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Review article

Systematic review and meta-analysis of mean age at menarche in Iranian girls

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Abstract

Background: Many observational studies were published concerning the mean age at menarche and suggested those which may be a decreasing age at menarche in Iranian girls. The aim of this systematic review and meta-analysis was to estimate the overall mean age at menarche in Iranian girls.

Methods: We searched using online databases through December 2014 using and examined the reference lists of pertinent paper. Finally, 28 cross-sectional studies were selected for this meta-analysis. Cochran and tau-two tests were used for the detection of homogeneity of samples. The common average was calculated by random effect using RevMan 5 and Stata software. The cumulative meta-analysis and meta-regression were used to review the factors affecting heterogeneity.

Results: The mean age at menarche was13.9 years before 2000 and after 2000 was 12.6 years. The overall mean (95% CI) age at menarche was calculated 12.872 (95% CI: 12.874, 12.870) years based on stochastic models.

Conclusion: These findings indicated that the mean age at menarche in Iranian girls was less than that of the region and developing countries therefore performing a systematic review and meta-analysis to evaluate related factors that influence age at menarche in Iranian girls could be beneficial.

Keywords: Age at menarche, Menstruation, Meta-analysis, Systematic review

Introduction

Puberty is a period accompanied by a number of the particular symptoms of physical, sexual, and mental changes, and most of these physical changes are along the changes in the hypothalamus - pituitary-gonadal axis. One of the signs of puberty is menarche, which has been commonly regarded as the final stage of development in girls (1).

The age of which first menstrual bleeding, occurs is considered as the age of menarche and it is a significant event in a woman's reproductive life. Gonadal activation mechanisms of puberty in girls are not fully identified (2). But in a study on different populations, the impact of genetics, socioeconomic, geographical, nutritional and environmental factors on the age at menarche was well known (3-5). Menstruation at an early age can cause the risk of breast cancer and weight gain (6). The mean age at menarche in the world is between 8-12 years (7). Given the importance of age of menarche as the degree of maturity of females (2) studies on the age at menarche have reported a different range of 11.7 to 14.9 in the female population in the different parts of Iran (8-10).

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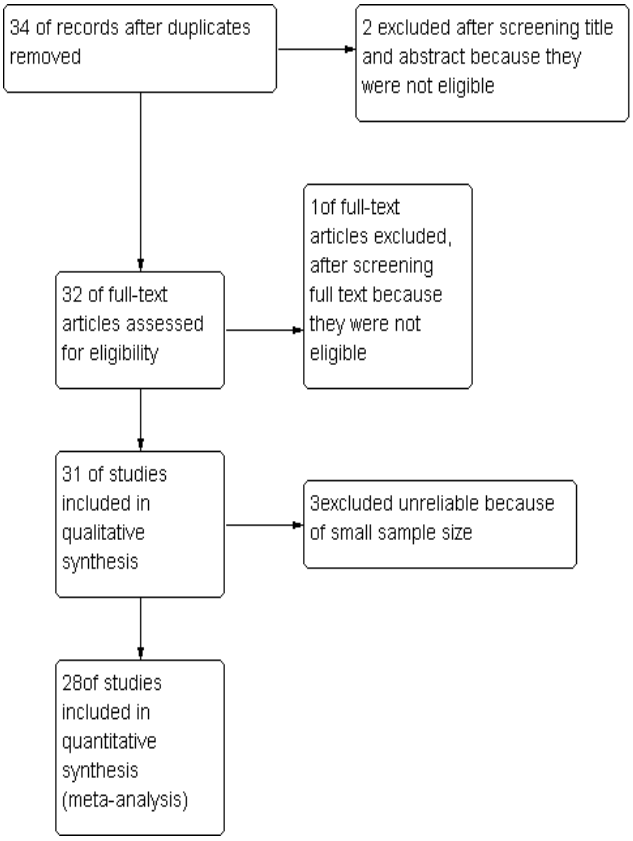

Fig. 1. Chart of literature review with meta-analysis

Therefore, this meta-analysis was conducted to estimate the overall mean age at menarche of the girls in Iran to be a final criterion to provide guidance to policy makers in the health field.

Materials and Methods

The present systematic review and meta-analysis study was done to estimate the mean age at menarche in Iranian girls. We searched online databases including Pub MED, ISI (International Statistical Institute), Google Schola, Science Citation Index Expanded, Iranian technical and scientific websites such as Magiran, Iranmedex, SID. All published cross sectional studies that determined mean age at menarche through December 2014 using keywords "menstruation" and "menarche" were selected. Studies were excluded if they did not report mean ± SD age at menarche or have used case-control and cohort methods (10-12).

Figure 1 shows chart of describing the study selection process. In total 34 articles were found by key words yields and 28 articles, contained relevant to our study (10, 13, 14).

In reviewing the quality of abstracts, eight questions about the STROBE checklist were used for the quality assessment of articles. The studies with utmost one inappropriate measure was considered as low risk, otherwise considered as high risk in terms of quality (15). The criteria to evaluate the quality of the articles include the following: clearly define the age of menarche, the age of menarche is clearly marked, eligibility criteria, accuracy of the estimates, shows the design study, shows the calculated sample size, description of location, description of time. Figure 2 shows the assessment of articles' quality using the STROBE criteria.

To investigate the factors affecting the heterogeneity, cumulative meta-regression and meta-analysis were used. Given that the weather is affecting puberty, the studies have been divided into three zones based on climate: the Caspian mild and humid areas, the

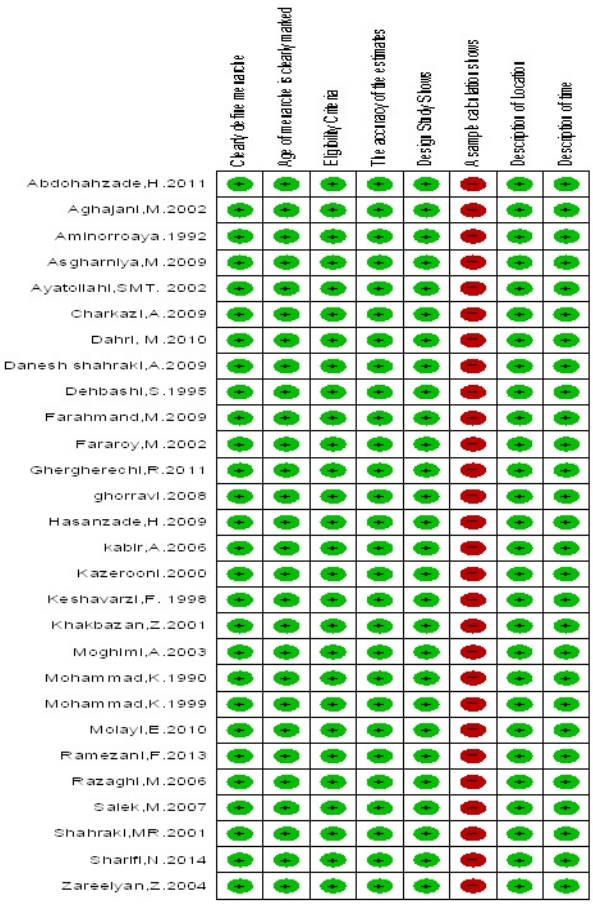

Fig. 2. The assessment of articles' quality using the STROBE criteria

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temperate and mountainous semi-arid, and the south coast hot and humid climates. In a meta-analysis, the climate impact has been studied along with the years of studies in meta-regression. The analysis of the results was performed using the Stata and Revman software.

Results

Among the 28 studies, two studies examined the whole country in terms of health and disease, and there was one provincial study in Mazandaran; other studies have been done in other cities. Five studies were done in Tehran, 3 in Gorgan, 2 in Isfahan and Shiraz, and from each city of Aq-Qala, Zahedan, Rasht, Mashhad, Yasouj, Rei, Sabzevar, Shahrekord, Kermanshah, and Ahwaz, one study was included in the analysis. Table 1 shows the general characteristics of each of the above examples. Studies were selected from 1990 to 2014 and were investigated in the overall analysis using the meta-regression of the effects of the geographical area with respect to their heterogeneity and given the significance of the year of study, the cumulative analysis was used (Fig. 3). Figure 3 shows that since 2000, the average age of menarche has declined; followed the performance of a two-group analysis. The mean age of menarche was 13.86 years before 2000, and after 2000 was 12.62 years (Fig. 4). The mean comparison showed a significant difference between the two groups, so that from 2000 onwards, the average age of menarche was significantly reduced.

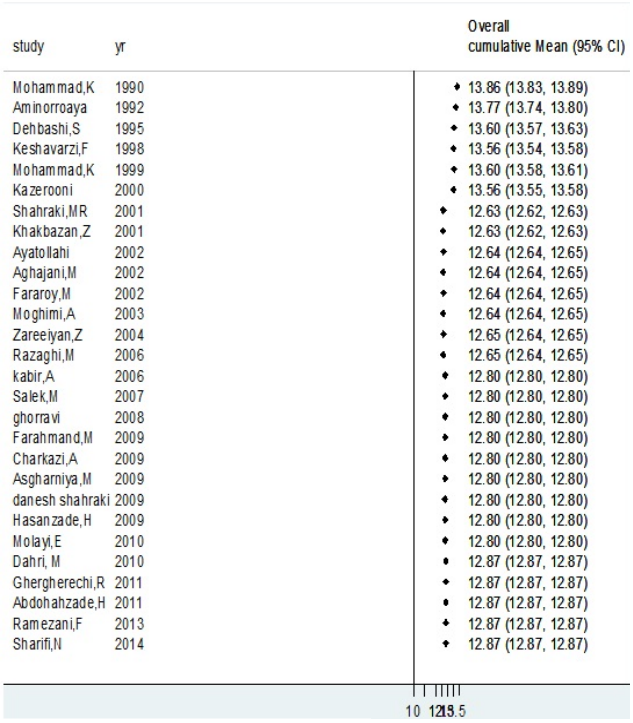

Fig. 3. Cumulative mean of menarche

Discussion

Findings from the present meta-analysis indicate that the mean age at menarche has declined over a period of 25 years from 13.30 to 12.78 years. The results were consistent with a study carried out in the United States in recent years. They have demonstrated a significant decrease in the age at menarche due to changes in lifestyle from 12.7 to 12.5 years over a period of 25 years (16). Because virtually the meta-analysis uses all the sample size of the studies, it has more reliable and accurate estimates than other estimates (17, 18) in studies conducted in various cities of the country. So, the results of this study can be more helpful in the planning and providing services to the society than other studies.

Considering this fact that the age of menarch influenced by several factors such as gene economic, social, health issues and body, diet, climate and geographic location (19), it seems that primarily the average age at menarche in Iranian women has to be compared to neighboring countries. The results of a study on 282 women in Pakistan, the average age of menarche has been estimated 13.60 years (20). Another study on 1017 Turkish women was shown the age of 15.70 years (21). In other studies, the mean age of menarche in Europe was 13.59 and in Africa 13.18 [23], USA 12.43 (22) and in India 13.71 (23) and in Nepal 12.69 (24) and in Italy 12.4 years, respectively (25). Accordingly, it seems the average age of menarche in Iranian girls is desirable compared to the region and developing countries.

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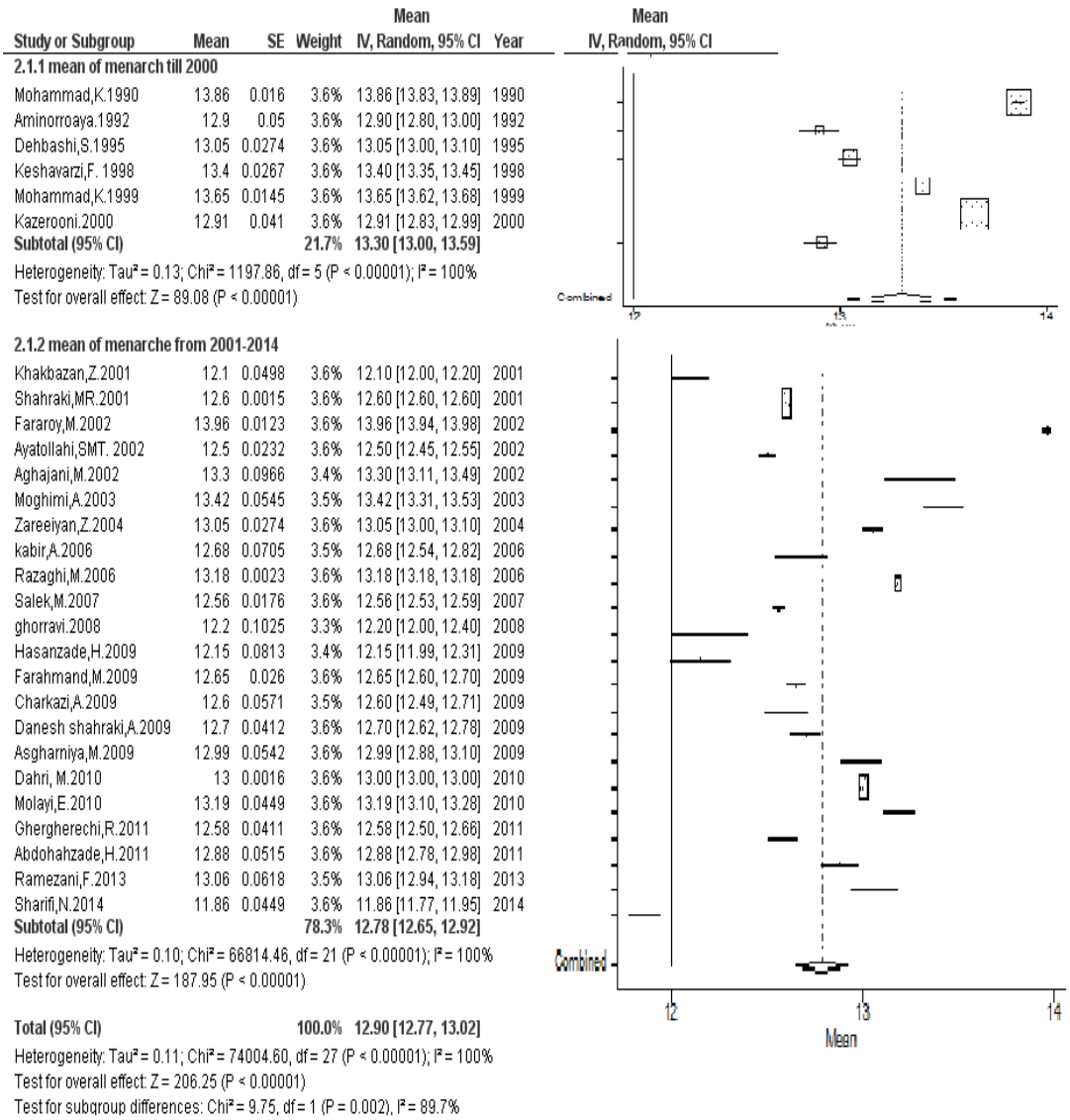

Fig. 4. The comparison of mean at menarche before and after 2000.

Although the studies on Iranian women and the samples inserted in this meta-analysis are trying to find the average age normal menarche in their own society, however, these studies had several differences, while inclusion criteria for the study attempted to reduce heterogeneity. The major differences between these samples of our study can be different target groups in each of the study. There was no structure or formula specified for the purpose of the study was not mentioned. Also, each study had a target population different from the others. The objection raised to the methodology of these studies can be the bias and recall error in the estimation of the age menarche, or the onset of menstruation in subjects, which was observed in all samples. Accurate method to estimate age menarche can be performed based on a cohort study with a high-volume sample size that's ever been done in Iran.

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The study of Mohammad et al, conducted based on the data from the Health and disease plan in the whole country has been one of the strongest studies used in this analysis, given the high-volume sample size of the study has an important effect on the common estimates (12.78 years). But, it has been observed that the common average obtained from this meta-analysis is less than the estimate obtained of the above mentioned study (13.86 year). Considering that this study was conducted in the country level and the research population involved all provinces of the country, it is reliable (25); But it must be noted that the sample of the study of Mohammed et al. is affected by the number of the population more than anything else, and more populous provinces had more samples and higher impact on their estimation.

Another point that should be mentioned is the decreasing trend in the age menarche due to better

Table 1. Characteristics of the studies under investigation

No	Author	Location	Year	Sample size	Average	SD	Target population	SE
1	Mohammadi	Gorgan	1990	*557*	13.19	1.06	14-19	0.0449
2	Alroaya	Aq-qala	1992	145	12.15	0.98	Guidance school	0.0813
3	Dehbashi	Zahedan	1995	558	12.60	0.05	Guidance school	0.0015
4	Keshavarzi	Tehran	1998	370	12.60	1.10	10-16	0.0571
5	Mohammadi	Athletes of 24 provinces	1999	629	13.18	0.06	12-19	0.0023
6	Kazerouni	Mashhad	2000	1300	13.00	0.06	11-15	0.0016
7	Shahraki	Isfahan	2001	3192	12.65	1.47	6-17	0.0260
8	Khakbazan	Mazandaran	2001	2246	12.50	1.10	13-17	0.0232
9	Ayatollahi	Raht	2002	600	12.99	1.33	11-16	0.0542
10	Aqajani	Shiraz	2002	2074	13.05	1.25	12-22	0.0274
11	Fararoui	Isfahan	2002	3204	12.56	1.15	5.5-17	0.0176
12	Moqimi	Yasouj	2003	181	13.30	1.30	High school	0.0966
13	Zareian	Rei	2004	658	13.42	1.40	7-16	0.0545
14	Razaqi	Tehran	2006	399	12.68	1.41	7-17	0.0705
15	Kabir	Shiraz	2006	900	12.91	1.23	-	0.041
16	Salek	Gorgan	2007	200	12.20	1.45	12-15	0.1025
17	Qarroi	Sabzevar	2008	400	12.88	1.26	10-17	0.0515
18	Farahmand	Shahrekord	2009	778	12.70	1.15	11-18	0.0412
19	Cherkezi	Tehran 7th district	2009	580	12.10	1.20	Elementary-High school	0.0498
20	Asqarnia	Kermanshah	2009	810	13.40	0.76	Guidance school	0.0267
21	Shahraki	Shiraz	2009	2074	13.05	1.25	12-22	0.0274
22	Hasanzade kashani	The whole country	2009	8820	13.86	1.51	15-49	0.0160
23	Molaei	The whole country	2010	10228	13.65	1.47	15-49	0.0145
24	Dahri	Ahwaz	2010	566	11.86	1.07	8-15	0.0449
25	Qeqerechi	Tabriz	2011	1000	12.58	1.30	7-17	0.0411
26	Abdollahzade	Tehran 13th district	2011	402	13.06	1.24	12-18	0.0618
27	Rmezani	Tehran	2013	400	12.90	1.20	6-18	0.05
28	Shrifi	Shiraz	2014	9349	13.96	1.23	-	0.0123

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nutrition and lifestyle changes in societies and communities based on the available studies (16, 22, 26).

Conclusion

The results from this meta-analysis showed that mean age at menarche was less the regional and developed countries. Therefore performing a systematic review and meta-analysis to evaluate the adequate nutrition for children and teenage population excessive body fat that influence age at menarche could be beneficial (27-29).

Conflict of interest

None declared.

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