Review Paper
The Prevalence of Obesity in Iranian Children: A Systematic Review and Meta-analysis

Hakimeh Akbari[1] , Masoud Mohammadi[1*]

1. Cellular and Molecular Research Center, Gerash University of Medical Sciences, Gerash, Iran.

A B S T R A C T

Background: The prevalence of childhood obesity has been on an increasing trend in the world during the past decades, with studies in Iran showing different and inconsistent prevalence rates.

Objectives: This study was done to determine the prevalence of obesity in children through a meta-analysis approach.

Methods: This study was done to determine the prevalence of obesity in children through a meta-analysis approach from January 2000 to January 2021. Articles related to the subject were obtained by searching Scopus, ScienceDirect, SID, Magiran, Barakat Knowledge Network System, Medline (PubMed), and Google Scholar databases. The heterogeneity of the studies was evaluated using the I2 index and the data were analyzed by Comprehensive Meta-analysis software.

Results: In a study on 2,637,912 individuals aged 2-15 years, the overall prevalence of obesity in Iranian children was 11.4% (95% CI: 9.4-13.7%) based on a meta-analysis. Also, in order to investigate the effects of potential factors (sample size and year of study) on the heterogeneity of obesity prevalence in Iranian children, meta-regression was used. It was reported that the prevalence of obesity in Iranian children decreased and increased with increasing sample size and increasing years of the study, respectively, and both were significantly different from each other ($P<0.05$).

Conclusions: Considering the high prevalence of obesity in Iranian children, it is necessary for health policymakers to take effective educational measures.

* Corresponding Author:
Masoud Mohammadi.
Address: *Cellular and Molecular Research Center, Gerash University of Medical Sciences, Gerash, Iran.*
Tel: *+98 (71) 52448101*
E-mail: *masoud.mohammadi1989@yahoo.com*

1. Background

O besity is the most important nutrition-related disorder in developed countries and has been increasing in the world in recent decades [1]. The importance of childhood obesity is attributed not only to its premature physical and psychological effects but also to increasing adolescent obesity, increasing the incidence of disease and mortality, and a huge economic burden on society [2].

Childhood obesity is directly related to adulthood obesity, with adulthood obesity being reported to be 2-3 times higher in obese children than in non-obese children [2-4]. Obesity is associated with problems, such as depression, obstructive sleep apnea, risk of cardiovascular disease, diabetes, and hypertension in children [4]. Childhood obesity increases fat and blood pressure levels and also the risk of hyperlipidemia and type 2 diabetes during adulthood in developing and developed countries [5, 6].

Childhood obesity continues into adulthood, and more than 69% of children aged 6-10 years are also obese during adulthood [7]. According to the World Health Organization (WHO) and National Health and Nutrition Examination Survey (NHANES) IV, 16% of children are overweight and 30% are at risk of being overweight [7, 8].

A total of 14.6% of preschoolers in low-income countries were obese in 2008, and the prevalence of obesity in the total population was 12.4% in the same age group [9]. Various studies in Iran have shown different prevalence rates including 5.2% in Tehran [10], 14.1% in Golestan [11], 7.6% in Birjand [12], and 17.2% in Rasht [13]. Considering that interventional studies to reduce the prevalence of obesity in children require accurate and consistent information to prevent obesity-related problems and complications in children, the question of this study is how much is the overall prevalence of obesity in children?

This study reviewed the overall prevalence of childhood obesity using a meta-analysis approach.

2. Methods

Searching technique

This study was a systematic review, based on the findings of studies on the prevalence of childhood obesity, including articles published in Persian and English in the databases of ScienceDirect, Scopus, SID, Magiran, Medline (PubMed), Barakat Knowledge Network System, and Google Scholar between January 2000 and January 2021. The search process was carried out using the Persian keywords, including children, obesity, body mass index, and their equivalent English words and possible combinations, and the Google Scholar search engine was searched using both English and Persian words. AND and OR operators were used in combination to provide more comprehensive access to all articles; therefore, the OR operator was used to check for common names for disorders, such as Obesity OR Hyperglycemia OR Body Weight) and BMI OR Body Mass Index. Also, the AND operator among the keywords (Children and Obesity and Body Mass Index) was used for matching words in the MeSH: (Children [Title/Abstract]) AND Obesity [Title/Abstract]) OR Hyperglycemia [Title/Abstract]) OR Body Weight [Title/Abstract]) AND BMI [Title/Abstract]) OR Body Mass Index [Title/Abstract]).

Criteria for selection and evaluation of articles

All articles were first collected using the selected keywords and a list of abstracts was prepared after the search was completed. After hiding the article specifications, including the name of the magazine and the author, the full text of the articles was made available to the reviewers. Each article was studied independently by two reviewers and if the article was excluded, the reason was mentioned and if there were differences between the two reviewers, the article was judged by the third reviewer, and the third reviewer's opinion was considered. Articles in Persian and English extracted from cross-sectional studies on the prevalence of obesity in Iranian children met the inclusion criteria. Review, case-control, cohort, and intervention studies were excluded from the list of articles. To review gray literature, i.e. documents that had not been published for any reason, attempts to search the Google search engine and related websites were also on our agenda. The studies were then reviewed based on four-phase PRISMA (2009), including identifying articles, screening, reviewing articles, acceptance criteria, and finally, articles and entered the meta-analysis.

Quality Assessment

STROBE checklist was used to review studies. This checklist consists of 22 sections, 18 of which are general and applicable to all observational studies, including cohort, case-control, and cross-sectional, and four are specific depending on the type of study and the various methodological aspects, including objectives, de-

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termination of appropriate sample size, type of study, sampling method, research population, data collection method, the definition of variables and procedure, data collection tool, statistical tests, and findings. Accordingly, the maximum quality score of 32 was considered and articles with scores below 14 were recognized as poor in terms of quality and were excluded from the study.

Statistical analysis

In each study, the prevalence of childhood obesity was determined in the Iranian population. The heterogeneity of the studies was assessed using the I2 test. In general, heterogeneity was classified into three categories, heterogeneity less than 25% (low heterogeneity), 25-75% (moderate heterogeneity), and above 75% (high heterogeneity). Data were analyzed using Comprehensive Meta-analysis software (Biostat, Englewood, NJ, USA ver. 3). The probability of publication bias was assessed using a funnel plot in the Egger test (P=0.05) and Begg and Mazumdar test (P=0.1). Moreover, to investigate the effects of potentially effective factors on heterogeneity, meta-regression was used regarding sample size and the year of study.

3. Results

Based on investigations on the prevalence of obesity in Iranian children, including articles published in domestic and foreign journals and searches in Magiran, SID, and Barakat Knowledge Network System databases, the following results were obtained: Medline (132 articles), PubMed (168 articles), ScienceDirect (457 articles), Scopus (112 articles), and Google Scholar (475 articles) and a total of 1344 articles. PRISMA 2009 was used to indicate the process of reviewing articles (Figure 1), and then, a total of 322 articles met the initial inclusion criteria based on initial reviews after deleting 1022 duplicate articles. Ultimately, 23 articles entered the meta-analysis phase after excluding 294 unrelated articles, 5 articles during secondary review because of lack of access to their abstracts and main articles, and low-quality of articles (Table 1).

Investigation of the heterogeneity and publication bias

The heterogeneity of the studies was evaluated using the I2 test and the value I2=98.7% was obtained indicating high heterogeneity of the included studies; therefore, the random-effects model was used to combine the results of the studies. Also, the results of the publication bias were compared using the Egger test (Figure 2), which was not statistically significant

(P=0.459). The results of the Begg and Mazumdar test also showed that the publication bias was not statistically significant (P=0.874).

The total number of samples included in the study was 2637912 individuals aged 2-15 years. The overall prevalence of obesity in Iranian children was 11.4% (95% CI: 9.4-13.7%) according to the meta-analysis. The highest prevalence of obesity (66.5%) was seen among children in Mashhad (95% CI: 60.2-71.9%) in 2009 [26], and the lowest prevalence of obesity (3.6%) was also reported in children in Ahwaz (95% CI: 3-4.3%) in 2002 [18] (Figure 3). Figure 3 shows the prevalence of childhood obesity by a random-effects model, in which the black square indicates the prevalence rate, and the length of the segment, on which, the square is located represents 95% CI in each study. The diamond sign indicates the prevalence rate at the national level in all studies.

Meta-regression test

In order to investigate the effects of potential contributing factors on the heterogeneity of studies on obesity prevalence in Iranian children, the meta-regression test was used to study the two factors of sample size and year of study (Figures 4 and 5). According to Figure 4, with an increase in sample size, the prevalence of obesity in Iranian children decreases, which is statistically significant (P<0.05). Figure 5 also demonstrates that the prevalence of obesity in Iranian children increases over time by increasing the publication year, which is statistically significant (P<0.05).

4. Discussion

The results of this study and in a study on 2637912 people aged 2-15 years, the overall prevalence of obesity in Iranian children was reported to be 11.4% based on a meta-analysis. The prevalence of childhood obesity was 16.9% [9] in the United States and 13.7% in the UAE [33], and 1% among children aged 5-1% in India [34] in 2010. According to estimates in the UK in 2001, obesity was prevalent approximately among 8.5% of 6-year-old children, and recent reports indicate a 13% increase in obesity among children aged 6-12 years in this country [15].

In another study, the prevalence of childhood obesity was 11.7% in the UK [35] and 11.3% in China [36]. This figure was estimated to be 1.4% in Greece [37] and 1.6% in Turkish children [38].
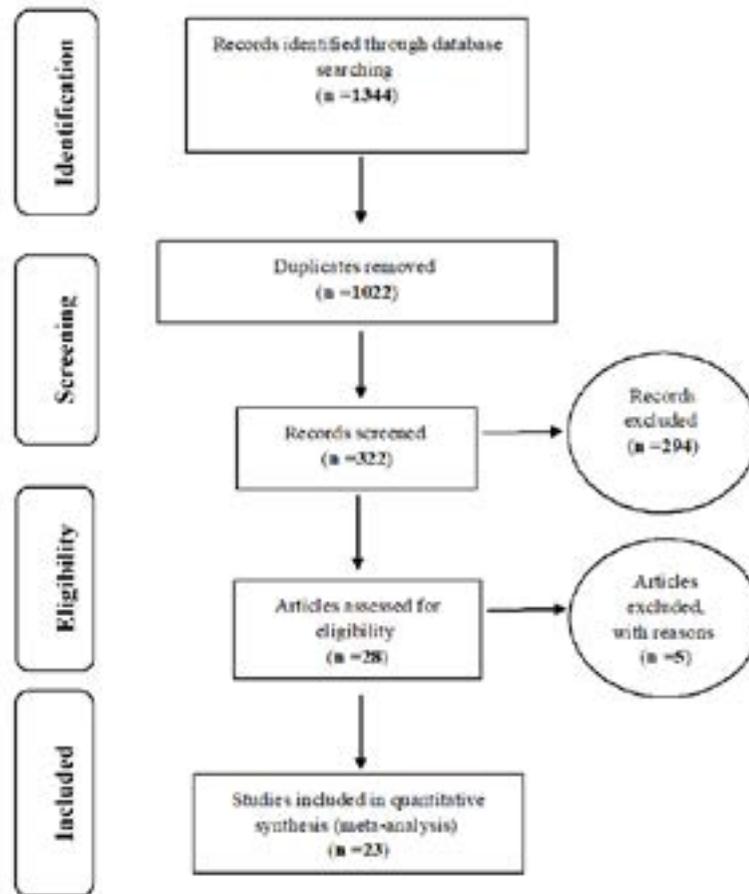
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Figure 1. The flowchart on the stages of including the studies in the systematic review and meta-analysis (PRISMA 2009)

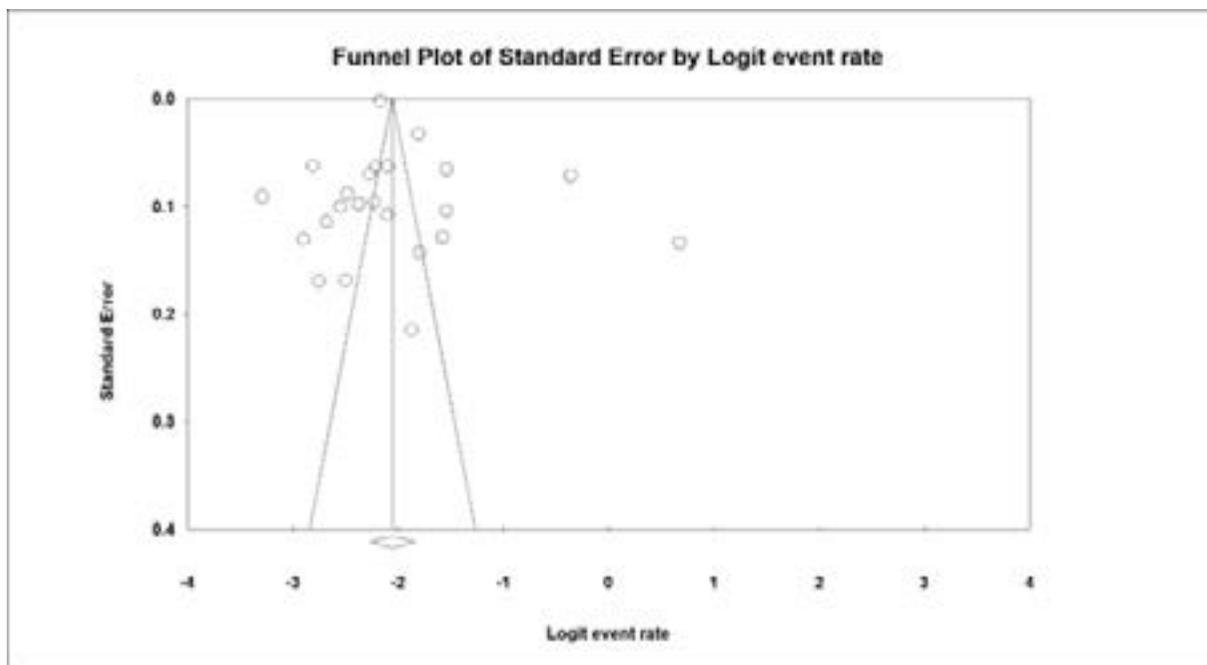*Journal of Pediatrics Review*

Figure 2. Funnel plot of the results on the prevalence of obesity in Iranian children

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Table 1. Specifications of included studies

Row	Authors	year	Area	Participants' Age	Sample size	Prevalence
1	Shidfar et al. [10]	2014	Tehran	10-13	1184	5.2
2	Vaghari et al. [11]	2011	Golestan	6-11	7399	14.1
3	Taheri et al. [12]	2014	Birjand	2-5	500	7.6
4	Mirsolaymani et al. [13]	2015	Rasht	6-7	426	17.2
5	Torabi et al. [14]	2015	Zanjan	2-5	890	10.9
6	Nabavi et al. [15]	2010	Semnan	7-12	400	14.3
7	Abdoullahi et al. [16]	2016	Mazandaran	7-15	1230	10
8	Mozafari et al. [17]	2002	Tehran	2-12	1800	7.7
9	Tabatabaei et al. [18]	2002	Ahwaz	6-12	3482	3.6
10	Aminzadeh et al. [19]	2012	Ahwaz	6-10	1594	17.7
11	Asnaashari et al. [20]	2015	Hamedan	7-12	795	5.7
12	Asadinoghabi [21]	2011	Bandar-e-Abbas	7-11	1350	8.5
13	Dorosty et al. [22]	2008	Nayshabor	6-12	1471	7.3
14	Ebrahimzadehkar et al. [23]	2011	Bandar-e-Tork-aman	≤5	616	6
15	Karamsultani et al. [24]	2007	Yazd	6-11	187	13.3
16	Salem et al. [25]	2008	Rafsanjan	7-11	1275	6.4
17	Ghaemi et al. [26]	2009	Mashhad	5-15	249	66.5
18	Shahgholyan et al. [27]	2003	Chaharmahal-e-Bakhtyari	7-12	2772	9.9
19	Dorosti et al. [28]	2002	Iran	2-5	2560	10.9
20	Motlagh et al. [29]	2011	Iran	≤6	2600000	10.3
21	Ayattollahi et al. [30]	2007	Shiraz	6.5-11.5	2397	9.4
22	Salehi et al. [31]	2014	Isfahan	6-12	635	17.6
23	Jafari et al. [32]	2014	Isfahan	9-15	4700	5.7

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With the rise in social welfare status and industrialization of countries, it seems that the prevalence and risk of overweight and obesity in children are also increasing [39]. Considering the increasing nutritional and health status of societies and the increasing influence of digital technology on daily life, there will be an increase in the obesity rate in children according to the development level [40].

The results of longitudinal studies show that the prevalence of childhood obesity has doubled in the last three decades [41]. In the United States, the prevalence in children has been reported at 21% [41], In other studies in North Korea, this prevalence is 9.7%, in Cyprus, it was 8.1%, and in Spain, it was 8.5% [42-44].

Also, in the study by Kelishadi et al. (2014), the prevalence of obesity in people under 18 years of age was reported to be 5.1%. [45] In a meta-analysis in China, the prevalence of obesity in people under 18 years of age was 7.5% between 2001 and 2005 [46].

In a meta-analysis, the overall prevalence of obesity was 8.5% between 2000 and 2013, and the prevalence
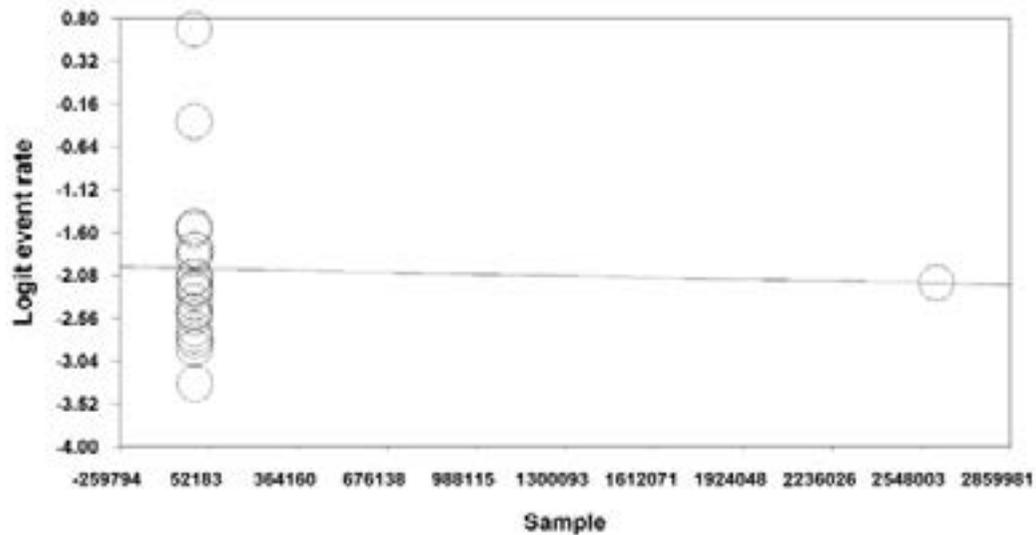
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Figure 4. A meta-regression chart of the prevalence of obesity in Iranian children by sample size   *Journal of Pediatrics Review*

of obesity in people under 18 was 5.5%. The results of this study showed that the prevalence of overweight and obesity increased until 2010 and decreased from 2011 to 2013. In all three periods, the prevalence of obesity and overweight was higher in people over 18 years [47].

Most studies have also reported that girls are at a higher risk for obesity and overweight [48, 49], which could be justified by less physical activity in girls, due to hormonal and behavioral physiology, and somewhat due to social culture [48-50]. Therefore, considering this issue and the increasing prevalence of overweight and obesity in children, this disorder can lead to behavioral and mental disorders, cardiovascular disease, and skeletal abnormalities in the next decades, and in turn a dra-

matic reduction in one's social efficiency and huge costs on families and the health system in any society [50].

The high prevalence of obesity in Iran can be the result of changing people's lifestyles so that the level of access to food and fast foods as well as the use of mass media and computer games in children has increased [46-50].

According to the above-mentioned issues, it is essential to raise awareness of families, especially in the affluent classes, and warn them about the risk factors for obesity so that we pave the way for educating children on proper nutrition and exercise activities and reduce the prevalence of obesity and overweight in children. In addition, since timely detection and treatment can prevent obesity-related complications, and it is possible
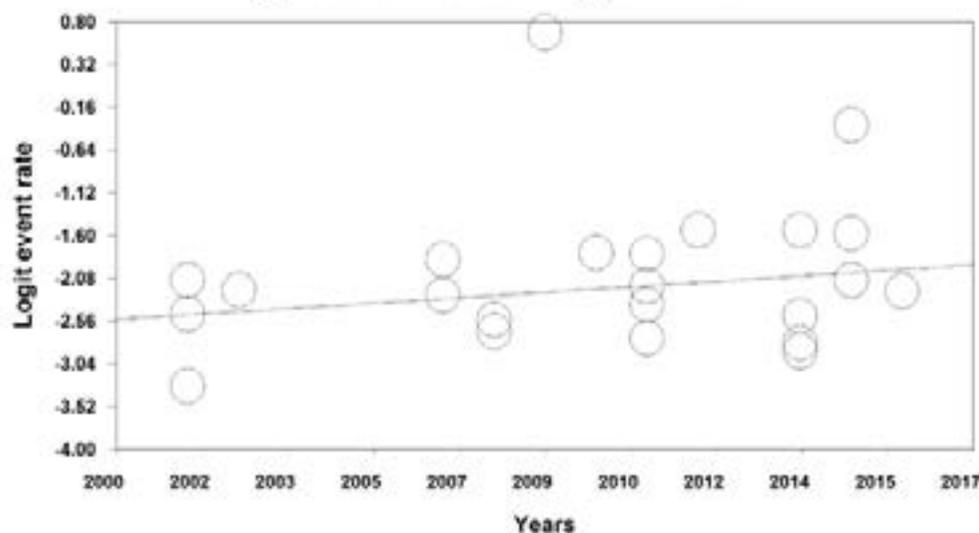

Figure 5. A meta-regression chart of the prevalence of obesity in Iranian children by publication year   *Journal of Pediatrics Review*
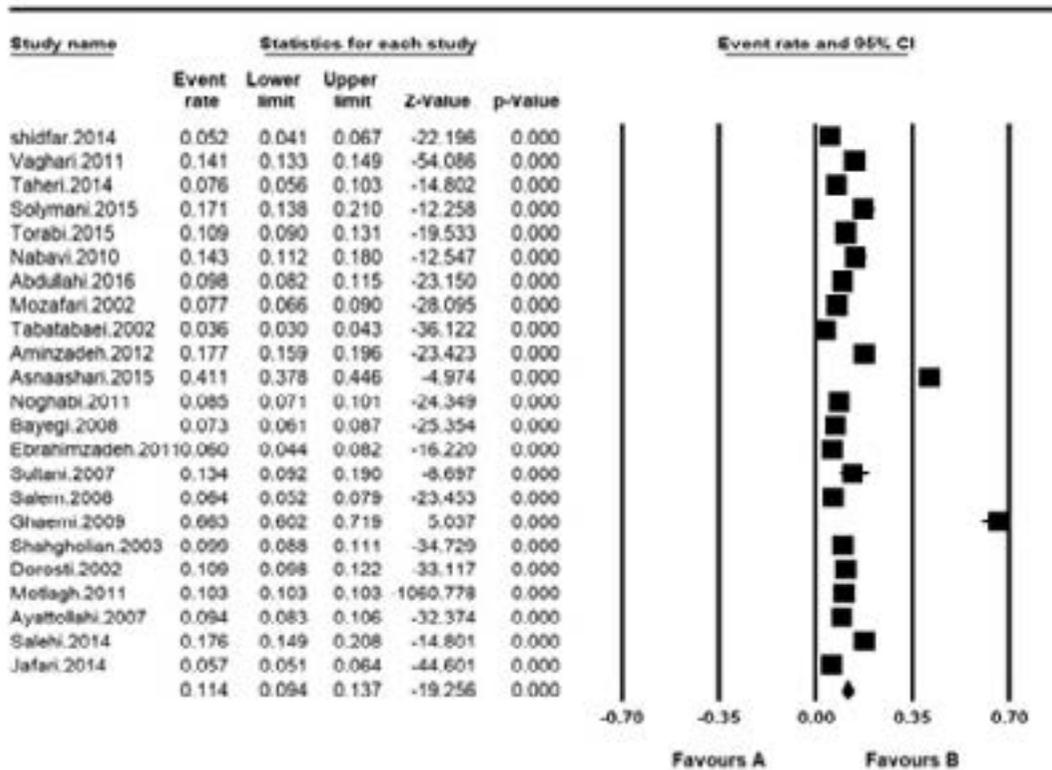
Figure 3. Prevalence of obesity in Iranian children based on the random-effects model

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to treat obesity in children, identification of overweight and obese children through screening and periodic examinations in schools can also be taken into account.

It is recommended that future studies focus on the risk factors for childhood obesity based on case-control studies to provide accurate statistics to health policymakers to prevent and intervention measures.

Limitations

The most important limitations of the current study include the lack of access to full text and the poor quality of some of the studies studied.

5. Conclusion

Considering the high prevalence of obesity in Iranian children, health policymakers should take effective measures in the field of education as well as periodic screening.

Ethical Considerations

Compliance with ethical guidelines

The Ethics Committee of the Deputy of Research and Technology, Kermanshah University of Medi-

cal Sciences approved the study (Code: IR.KUMS. REC.1398.814).

Authors' contributions

Both authors equally contributed to preparing this article.of the manuscript.

Conflicts of interest

The authors declared no conflict of interest.

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