

A Systematic Review and Meta-Analysis of the Prevalence of Malnutrition Among 6-14-Year-Old Children in Iran

Abstract

Background: Malnutrition is a major public health issue worldwide. It has significant consequences, including weakened immune systems, which may lead to increased incidences of infectious disease and higher mortality, particularly in children. A systematic review and meta-analysis were conducted to estimate the overall prevalence of malnutrition (wasting, underweight, and stunting) among children of 6–14 years of age in Iran. **Methods:** Data were collected in 2018 based on searches of the PubMed, Science Direct, Scopus, Google Scholar, Science Information Database (SID), Magiran, Irandoc, and Iranmedex databases using the following keywords: childhood, childhood malnutrition, children, nutrition, malnutrition, wasting, underweight, stunting, child, student, boy, girl, cause, prevalence, and Iran, in order to identify studies eligible for inclusion in the review. Comprehensive Meta-Analysis, version 2 (CMA: 2) was used to estimate the overall prevalence of malnutrition. **Results:** Nine out of 328 articles were included in our analyses. The overall of wasting among children of 6–14 years of age in Iran based on the random-effects model (according to nine studies and 18,296 participants) was 12.5% (95% Confidence Interval, 7.1-21.2). The overall prevalence of underweight based on the random-effects model (according to 10 studies and 19,185 participants) was 19% (95% CI, 8.1-38.6). Also, the overall prevalence of stunting based on the random-effects model (according to 10 studies and 19,185 participants) was 20% (95% CI, 9.4-37.8). **Conclusions:** The results of this study show that the prevalence of malnutrition among 6–14-year-old children in Iran is similar to the global average. We need solutions that can be used for both prevention and reduction of malnutrition, especially in areas with middle or low socioeconomic status. It is necessary to identify factors associated with malnutrition in various geographic regions in order to implement appropriate programs based on factors with the highest impact in each region.

Keywords: Child, malnutrition, meta-analysis, prevalence

Introduction

Malnutrition is a general term to describe the inadequate intake of protein-energy or nutrients.^[1,2] Malnutrition is a major public health issue worldwide.^[3,4] Due to their rapid linear growth, children are more affected by malnutrition than other population groups.^[5] In addition, school-age students constitute a significant percentage of the population of growth age, who are particularly vulnerable due to their physical, social, and mental characteristics. Malnutrition in school-age children may result in physical and mental disorders and even negatively impact learning.^[6] Inadequate food preparation, poor nutritional habits, psychological factors, family food security, and metabolic disorders and diseases may limit the intake of food and foodstuffs.^[7] In addition to

the lack of adequate food and increased incidence of infections, inadequate access to hygienic services, and problems associated with poor living environments as well as socio-economic and cultural factors may also contribute to the incidences and prevalence of malnutrition. The intensity and scope of malnutrition are closely linked to socioeconomic status, education, literacy level, climate status, food production, access to clean water, and the coverage and quality of healthcare services.^[8] A 2011 study estimated that 45% of child mortality was related to malnutrition.^[9] The most important indicators for the assessment of health status and food security include the prevalence of malnutrition as well as growth patterns in children.^[10] Anthropometric indicators such as height, weight, and age can be used to determine the malnutrition status of children.^[11] The main indicators

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calculated from the measurements include underweight (low weight for age), wasting (low weight for height), and stunting (low height for age).^[12] Given the potentially serious consequences of malnutrition and underweight in children, the World Health Organization (WHO) in 1990 obligated the member states to reduce the incidences of these health problems by up to 50% by 2015.^[13] Generally, the percentage of underweight and stunted children worldwide has decreased since 1990,^[14] with the number of stunted children decreasing from 255 to 159 million children between 1990 and 2014. In 2014, nearly one in 13 children worldwide experienced wasting, one-third of whom (16 of 50 million) suffered severe wasting (corresponding to a global prevalence of 2.4%).^[15] Assessments of nutritional status in elementary school children have revealed stunting, underweight, and wasting in some areas of the world.^[16,17] The 10-year trend of the indicators for malnutrition in children under five years of age in Iran also revealed a reduction in all types of protein-energy malnutrition at all levels; however, differences between various provinces and areas of the country according to developmental levels indicate the necessity for design and implementation of targeted solutions.^[18] Despite significant advances in recent decades in reducing the number of children suffering from malnutrition in developing countries, underweight, stunting, wasting, and even obesity are still observed in many societies.^[6] Therefore, according to the importance of children's health and the reasons mentioned in this section, the current study is aimed to systematically review and analyze the prevalence of malnutrition among children aged between 6 and 14 years in Iran.

Methods

This systematic review and meta-analysis were conducted in November 2018 according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement.^[19]

Literature search

First, a literature search was performed in order to identify all relevant publications on the prevalence of malnutrition among children of 6–14 years of age in Iran. There were no publication time limitations for this search. Data were collected using the following keywords: childhood, childhood malnutrition, children, nutrition, malnutrition, wasting, underweight, stunting, child, student, boy, girl, cause, prevalence, and Iran. Data were collected from PubMed, Google Scholar, Scopus, Magiran, Iranmedex, and the Scientific Information Database (SID). Potential articles were manually reviewed for relevance and their reference lists were also manually curated to identify additional articles. Finally, we also searched the gray literature and consulted with experts. Abstracts were independently reviewed by two authors; articles were included in the analyses if they were determined by consensus to satisfy the following inclusion criteria:

original research (descriptive-analytical, cross-sectional, case-control), published in English or Persian, evaluation of the prevalence of malnutrition among children between 6 and 14 years of age in Iran, and conducted in Iran. Reference management software (Endnote X5) was used to manage the references.

Study selection

The quality of the studies was evaluated based on recommendations from the 'Strengthening the Reporting of Observational Studies in Epidemiology' (STROBE).^[20] This checklist has 43 questions and the highest score was 45. The studies with a score of over 40 were selected as articles with adequate quality. Two reviewers independently reviewed the titles and abstracts to identify studies which were potentially eligible for full-text review. During this stage, in the case of conflicts between these two reviewers, a consensus was reached using a third reviewer's opinion as a tie-breaker. Studies were selected and included in the analyses based on the inclusion criteria.

Data extraction

In the first stage, articles with non-relevant titles were excluded. Next, the abstracts and full texts of articles were reviewed in order to identify articles that met the inclusion criteria using a data collection form [Table 1]. Data were independently extracted by two reviewers. The following information was extracted for each study: study characteristics, city, sample, sample size, the prevalence of malnutrition (%), associated risk factors, and differences in prevalence between boys and girls.

Data analysis

Comprehensive Meta-Analysis, version 2 (CMA: 2, Englewood, NJ, USA) was used to perform the meta-analysis and to estimate the overall prevalence of malnutrition. The meta-analysis was performed using a random-effects model to estimate the prevalence of malnutrition with 95% confidence intervals. Q statistics and I^2 were used to measure heterogeneity (I^2 greater than 50% is considered as heterogeneity). Sensitivity analysis was done by examining the effect of excluding the most heterogeneous studies. Publication bias was assessed using funnel plots. The prevalence of 95% (95% confidence interval [CI]) was displayed using forest plots such that the size of each square represented the sample size and the lines on each side of the square indicated the confidence interval. Graphs were plotted using Microsoft Office Excel 2010.

Results

Of 328 studies identified in the initial search, 94 and 193 were omitted for repetition and exclusion criteria, respectively. An additional 41 studies were excluded from the analysis after the full-text review. Three studies found through manual searches were also included in the current analyses. Finally, nine studies were selected for

Table 1: Study characteristics

Author, year of Publication	City	Sample	Sample size	Prevalence of Malnutrition (%)		Associated risk factors	Difference in prevalence between boys and girls
				Underweight (weight for age)	Stunting (height for age) / Wasting (weight for height)		
Karimi <i>et al.</i> (2016) ⁽²¹⁾	Semnan	students 6-12 years of age	2195	9.2	9.0 / 12.5	Lack of access to a computer increased the odds ratio (OR) of wasting by 1.38 times. Only access to a computer showed a significant association with the prevalence of underweight (OR=1.37, $P=0.036$). The prevalence of stunting was associated significantly with a history of parasitic infection (OR=2.32, $P<0.001$) and living in rural areas (OR=1.57, $P=0.005$).	there were no associations between underweight, wasting, stunting and sex
Gholami <i>et al.</i> (2014) ⁽²²⁾	Kerman	Students 7-12 years of age	1,056	Sever: 6.06 Medium: 24.43	5.58 / 26.04 / 24.91	9.75	Comparison of weight-for-age and weight-for-height indices in children showed higher prevalence of malnutrition in girls compared to boys ($P<0.05$). The prevalence of malnutrition was more common in girls than in boys. That was not significant in genders. The prevalence of underweight and stunting were significantly higher in boys than girls ($P<0.05$)
Veghari (2013) ⁽²³⁾	north of Iran	primary school children	5698	3.2	4.93	5.13	Malnutrition of weight-for-age and weight-for-height had a higher prevalence in girls than in boys ($P<0.05$). The proportion of underweight boys was higher than that in girls ($P<0.05$).
Namakin <i>et al.</i> (2011) ⁽²⁴⁾	South Khorasan	Children 7-14 years of age in five deprived regions	1,211	70.6	70	20	Results of logistic regression analyses showed that the risk of malnutrition was in rural area 1.34 times more than urban area, in girls 1.17 times more than boys, in Sistani ethnic group 1.82 times more than Fars-native ethnic group, in low economic families 2.01 times more than high economic families. With increasing levels of education among mothers, stunting and underweight significantly decreased in children ($P<0.001$).
Dehghan <i>et al.</i> (2011) ⁽²⁵⁾	Larestan	Elementary school schools	876	7.3	6.5	9.8	There was a significant relationship between the mothers' occupations and chronic malnutrition (H/A), and W/H ($P<0.01$), between the parent education level and H/A, and W/H ($P<0.01$), between weekly consumption of meat and chronic malnutrition ($P<0.05$). There was also a significant relationship between weekly consumption of cheese and milk and chronic malnutrition ($P<0.01$), between consumption of soft drinks and chronic malnutrition ($P<0.01$), and between consumption of confectioneries and W/H ($P<0.01$).
Darvishi <i>et al.</i> (2009) ⁽²⁶⁾	Kurdistan	Primary school students	1100	27.5	36.9	32.3	

Contd...

Table 1: Contd...

Author, year of Publication	City	Sample	Sample size	Prevalence of Malnutrition (%)			Associated risk factors	Difference in prevalence between boys and girls
				Underweight (weight for age)	Stunting (height for age)	Wasting (weight for height)		
Delvarianzadeh and Sadeghian (2006) ^[27]	Shahrood	Students 6-12 years of age	890	14.7	15.3	11.6	Breakfast meal consumption was effective in malnutrition related to weight for height in children	Malnutrition was significantly higher in boys than in girls. There was a statistically significant relationship between gender and weight for age (W/A) ($P<0.001$).
Delvarian Zadeh and Hossein Zadeh (2005) ^[28]	Shahrood	Students 6-12 years of age	630	6.5	8.1	5.9	The prevalence of malnutrition among children with illiterate mothers and fathers with low education was significantly higher than that in other children. Also, there was a statistically significant relationship between mothers' employment status all three indicators; there was also a statistically significant relationship between the employment of father and current malnutrition. The prevalence of malnutrition among children in public schools was significantly higher than among those in non-for profit schools ($P<0.05$).	
Taheri <i>et al.</i> (2009) ^[29]	Birgand	Students 11-14 years of age	889	81.1	69.1		There was a statistically significant relationship between the relative frequency of underweight as well as stunting and parent' educational level ($P<0.05$).	
Ghorbani (1998) ^[30]	Zanjan	Students 6-12 years of age	4640	8.5	10.7	5.4	Considering the W/A indicator, there was a statistically significant relationship between the reduction in malnutrition and the increase in age. Regarding W/A and H/A the prevalence of malnutrition was in children with illiterate mothers was significantly higher than those with educated mothers	Regarding W/A and W/H indicators, malnutrition was significantly higher in girls than boys

inclusion in the current study [Figure 1]. These studies were conducted between 1998 and 2016. Nine, 10, and 10 studies, respectively, assessed wasting, underweight, and stunting, and were included in the meta-analysis. The results of the meta-analysis showed that the overall prevalence of all types of malnutrition among children between 6 and 14 years of age in Iran, in terms of wasting, underweight, and stunting was 12.5%, 19%, and 20%, respectively. Among factors associated with these indicators of malnutrition, statistically significant relationships were observed between child gender, parent educational level (particularly of the mother), and parent employment status. In most of the studies, the prevalence was significantly higher among girls than in boys. A lower prevalence has also been reported among children of parents with higher levels of education. Factors related to the consumption of meat, cheese, and milk as well as the type of school (public or not-for-profit), ethnic group, and economic conditions in families have also been identified as significantly related to malnutrition indicators.

The overall prevalence of wasting [Figure 2], underweighting [Figure 3], and stunting [Figure 4] among children of 6–14 years of age in Iran.

The overall wasting among children of 6–14 years of age in Iran based on the random-effects model (according to nine studies and 18,296 participants) was 12.5% (95% CI,

7.1-21.2). The 95% CIs for each study were displayed as horizontal lines ($Q = 1296$, $df = 8$, $P < 0.001$, $I^2 = 99.3$). Due to the high heterogeneity of the results, sensitivity analysis was done after excluding Gholami *et al.*^[22] Namakin *et al.*,^[24] and Darvishi *et al.* studies.^[26] The results showed that after sensitivity analysis, heterogeneity improved considerably [Figure 2] ($Q = 181.8$, $df = 5$, $P < 0.01$, $I^2 = 97.2$). After this change, the overall prevalence of wasting based on the random-effects model was determined to be 7.9% (95% CI, 5.4-11.3).

The overall prevalence of underweight in children of 6–14 years of age in Iran based on the random-effects model (according to 10 studies and 19,185 participants) was 19% (95% CI, 8.1-38.6). The 95% CI for the prevalence of each study was drawn as a horizontal line ($Q = 3790.1$, $df = 9$, $P < 0.001$, $I^2 = 99.7$). Due to the high heterogeneity of the results, sensitivity analysis was done after excluding Gholami *et al.*^[22] Namakin *et al.*^[24] Darvishi *et al.*,^[26] and Taheri *et al.* studies.^[29] The results showed that after sensitivity analysis, heterogeneity improved considerably [Figure 3] ($Q = 222$, $df = 5$, $P < 0.001$, $I^2 = 97.7$). After this change, the overall prevalence of underweight based on the random-effects model was determined to be 7.5% (95% CI, 4.9-11.4).

The overall prevalence of stunting in children of 6–14 years of age in Iran based on the random-effects

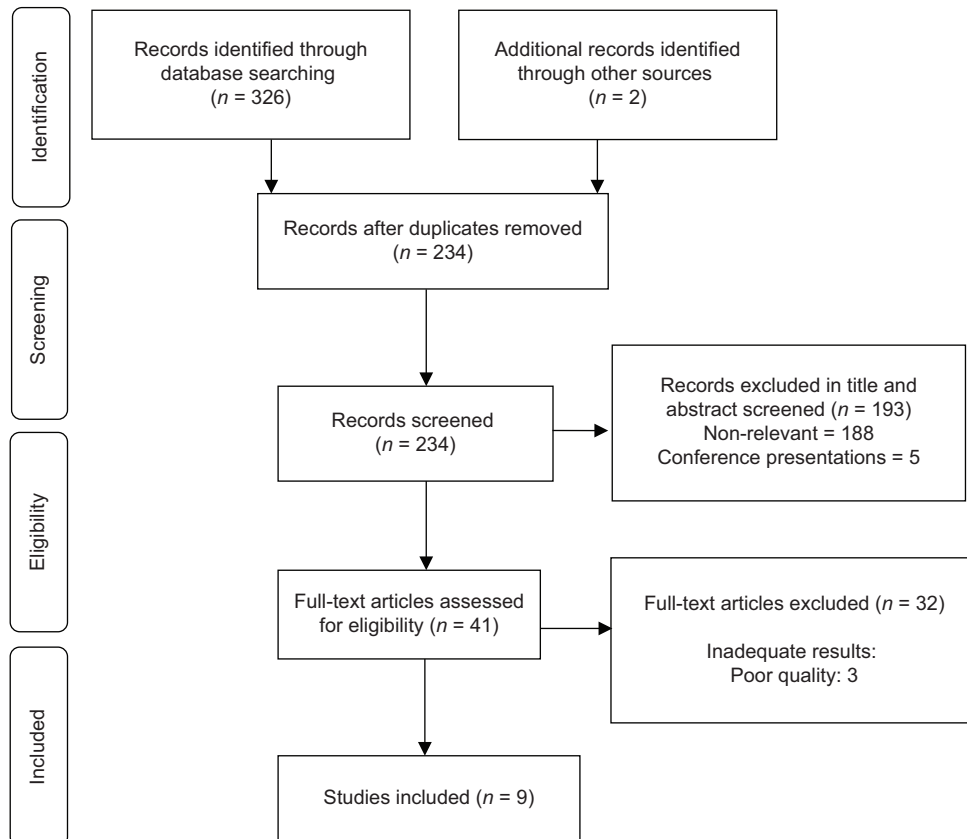


Figure 1: Flowchart of study review process and selection

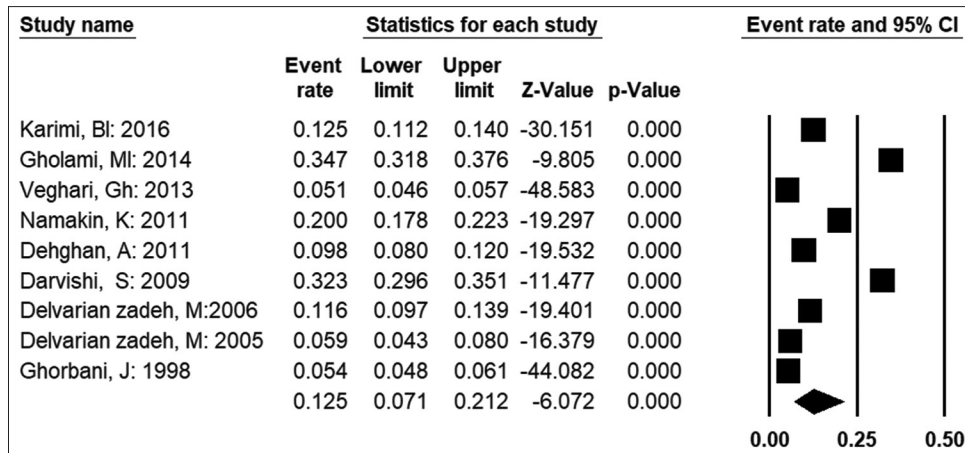


Figure 2: Wasting among children 6-14 years of age

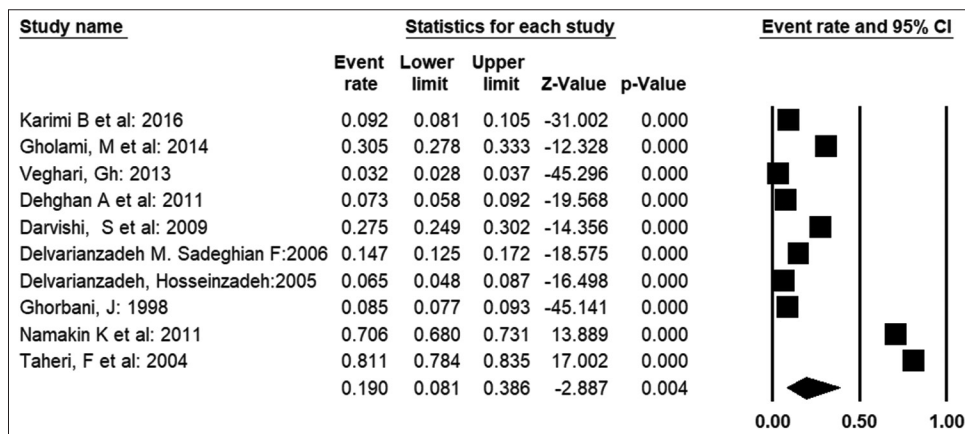


Figure 3: Underweight among children 6-14 years of age

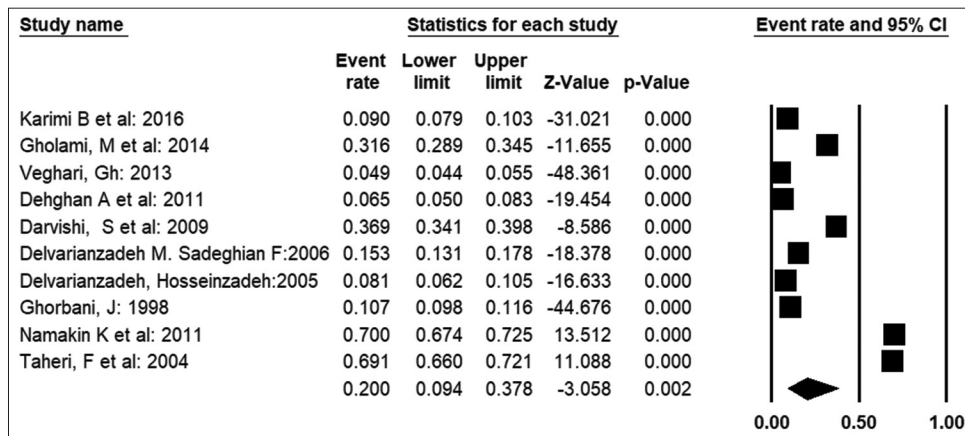


Figure 4: Stunting among children 6-14 years of age

model (according to 10 studies and 19,185 participants) was 20% (95% CI, 9.4-37.8). The 95% CI for the prevalence of each study was drawn as a horizontal line ($Q = 3619.8$, $df = 9$, $P < 0.001$, $I^2 = 99.7$). Due to the high heterogeneity of the results, sensitivity analysis was done after excluding Gholami *et al.*,^[22] Namakin *et al.*,^[24] Darvishi *et al.*,^[26] and Taheri *et al.* studies.^[29] The results showed that after sensitivity analysis, heterogeneity

improved considerably [Figure 4] ($Q = 175$, $df = 5$, $P < 0.001$, $I^2 = 97.1$). After this change, the overall prevalence of stunting based on the random-effects model was determined to be 8.6% (95% CI, 6.1-12).

Discussion

As assessed by wasting, underweight, and stunting, the overall prevalence of all types of malnutrition among

children between 6 and 14 years of age in Iran was 12.5%, 19%, and 20%, respectively. The worldwide prevalence of these indicators in the 2014 UNICEF annual report was 8%, 15%, and 25%, respectively.^[31] Also, the overall prevalence of these indicators among Iran's under five-year-old children were 7.8%, 10.5%, and 12.4%, respectively.^[4] Studies on malnutrition have reported an estimated 35% reduction in malnutrition worldwide between 1999 and 2011.^[13] There have been significant reductions in the numbers of children suffering from malnutrition in recent decades in developing countries; however, underweight, stunting, wasting, and even obesity are all still observed in many societies.^[6] Thus, despite socioeconomic development, childhood malnutrition remains a health issue in developing countries.^[32-34] Approximately 20–50% of elementary-school-children currently suffer nutritional deficiencies.^[35] Studies have shown that, based on current trends, the 50% reduction of malnutrition by 2015 proposed by the WHO did not materialize.^[13] The overall prevalence of malnutrition in terms of stunting among children aged between 6 and 14 years in Iran was 12%. The overall prevalence of malnutrition in terms of stunting among children aged <5 years of age was estimated at 3.7%, with significantly higher rates in rural areas than those of urban areas. The results of the current study indicated that Iran has a relatively low prevalence of child malnutrition.^[36] In addition, in a study of 480 children, conducted by Fesharakinia and Sharifzadeh, considering wasting as an indicator of malnutrition, 99.2% of children were found to be normal, while 0.8% suffered from moderate wasting.^[37] Other studies have reported wasting in 10.3%,^[38] 7.5%,^[39] 10.8%,^[5] and 17.8%^[40] of their study populations, respectively. This indicator represents the current status of nutrition in children and is useful for screening or recording short-term changes in nutrition. However, a relative lack of wasting does not necessarily indicate the absence of nutritional problems,^[41] as long-term changes in child nutrition contribute to the incidence of other malnutrition indicators, such as stunting and being underweight. Appropriate short-term monitoring in addition to indicator assessment and application of appropriate solutions for prevention and treatment may reduce the incidences of other symptoms of malnutrition that may occur over time. The results of the current study also showed an overall prevalence of malnutrition in terms of stunting among children aged between 6 and 14 years in Iran to be 12%. Fesharakinia reported that 90.2% of children reached normal height while 9.8% experienced stunting (7.7% and 2.1% with moderate and severe stunting, respectively).^[37] Shivaprakash reported a 27.9% prevalence of stunting among elementary-school-children aged between 6 and 12 years.^[35] Studies conducted in the Philippines, India, Brazil, Guatemala, and South Africa also reported a relationship between stunting, reduced school attendance, and efficiency at school. The results of these studies also indicated that stunting may lead to educational

challenges.^[42] Stunting may lead to behavior disorders in school-age children. These complications are not reversible through proper nutrition, better care, or improved living conditions; therefore, this problem may cause irreparable harm to the sustainable development of the country.^[43] Stunting represents chronic nutritional inadequacy and/or frequent or chronic disease rather than short-term changes in nutritional status.^[41] As a result, long-term monitoring for changes in this indicator is required. In addition, the overall prevalence of malnutrition in terms of underweight children between 6 and 14 years of age in Iran was 20%. A study on malnutrition in elementary-school-children conducted in Nigeria observed that 47.1%, 20.1%, and 4% of children were mildly, moderately, and severely underweight.^[44] In addition, Shivaprakash reported a prevalence of underweight among school-children between 6 and 12 years of age was 30.3%.^[35] Furthermore, studies of children under five years of age have reported underweight prevalence rates of 21.4%,^[45] 9.8%,^[46] and 6.3%.^[37] Being underweight is a combination of wasting and stunting.^[41] As a result, the incidence of this indicator, can to a large extent, be prevented through regular, short-term, and periodic monitoring and treatment of current causes and symptoms. Child gender,^[24-27] parent educational level,^[24,26,29] and parent employment status^[26] were identified as significant factors related to the malnutrition indicators assessed in the studies included in this review. The lower prevalence of these indicators appeared to be related to increased levels of parental education. Factors related to the consumption of meat, cheese, and milk, as well as the type of school (public or not-for-profit) have also been associated with these malnutrition indicators. The results of studies in other countries also indicate that mothers' education may be effective in the prevention of malnutrition, particularly stunting.^[47-49] In addition, a statistically significant relationship was observed between social factors and nutritional status, including malnutrition, among school-age children.^[44] Proper interventional strategies and policies may improve the nutritional status of children and also improve their health status by identifying risk factors associated with health.^[50] The strengths of this paper are in providing wide information about the prevalence of malnutrition among 6–14-year-old children and various aspects of malnutrition (wasting, underweight, and stunting) that can be used by policymakers in decision-making about interventions to prevent malnutrition and improve the situation.

Limitations

The limitation of this study was the lack of access to some databases and also the fact that included articles were only in English and Persian languages.

Conclusions

There is a need for solutions that can be used for both prevention and reduction of malnutrition, especially in areas

with middle or low socioeconomic status. Socioeconomic factors generally have a higher impact on malnutrition in children; therefore, improving living conditions for families and implementing proper educational and cultural programs for students and their parents can lead to a decrease in the incidences and prevalence of malnutrition. It is necessary to identify factors associated with malnutrition in various geographic regions in order to implement appropriate programs based on factors with the highest impact in each region. In addition, prospective studies may be useful to assess the effectiveness of these programs. Furthermore, policies for malnutrition prevention should be based on incidences, causes, and other factors. In other words, policies should be based on scientific evidence.

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Conflicts of interest

There are no conflicts of interest.

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