneity assumption for the 44 reviewed studies was attained (Tau-square = 0.00). The mean (95% CI) menarche age of Iranian girls from the random effects was 12.81 (95% CI: 12.56-13.06) years.

## DISCUSSION

The main objective of this study was to estimate the mean age at menarche in the Iranian society. Based on the results of the meta-analysis, the mean age of Iranian girls at menarche was estimated to be 12.81 years (95% CI: 12.56-13.06). As regards in the meta-analysis, the larger

sample size will be reviewed; estimation would be more accurate for researchers and users of results.<sup>[60]</sup>

It seems that during the 20<sup>th</sup> century, a significant improvement occurred in the socioeconomic conditions and public health of industrialized countries, which is the reason for the early onset of puberty in children. It is estimated that the age at menarche declined by 3 months during each decade of the 20<sup>th</sup> century, although in some industrialized countries, this process is reported to have stopped and an upward trend is emerging.<sup>[5,7]</sup> Various estimations of the age at menarche have been carried out on a limited population of each country in the world, and are usually related to the years before 2000.<sup>[1]</sup> Although these studies may not provide a precise estimate of the age at menarche in the total population of a country, they can partly reflect the age at menarche in a limited population of that country.

Studies report the mean ages at menarche as 13.28 years in Turkey,<sup>[61]</sup> 13 years in Russia,<sup>[62]</sup> 12.3 years in Thailand,<sup>[63]</sup> 12.5 years in Japan,<sup>[64]</sup> 13.2 years in Egypt,<sup>[65]</sup> 12.2 years in Italy,<sup>[66]</sup> 12 years in Greece,<sup>[67]</sup> 13.09 years in Sweden,<sup>[68]</sup> 13 years in Switzerland,<sup>[69]</sup> 12.31 years in Spain,<sup>[68]</sup> 13 years in Denmark,<sup>[70]</sup> 13.2 years in Finland,<sup>[71]</sup> 12.8 years in the United States,<sup>[72]</sup> 12.8 years in Colombia,<sup>[73]</sup> and 12.4 years in Mexico.<sup>[1]</sup> The mean age at menarche in Iran is less than that of some developed countries in Europe and more than that of some Asian and European countries. Although the difference in age at menarche rarely exceeds 1 year standard deviation, in the investigation of the age at menarche and its trend, even the increase or decrease in the number of the days is also important. Age at menarche among girls from different countries or even between different races differs to a large extent, while the reasons for these changes are not yet well known.<sup>[3]</sup> Age at menarche is influenced by several factors such as biological factors, social factors, nutritional status, geographic location, and lifestyle, and it cannot be attributed to specific factors.<sup>[5,6,8,9]</sup>

Many of the reviewed studies on age at menarche were retrospective (in later stages of women's life (e.g., during or after menopause and breast cancer); therefore, we excluded them because of the probable increase in recall bias. The studies in which the age at menarche of the girls was investigated at the same age were included in the present meta-analysis. In Iran, one of the largest studies conducted on the age at menarche and its trend was the study of Kazem Mohammad *et al.* In this study that included two national projects of health and disease, 8220 and 10,228 cases of married women aged 15-49 years participated, respectively. The population of the study was selected from all over the country including urban and rural areas by using cluster sampling method.<sup>[24]</sup> Although the

Table 1: Characteristics of the studies selected for the meta-analysis

Authors	Years	Place	Sample size	Sampling methods	Study type	Menarche age (mean±SD)	95% CI
Aghajani Delavar <i>et al.</i> <sup>[17]</sup>	2002	Mazandaran	1797	Randomly and cluster	Cross sectional	12.5±1.1	-
Ainy <i>et al.</i> <sup>[18]</sup>	2006	Tehran	406	Randomly and cluster	Cross sectional	13.2±1.4	-
Alavi <i>et al.</i> <sup>[19]</sup>	2005, 2006	Tehran	386	Randomly and cluster	Cross sectional	12.5±1.1	-
Asgharnia <i>et al.</i> <sup>[20]</sup>	2009	Rasht	600	Stratified randomized	Cross sectional	12.99±1.33	-
Ayatollahi <i>et al.</i> <sup>[21]</sup>	1997, 1998	Shiraz	1272	Randomly and cluster	Cross sectional	12.91±1.23	-
Baiali Meibodi <i>et al.</i> <sup>[22]</sup>	2009	Kerman	196	Randomly and cluster	Cross sectional	11.98±1.25	-
Basirat <i>et al.</i> <sup>[23]</sup>	2006	Babol	408	Randomly and cluster	Cross sectional	12.48±1	-
Bayat <i>et al.</i> <sup>[24]</sup>	2010	Arak	1223	Randomly and cluster	Cross sectional	13.21±1.33	-
Bazrafshan <i>et al.</i> <sup>[25]</sup>	2005	Gorgan	172	Randomly and cluster	Cross sectional	12.5±1.11	-
Berenjy <i>et al.</i> <sup>[26]</sup>	2006	Kermanshah	399	Randomly and cluster	Cross sectional	12.16±1.18	-
Charkazi <i>et al.</i> <sup>[27]</sup>	2009	AqQala	145	Census	Cross sectional	12.15±0.98	-
Dahri <i>et al.</i> <sup>[28]</sup>	2007	Mashhad	819	Randomly and cluster	Cross sectional	13±0.07	-
Danesh Shahraki <i>et al.</i> <sup>[29]</sup>	2009	Shahrekord	351	Randomly and cluster	Cross sectional	12.7±1.15	-
Broomand <i>et al.</i> <sup>[30]</sup>	2003	Urmia	124	Simple randomly	Cross sectional	13.12±0.82	-
Delvarian-Zadeh <i>et al.</i> <sup>[31]</sup>	2008	Shahroud	184	Simple randomly	Cross sectional	12.9±0.8	11-14
Farahmand <i>et al.</i> <sup>[32]</sup>	2009	Tehran	370	Convenience	Cross sectional	12.6±1.1	-
Fararoei <i>et al.</i> <sup>[33]</sup>	1998	Yasouj	161	Convenience	Cross sectional	13.4±1.3	-
Farhud <i>et al.</i> <sup>[34]</sup>	1990	Iran	3570	Randomly and cluster	Cross sectional	13.59±1.3	-
Gharravi <i>et al.</i> <sup>[35]</sup>	2005, 2006	Gorgan	200	Convenience	Cross sectional	12.2±1.45	-
Ghergherehchi <i>et al.</i> <sup>[36]</sup>	2008	Tabriz	462	Random cluster	Cross sectional	12.58±1.30	10.1-15.8
Hashemipour <i>et al.</i> <sup>[37]</sup>	2006	Isfahan	3204	Multistage random cluster probability	Cross sectional	12.56±1.15	-
Javadifar <i>et al.</i> <sup>[38]</sup>	2004	Ahvaz	236	Random	Cross sectional	13.1±1.81	-
Karamizadeh <i>et al.</i> <sup>[39]</sup>	1995	Shiraz	3000	Random	Cross sectional	12.55±0.78	-
Keshavarzi <i>et al.</i> <sup>[40]</sup>	1998	Kermanshah	810	Random cluster	Cross sectional	13.40±0.76	-
Khakbazan <i>et al.</i> <sup>[41]</sup>	2001	Tehran	580	Random cluster	Cross sectional	12.1±1.2	-
Maddah <i>et al.</i> <sup>[42]</sup>	2005, 2006	Guilan	822	Random cluster	Cross sectional	12.9±1.0	-
			789	Random cluster	Cross sectional	12.8±1.0	-
			232	Random cluster	Cross sectional	12.6±1.1	-
			247	Random cluster	Cross sectional	12.6±1.2	-
Moghimi <i>et al.</i> <sup>[43]</sup>	2001	Shahre Rey	658	Random cluster	Cross sectional	13.42±1.4	-
Mohammadzadeh <i>et al.</i> <sup>[44]</sup>	2002	Isfahan	350	Random	Interventional	12.5±1	-
Mollaei <i>et al.</i> <sup>[45]</sup>	2006	Gorgan	547	Random	Cross sectional	13.19±1.06	-
Modaress Nejad <i>et al.</i> <sup>[46]</sup>	2002	Kerman	55	Random	Interventional	13.1±0.9	-
Modaress Nejad <i>et al.</i> <sup>[46]</sup>	2002	Kerman	55	Random	Interventional	13.2±0.9	-
Nemati <i>et al.</i> <sup>[47]</sup>	1999	Ardabil	611	Random	Cross sectional	12.07±1.32	-
Pejhan <i>et al.</i> <sup>[48]</sup>	2010	Sabzevar	105	Multi-stage probability	Cross sectional	12.5±1.4	-
Rahnama <i>et al.</i> <sup>[49]</sup>	2004	Zabol	232	Random cluster	Cross sectional	13.4±1.1	-
Ramezani Tehrani <i>et al.</i> <sup>[50]</sup>	2012	Tehran	134	-	Prospective study	12.7±1.3	-
Sayemiri <i>et al.</i> <sup>[51]</sup>	2005	Ilam	210	Stratified random	Cross sectional	13.62	13.42-13.83
Shahbazian <i>et al.</i> <sup>[52]</sup>	2007	Behbahan	244	Random cluster	Cross sectional	12.3±1.22	-
Shahraki <i>et al.</i> <sup>[53]</sup>	2001	Zahedan	588	Multistage stratified cluster	Cross sectional	12.6±0.05	-
Soltani <i>et al.</i> <sup>[54]</sup>	2007	Hamedan	1000	Random cluster	Cross sectional	13.7±3.1	-
Tehrani <i>et al.</i> <sup>[55]</sup>	2010	Tehran	770	-	Cohort study	13.17±1.36	0.22-0.63
Yusofi. <i>et al.</i> <sup>[56]</sup>	2000	Mashhad	260	Census	Cross sectional	12.77±0.7	12.68-12.85

Contd...

Table 1: Contd...

Authors	Years	Place	Sample size	Sampling methods	Study type	Menarche age (mean±SD)	95% CI
Zamani <i>et al.</i> <sup>[57]</sup>	1999	Hamadan	242	Random	Interventional	13.3±1.11	-
Zareian <i>et al.</i> <sup>[58]</sup>	1994	Shiraz	1979	Random cluster	Cross sectional	13.05±1.25	-
Zeinal Zadeh <i>et al.</i> <sup>[59]</sup>	2001, 2002	Babol	800	Random cluster	Cross sectional	13.3±3.3	-

present study included a large number of studies conducted on Iranian populations, they were excluded from our study due to the high probability of recall bias in the exact age at menarche in years and months. One of the best ways to study the age at menarche is by conducting cohort studies with large sample sizes in different regions of the country. Unfortunately, none of the reviewed studies had this feature.

The target population for the present study was healthy girls with no particular factor to influence the age at menarche. Therefore, the studies conducted on the blind girls<sup>[74]</sup> and the girls participating in Olympics games<sup>[54]</sup> were excluded. The age at menarche of the blind girls is less than that of healthy girls, and the results obtained in the studies conducted on them may confound the results. Also, doing vigorous physical activities at a professional level with changes in hypothalamic and pituitary hormones may influence the menstrual status and onset of age at menarche in females.<sup>[14,75]</sup>

As a rule, occurrence of later age at menarche is associated with the areas situated in lower or higher latitudes, while early menarche is more common in temperate regions and regions closer to the coast.<sup>[76]</sup>

However, since the climate is associated with economic, nutritional, and lifestyle development, it is difficult to say that the age at menarche in geographic areas is increased or decreased regardless of other factors.<sup>[77]</sup> In Iran, there are different climatic zones that may affect the age at menarche. One of the limitations of the present study was not estimating the age at menarche separately in different climatic zones. Lack of studies on the age at menarche in different climatic zones of the country was the main reason for this limitation. Living in rural and urban areas is one of the factors influencing the age at menarche.<sup>[5]</sup> In our study, more than 90% of the studies on the age at menarche had been carried out in urban population.

## CONCLUSION

The results of this study showed that mean age at menarche was less than that of some European developed countries such as Switzerland, Sweden, and Denmark, more than that of some countries such as Greece and Italy, and similar to the values obtained in the United States of America and

Colombia. Lower age at menarche in Iran can be largely attributed to the changes in lifestyle and diet of the children. It seems essential to perform a systematic review and other meta-analyses to determine the related factors that influence age at menarche, particularly the nutritional factors.

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