Prevalence and Risk Factors of Malnutrition among Primary School Children in Iran: A Systematic review

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Abstract

Background: Malnutrition is a serious threat to children's health and the primary cause of childhood mortality in the WHO Eastern Mediterranean Region. The present study aimed to evaluate the prevalence and risk factors of malnutrition among Iranian primary school children.

Materials and Methods: In this systematic review, a systemic search of online databases (Medline, EMBASE, Scopus, Web of Science, Cochrane Library, CIVILICA, SID, and Google Scholar search engine) was conducted for related studies with no time limit up to June 2022. Two reviewers evaluated the quality of eligible studies and carried out the selection procedure.

Results: Twelve related studies were selected. The prevalence of malnutrition based on weight-for-age, height-for-age, and weight-for-height were 46.6% (underweight, 3.2-46.6%), 36.9% (stunting, 3-36.9%), and 53.3% (wasting, 3.7-53.3%), respectively. The logistic regression analyses showed that the risk of malnutrition in rural areas was 1.34 times that of urban areas, in girls 1.17 times more than boys, in the Sistani ethnic group 1.82 times more than Fars-native ethnic group, and in low-income families 2.01 times more than high-income families. Thinness was significantly higher in public schools than in private schools. There was a statistically significant relationship between the consumption of snacks and the wasting of schoolchildren. Birth weight, parental education, father's height, father's job, family income, and maternal age were the main contributing factors to malnutrition in schoolchildren ($p<0.05$).

Conclusion: The prevalence of malnutrition in Iranian schoolchildren in the Sistan and Balochistan, Kerman, and Kurdistan provinces was relatively high in terms of wasting, stunting, and being underweight. The risk of malnutrition was high in rural areas, girls, Sistani ethnic groups, and low-income families.

Key Words: Iran, School Children, Malnutrition, Prevalence, Primary School

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1- INTRODUCTION

Children are the main assets of society. Their health is the foundation of the future health of the entire society and has an essential effect on the health level of a country. Evidence shows that the delay in growth in school-aged children impairs their learning, intelligence, and academic progress (1). Therefore, growth assessment is an essential part of health care for children and adolescents (2). The scientific consensus considers child growth an important indicator of nutritional status and health. Child malnutrition estimations for stunting, wasting, overweight, and underweight indicators describe the magnitude and patterns of under- and overnutrition (3).

Malnutrition has various forms, including undernutrition (wasting, stunting, and being underweight), vitamin or mineral deficiency, overweightness, obesity, and diet-related noncommunicable diseases (4, 5). It is estimated that nearly one in three persons has at least one form of malnutrition globally (6). Undernutrition is more common in developing countries (7). Stunting is more prevalent in urban slums than in rural areas (8). In 2020, 149.2 million children under the age of five were stunted, 45.4 million were wasted, and 38.9 million were overweight. The number of children with stunting is declining in all regions except Africa. More than half of all children affected by wasting live in Southern Asia, and Asia is home to more than three-quarters of all children suffering from severe wasting (9).

Weight and height are essential anthropometric indicators for all age groups. Studies on malnutrition categorize the population into infants, under-five children, children, adolescents, pregnant women, adults, and the elderly. Various studies have used growth references to define variances in the undernutrition prevalence. The growth references used in studies include the National Center for Health Statistics (NCHS) growth charts, the WHO reference 2007, Centers for Disease Control and Prevention (CDC) growth charts, National Health and Nutrition Examination Survey (NHANES), the WHO reference 1995, Obesity Task Force (IOTF) criteria, and Indian Academy of Pediatrics (IAP) growth charts (10). In 2015, 795 million people (about one in ten) had undernutrition (11). In 2020, one in nine people (820 million) worldwide was hungry (12). Increases in these indicators are in part related to the ongoing COVID-19 pandemic, which continues to highlight the inadequacy of current food and health systems. Experts estimated that by the end of 2020, the pandemic could double the number of people at risk of acute hunger (13), and the prevalence of moderate and severe wasting could increase by 14% due to COVID-19 (14).

Numerous studies have investigated the height and weight curves of children and adolescents in different regions of Iran. It has been found that the height and weight indicators are lower than NCHS standards in parts of Iran, including Mashhad, Tehran, Shiraz, Kashan, Zahedan, Chabahar, Malayer, and Rasht (15-21). People younger than 18 constitute almost half of the population of Iran (12). This vulnerable group requires higher attention. The middle point of childhood (seven to 12 years) is the time of rapid growth and the onset of puberty, doubling the importance of food and nutrition (22).

Consequently, evaluations of the nutritional status of primary school children have been carried out in the world and Iran, indicating problems such as low height, underweightness, thinness, weight gain, and obesity in children (23-27). Children in primary school are among the most vulnerable groups, and their health provides the context to increase their learning (28, 29). The results of growth monitoring can be a basis for planning for the health of society (30). Therefore, the

present study aimed to evaluate the prevalence and risk factors of malnutrition among Iranian primary school children.

2- MATERIALS AND METHODS

The Preferred Reporting Items for Systematic review and Meta-Analysis (PRISMA) checklist was used as the template for this review (31). Based on the definition of the WHO, malnutrition in children is diagnosed when weight for age, height for age (HAZ), or weight for height (WHZ) z-scores are below two standard deviations (2 SD) compared with the international reference median value (32).

2-1. Eligibility criteria

The participants, interventions, comparators, and outcomes (PICO), as a framework, was used to formulate the review objective and inclusion criteria.

2-1-1. Participants: Iranian primary school students (7-12 years old).

2-1-2. Interventions*:* The included studies are non-interventional, so an intervention group did not exist.

2-1-3. Comparison: The study did not have a comparison group.

2-1-4. Outcome: Malnutrition (wasting, stunting, underweight).

2-2. Included studies: The review included studies containing any form of quantitative assessment, measurement, and evaluation of malnutrition in primary school children in Iran. The inclusion criteria were: focusing on malnutrition (undernutrition) among primary school students only, published up to June 2022, written in English or Persian, participants younger than 12 years, and classification of malnutrition according to the National Center for Health Statistics (NCHS)/WHO criteria (33).

2-3. Exclusion criteria: The exclusion criteria were abstracts without the full article, studies on high school students,

reported malnutrition using percentiles or percent of median (not based on the WHO definition of malnutrition), articles not written in English or Persian, review articles, meta-analyses, letters to the editor, editorials, short reports, case reports, and briefs.

2-4. Information sources

A systemic search of electronic databases Medline, EMBASE, Scopus, Web of Science, Cochrane Library, CIVILICA, SID, Magiran, and Google Scholar search engine was conducted. The search was done independently and in duplication by two reviewers, and any disagreement between the reviewers was resolved by the supervisor.

2-5. Search

Keywords were obtained from MeSH and also extracted from related articles. Search words were a combination of (Students OR Primary school children OR Elementary students OR Children) AND (Malnutrition OR undernutrition OR Wasting OR Stunting OR Underweight) AND (Prevalence) AND (Iran).

2-6. Study selection

A database search was done for possible studies, abstracts were screened for eligible studies, full-text articles were obtained and assessed, and a final list of included studies was made. In addition to primary articles, their references were also searched for additional studies. This process was done independently and in duplication by two reviewers, and any disagreement was resolved by the third reviewer. References were organized and managed using EndNote software (version X8).

2-7. Data collection process

A researcher's form was developed and followed for each study. Two reviewers collected the data independently. The following data were extracted for all

studies: first author, year of study, study location, sample size, age group, gender, and the prevalence of malnutrition. The collected data were combined and compared for accuracy, and any discrepancies were solved by a third reviewer.

2-8. Risk of bias in individual studies

The quality of studies was assessed through the Quality Assessment Checklist for Prevalence Studies (34). The total score of this checklist was categorized into three subgroups, including low risk (0–3), moderate risk (4–6), and high risk (7–9) of bias. Studies with a low risk of bias were included in this systematic review.

2-9. Synthesis of results

Due to the difference in the included studies, study designs, age groups in some studies, and sample size, a meta-analysis was not conducted.

2-10. Ethics statement

Ethical approval was not required for this study as it is a systematic review.

3- RESULTS

Based on the initial search in national and international databases, 12 related articles were selected (**Figure 1**). The prevalence of malnutrition was relatively high according to the weight for age (46.6%), the height for age (36.9%), and the weight for height (53.3%) indicators for boys and girls in primary schools in Sistan and Balochistan, Kerman, and Kurdistan provinces. The general specifications and data of the selected articles are presented in **Table 1** and the following:

Table-1: General characteristics of included studies (n=12).

Author, (Reference)	Study location	Study design	Sample size	Age group	Gender	Prevalence of malnutrition
Malekzadeh et al., (35)	Boirahmad	cross-sectional	544	6-12	girl-boy	15.7%, 12.5%, and 3.6% of children suffered from stunting, being underweight, and wasting, respectively.
Gholami et al., (36)	Kerman	cross-sectional	1056	7-12	girl-boy	26.04%, 24.43%, and 24.90% of children suffered from stunting, being underweight, and wasting, respectively.
Darvishi et al., (37)	Kurdistan province	descriptive-analytical study	1100	7-12	girl-boy	The prevalence of malnutrition according to the weight-for-age, weight-for-height, and height-for-age indicators was 27.5, 32.3, and 36.9%, respectively.
Hajian et al., (38)	Babol	cross-sectional	1000	7-12	girl-boy	The rates of underweightness, overweightness, and obesity were 13.5%, 12.3%, and 5.8%, respectively.
Karajibani et al., (39)	Iranshahr	cross-sectional	1000	6-14	girl-boy	50.2%, 46.6%, and 18.1% of children suffered from stunting, being underweight, and wasting, respectively.
Esfarjani et al., (40)	Tehran	case-control	3147	7	girl-boy	The prevalence of stunting was 3.7%.
Pasdar et al., (41)	Kermanshah	cross-sectional	704	7-12	girl-boy	The prevalence of wasting, overweightness, and obesity were 16.7%, 13.2%, and 4.3%, respectively.

Dehghan et al., (42)	Larestan	descriptive-analytical	876	7-12	girl-boy	6.5%, 7.3%, and 9.8% of children suffered from stunting, being underweight, and wasting, respectively.
Nowrozi et al., (43)	Golpaygan	descriptive-analytical	1062	7-12	girl-boy	3% and 5.4% of children suffered from stunting, and being underweight, respectively.
Delvarianzadeh et al., (44)	Villages of Shahrood	cross-sectional	890	6-12	girl-boy	15.3%, 14.7%, and 11.6% of children suffered from stunting, being underweight, and wasting, respectively.
Karajibani et al., (45)	Zahedan	randomized systemic method study	2067	7-11	girl	15.6% of students were underweight, 9% being wasting, and 15% suffered from stunting.
Veghari et al., (46)	North of Iran	cross-sectional	5698	7-12	girl-boy	The results showed that malnutrition was observed in 3.20%, 4.93%, and 5.13% based on underweight, stunting, and wasting, respectively.

1. A cross-sectional study on 544 schoolchildren aimed to determine the prevalence of protein-energy malnutrition in rural schoolchildren of Boirahmad. The results showed that based on the -2 SD cutoff point for indices, 15.7% (95%CI=12.6-18.8), 12.5% (95%CI=9.9-15.5), and 3.6 % (95%CI= 2-5.2) of children who suffered from stunting, being underweight, and wasting, respectively. Girls had a better height for their age than boys. Parents' education and father's job had a significant association with height for age (35).

2. A cross-sectional study on 1056 students aimed to determine the prevalence of malnutrition among school children in Kerman. The results showed that the prevalence of malnutrition based on weight-for-age, height-for-age, and weight-for-height was 6.06, 5.58, and 75.9%, respectively. The average prevalence of malnutrition with the above indicators was 24.43, 26.04, and 24.90%, respectively. A comparison of weight-for-age and weight-for-height indices in children showed a higher prevalence of malnutrition in girls than in boys (p<0.05) (36).

3. A descriptive-analytical study on 1100 students investigated the level of malnutrition and its related factors among elementary school students in the Kurdistan province. The results showed that the prevalence of malnutrition according to the weight-for-age, weight-for-height, and height-for-age indicators was 27.5, 32.3, and 36.9%, respectively. There was a statistically significant relationship between mothers' occupation and chronic malnutrition (height for age) as well as weight for the height of students. Also, there was a statistically significant relationship between parents' education level and height for age and weight for height indices. There was a statistically significant relationship between weekly meat consumption, soft drink consumption, cheese and milk consumption, and chronic malnutrition. There was also a statistically significant relationship between the consumption of junk snacks and weight for the height of students (37).

4. A cross-sectional study on 1000 primary school children aged 7-12 aimed to determine the prevalence of obesity, overweightness, and underweightness among primary school children in Babol. The results showed that the overall rates of

underweightness, overweightness, and respectively. The prevalence of underweightness was more common in public schools (38).

5. A cross-sectional study on 1000 6 to 14-year-old primary school children aimed to evaluate the anthropometric indices of primary school children in Iranshahr in the center of Sistan and Baluchestan province. The results showed that thinness was significantly more prevalent in public schools than in private schools (18.1% vs. 1%; p< 0.0001). The stunting and underweightness rates in public and private schools were 50.2% vs. 53.3% (p = 0.11), and 46.6% vs. 35% (p<0.0001), respectively. This means that although nutritional status was better in private schools, malnutrition is still a public health problem in this area (39).

6. A case-control study on 3147 schoolchildren aimed to investigate the determinants of stunting in first-grade primary school children of Tehran in 2007. The results showed that the prevalence of stunting was 3.7%. Birth weight, fathers' height, and maternal age were the main contributing factors to stunting in the studied population (40).

7. A cross-sectional study on 704 primary school children aimed to determine the relationship between dietary habits and educational achievement among primary school children in the Kermanshah suburbs. The results showed that according to the body mass index (BMI) percentiles, the prevalence of wasting, overweightness, and obesity were 16.7, 13.2, and 4.3%, respectively. A total of 3.3% of children attended the school without having breakfast, and 17.3% attended with irregular breakfast eating (41).

8. A descriptive-analytical study on 876 elementary school students aimed to investigate the prevalence of malnutrition in elementary students of Larestan County. The results showed that the prevalence of

obesity were 13.5%, 12.3%, and 5.8%, weight-for-age, height-for-age, and weight-for-height malnutrition were 7.3%, 6.5%, and 9.8%, respectively. Weight-for-age and weight-for-height malnutrition were more prevalent in female children (p<0.05) (42).

9. A descriptive-analytical study on 1062 primary school students aimed to investigate the rate of underweightness, underweightness, and stunting among primary school students in rural and urban areas of Golpaygan. According to the mean malnutrition index in the studied population, the weight for age on the Z scale (WAZ) was 5.4%, and the height for age on the Z scale (HAZ) was 3%. Malnutrition was less prevalent in girls than boys (43).

10. A cross-sectional study on 890 elementary school students aimed to investigate the prevalence of protein-energy malnutrition and the effective factors among students aged 6-12 years in the villages of Shahrood. The results showed that the prevalence of malnutrition for weight for age, height for age, and weight for height were 14.7%, 15.3%, and 11.6%, respectively. Chronic malnutrition had the highest rate (44).

11. A randomized systemic method study on 2067 girls aged 7-11 years aimed to determine the prevalence of obesity and wasting in primary school girls in Zahedan. The results showed that according to the weight for age, weight for height, and height for age indicators, 15.6% were underweight, 9% had wasting, and 15% had stunting. According to percentiles of weight for height, 11.2% and 14.2% of the students were wasting in lower and higher classes, respectively. Based on the body mass index, 33% of students were thin (45).

12. A cross-sectional study on 5698 primary students (2505 Fars-native, 2154 Turkman, and 1039 Sistani) aimed to

assess malnutrition and related socio-economic factors based on three ethnic groups among primary school children in the North of Iran. The results showed that malnutrition was observed in 3.20%, 4.93%, and 5.13% based on underweight, stunting, and wasting, respectively. It was more common in girls than in boys and Sistanis than in other ethnic groups. The correlation between malnutrition based on underweightness, stunting, and ethnicity was statistically significant (p=0.001). Results of the logistic regression analysis showed that the risk of malnutrition in rural areas was 1.34 times higher than in urban areas, in girls 1.17 times more than boys, in the Sistani ethnic group 1.82 times more than Fars-natives, and in low-income families was 2.01 times more than high-income families (46).
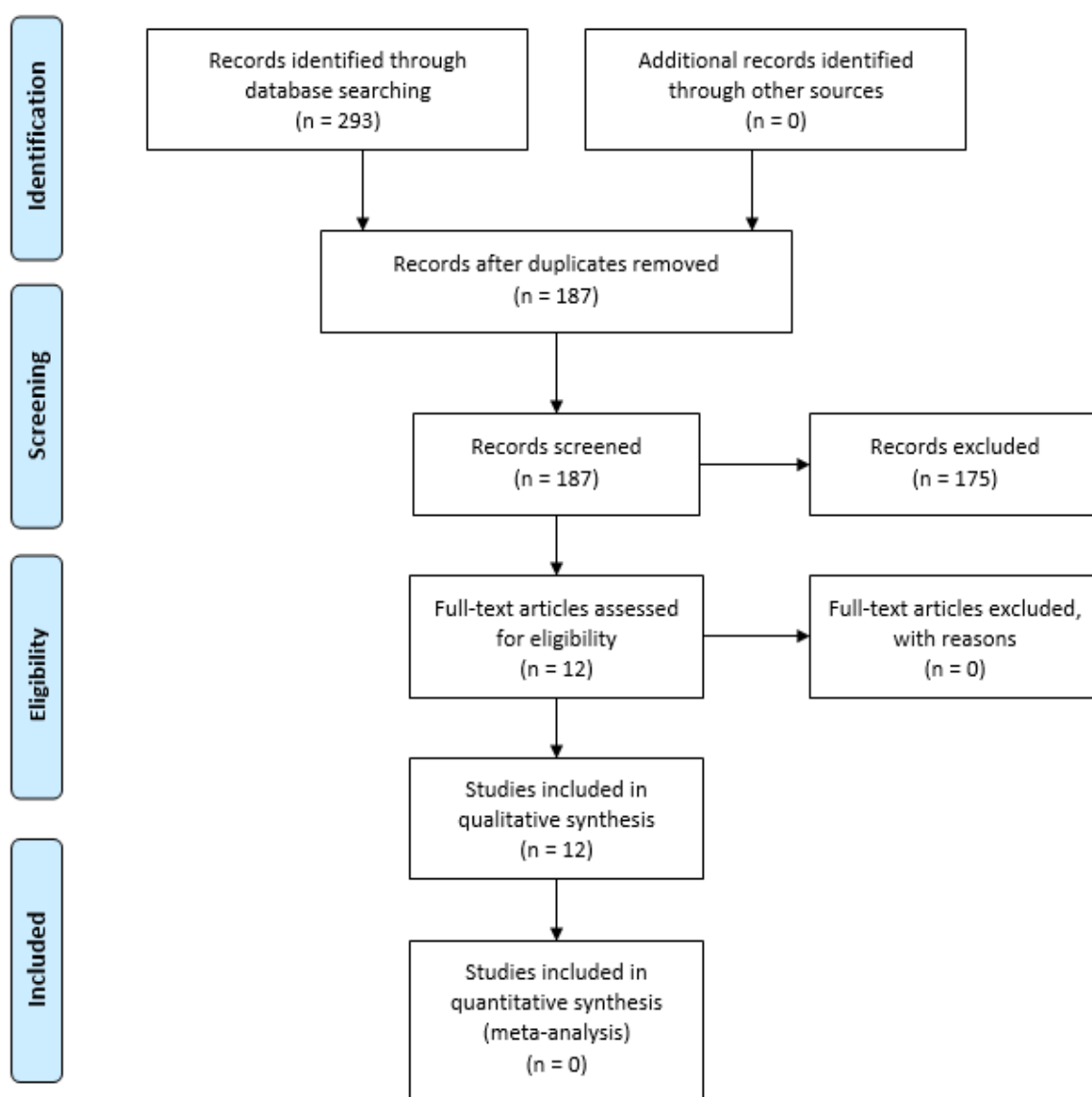
Fig.1: PRISMA flowchart.

4- DISCUSSION

This systematic review aimed to evaluate the prevalence and risk factors of malnutrition among Iranian primary school children. The results showed that the prevalence of malnutrition in all its forms, including wasting, stunting, and underweightness, was 53.3%, 36.9%, and 46.6%, respectively. The prevalence of malnutrition was high in Sistan and Balochistan, Kerman, and Kurdistan provinces. The logistic regression analysis showed that the risk of malnutrition in rural areas was 1.34 times more than in urban areas and in girls 1.17 times more than in boys. Weight at birth, parents' education, fathers' height, fathers' job, family income, and maternal age were the main contributing factors to malnutrition in the studied population (p<0.05).

Malnutrition is the most serious childhood health problem and the primary cause of child mortality in the WHO Eastern Mediterranean Region. Nearly one-third of children in the region are either underweight or stunted, and more than 30% suffer from micronutrient deficiencies (47). Malnutrition refers to deficiencies, excesses, or imbalances in a person's intake of energy and nutrients. The term malnutrition addresses three broad categories:

- Undernutrition, including wasting (low weight-for-height), stunting (low height-for-age), and underweightness (low weight-for-age);

- Micronutrient-related malnutrition, including micronutrient deficiency (a lack of important vitamins and minerals) or micronutrient excess, and

- Overweightness, obesity, and diet-related non-communicable diseases (e.g., heart disease, stroke, diabetes, and some cancers) (48).

The percentage of children with a low height-for-age (stunting) reflects the cumulative effects of undernutrition and infections since birth and even before birth. This measure can be an indication of poor environmental conditions or long-term restriction of a child's growth potential. The percentage of children with low weight-for-age (underweight) can reflect wasting (i.e., low weight-for-height), indicating acute weight loss, stunting, or both. Thus, underweightness is a complex indicator that may be difficult to interpret (3-5).

In 2020, 149.2 million children under five were stunted, 45.4 million were wasted, and 38.9 million were overweight. More than half of all children affected by wasting live in Southern Asia, and Asia as a whole is home to more than three-quarters of all children suffering from severe wasting (48, 49). It is estimated that nearly one in three persons has at least one form of malnutrition, i.e., wasting, stunting, vitamin or mineral deficiency, overweightness, obesity, or diet-related non-communicable diseases (6). Undernutrition is more common in developing countries (7). Stunting is more prevalent in urban slums than in rural areas (8). In Asia, India has one of the highest prevalences of wasting, with over 20%-wasted children (50).

Underweightness and thinness were higher among children in public schools than in private schools. Similarly, several studies indicated that underweightness in public schools was more prevalent than in private schools (51, 52). Karajibani et al. found that the rate of stunting was higher in students who attended private schools (53.3 %) than in public schools (50.2 %) (39). The discrepancy in results can be due to study methods and reference values. However, further studies are necessary to evaluate the nutritional status of children in public and private schools. Various causes are involved in the malnutrition of

children (54). The findings of the present study confirm that wasting was more noticeable in children aged 7–11 years than underweightness and stunting. This finding was comparable with a study in Nigeria by Adedeji et al. In this study, the prevalence of thinness was 11.1%, underweight had a prevalence of 10.7%, and 10.1% of children were stunted (53). A study in India also showed that most malnourished children were underweight, 33.3% of children were wasted, and 18.5% were stunted (54). The findings of the current systematic review showed that the risk of malnutrition was higher in girl students than in boys. Another study on schoolchildren in urban slums of India showed that malnutrition was significantly more prevalent in girls than boys. These findings may be due to family size, gender bias, parents' attention to boys, and parental preferences for male children in some areas (54). However, several studies indicated that malnutrition in boys was consistently more common than in girls (54-57), which is not consistent with the present study. UNICEF reports show that the prevalence of underweightness in boys and girls is similar in developing countries (58).

Residence in urban or rural areas is another contributing factor to malnutrition among schoolchildren. The current review revealed a higher prevalence of malnutrition in rural areas than in urban areas. However, in India, the concentration of stunting in children living in urban areas is higher than in rural areas (59). Other findings of the present study included the high rate of slimness, underweightness, and short stature in rural areas compared to urban areas. Similar results have been reported in other studies in other parts of the world (60-62). Access to food, safe water, and sanitation can have a role in different results. The present study also found that parental education level, weight at birth, father's height, father's job,

family income, and maternal age were the primary factors influencing the prevalence of malnutrition indices. The review articles and systematic reviews conducted in South Asia and sub-Saharan Africa have reported that factors such as low income, food shortage, parents illiteracy, and food insecurity are associated with malnutrition (63, 64). Malnutrition is usually associated with poverty, unsafe water, inadequate sanitation, insufficient hygiene, societal problems, diseases, maternal factors, and gender issues, among others (65). The WHO reported that two out of five children that are stunted live in Southern Asia (66). In Iran, the prevalence of malnutrition was higher in less privileged areas such as Kurdistan, Kerman, and Sistan and Baluchestan provinces.

4-1. Study Limitations

1. Due to the lack of sufficient information, this study did not provide a complete review of prevalence of malnutrition among primary school children in Iran.

2. Not all articles contained comprehensive and detailed data on all the reviewed elements.

3. There was considerable heterogeneity in the way studies reported their findings that limited some of the comparisons made in the present research.

4. The stated results are specific to Iranian society and primary school children and cannot be generalized to other societies.

5- CONCLUSION

Malnutrition varied in different regions of Iran. The results showed that 53.3%, 36.9% (range: 3-36.9%), and 46.6% (range: 3.2-46.6%) of primary school children (7-12 years old) suffered from wasting (range: 3.7-53.3%), stunting (range: 3-36.9%), and underweightness (range: 3.2-46.6%), respectively. It can be concluded that the prevalence of

malnutrition in Iranian schoolchildren in the Sistan and Balochistan, Kerman, and Kurdistan provinces was relatively high in terms of wasting, stunting, and underweightness. Weight at birth, parental education, father's height, father's job, and maternal age were the primary contributing factors to stunting in the studied population. Chronic malnutrition had a statistically significant relationship between soft drink consumption and weekly consumption of meat and dairy products. Weight-for-age and weight-for-height malnutrition were more prevalent in female children ($p<0.05$).

6- CONFLICT OF INTEREST: None.

7- REFERENCES

1. Grantham-McGregor SM, Powell CP, Walker SP, Himes JH. Nutritional Supplementation,
Psychosocial stimulation, and mental development of stunted children: the Jamaican Study. Lancet 1991; 6: 1-5.

2-Marambio M, Ivanovic D. Nutrition and education: Educational achivement and anthropometric parameters of childrenelementary and high school graduates. Nutr Rep Int 1998; 39:983-93.

3. de Onis M, Borghi E, Arimond M, Webb P, Croft T, Saha K, De-Regil LM, Thuita F, Heidkamp R, Krasevec J, Hayashi C, Flores-Ayala R. Prevalence thresholds for wasting, overweight and stunting in children under 5 years. Public Health Nutr. 2019 Jan;22(1):175-179. doi: 10.1017/S1368980018002434. Epub 2018 Oct 9.

4. WHO. Global nutrition targets 2025: stunting policy brief. Geneva: World Health Organization; 2014 (http://who.int/nutrition/publications/globaltargets2025_policybrief_stunting/en/).

5. WHO, United Nations Children's Fund (UNICEF), World Food Programme (WFP). Global nutrition targets 2025: wasting policy brief. Geneva: World Health Organization; 2014 (http://who.int/nutrition/publications/globaltargets2025_policybrief_wasting/en/).

6. WHO. The double burden of malnutrition. Policy brief. Geneva: World Health Organization; 2017.

7. Liz Young. World Hunger Routledge Introductions to Development. 2002, p. 20. ISBN 978-1-134-77494-4.

8. Murarkar, S., Gothankar, J., Doke, P., Pore, P., Lalwani, S., Dhumale, G., et al. Prevalence and determinants of undernutrition among under-five children residing in urban slums and rural area, Maharashtra, India: a community-based cross-sectional study. BMC Public Health, 2020; 20(1): 1559. doi: 10.1186/s12889-020-09642-0.

9. WHO. www.who.int. Retrieved November 19, 2021.

10. Estecha Querol, S., Al-Khudairy, L., Iqbal, R., Johnson, S. and Gill, P., 2021. Adolescent undernutrition in South Asia: a scoping review protocol. BMJ Open, 2021;10(1):e031955.

11. The State of Food Insecurity in the World 2018. Food and Agricultural Organization of the United Nations. 2020. doi:10.4060/CA9692EN.

12. Mark HE, Dias da Costa G, Pagliari C, Unger SA. "Malnutrition: the silent pandemic". BMJ, 2020; 371: m4593. doi:10.1136/bmj.m4593.

13. Goal 2020: Zero Hunger-United Nations". Available at: https://www.un.org/sustainabledevelopment/hunger/.

14. Mark HE, Dias da Costa G, Pagliari C, Unger SA. "Malnutrition: the silent pandemic". BMJ, 2020;371: m4593. doi:10.1136/bmj.m4593.

15. Rajabian R, Parizadeh J, Shahbazi H, Abdinejad A. Determination of growth criteria in Mashhad. Articles of Children's Diseases Congress of Tehran School of Medical Sciences, Iran, 2012.

16. Karamizadeh Z, Amirhakimi Gh. Investigating the physical growth and appearance of secondary sexual characteristics in 11-14 year old girls in Shiraz city. Research in medicine, 2001;26(2): 129-31.

17. Ershadi A. Statistical Indexes And Weight And Height Curves In 6-18 Years Old

Students Of Kashan In 2000. J Adv Med Biomed Res 2000; 8 (32):41-52.

18. Montazerifar F, Karaji Bani M, Shahrakipour M. Investigating the growth pattern in 11-19-year-old girls in Zahedan city. Journal of Shahid Sadoughi University of Medical Sciences and Health Services, 2001; 10(3): 74-9.

19. Hedayati Emami M. Barzegar S, Mirahmad E. Checking the height and weight of Rasht and Sangar students 1993;2(6, 7): 12-20.

20. Ramezankhani A. School health. 4th ed. Teran: Vaghefi publisher; 2001.

21. Ghiasvand R, Ghafarpour M, Hushyar Rad A. Investigating the prevalence of obesity and underweight in 7-year-old primary school children in Malair city in the academic year of 2008-2009. The 6th Iranian Nutrition Congress, 2008, p.32.

22. Hoseinipourabdollahi P. The nutritional problems of school children. J Ziton. 1998;2(24):32-40.

23. Sebastin SM, Santi S. The health Status of rural school children in the Amazon Basin of Ecuador

Journal, Trop Pediatrics 1999; 45: 379-82.

24. AL-Sharbati MM, Younan AA, Sudani HO. Growth pattern of primary schoolchildren in Benghazi Libya. Journal for Scientific Research, Medical Sciences 2001; 1: 45-9.

25. Mostofi F. Investigating the nutritional status of primary school children and some factors affecting it in the 13th education district of Tehran. Master's thesis in health Sciences, Islamic Azad University, Tehran branch, 2013.

26. Aminpoor A, Habibi M. The nutritional status of primary school children and adolescents aged 6-12 years in Mashhad. 1988;5:46-52.

27. Ghorbani J. Investigating the prevalence of energy protein malnutrition among primary school students in Zanjan city. Journal of Advances in Medical and Biomedical Research, 1998;23(6):24-31.

28. Tomkins A, Watson F. Malnutrition and Infection: a review. ACC/SCN Nutrition Policy Discussion paper No. 1989; 5: 1-136.

29. ACC/SCN. Ending Malnutrition by 2020: An agenda for change in the millennium. Food and Nutrition Bulletin 2000; 21: 3-88.

30. Ramazani AA, Raghebi SS, Amirkhizi F, The survey of the nutritional status and related factors in 0-24 month-old children in South Khorasan province in Iran 2006, Iranian Journal of Epidemiology 2010; 5(4): 8-13

31. Moher D, Shamseer L, Clarke M, Ghersi D, Liberati A, Petticrew M, Shekelle P, Stewart LA; PRISMA-P Group. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. Syst Rev. 2015 Jan 1;4(1):1. doi: 10.1186/2046-4053-4-1.

32. ECoPS W Physical status: The use of and interpretation of anthropometry. Report of a WHO Expert Committee. Geneva: World Health Organization; 1995.

33. Silveira CR, Beghetto MG, Carvalho PR, Mello ED. Comparison of NCHS, CDC and WHO growth charts in the nutritional assessment of hospitalized children up to five years old. Nutr Hosp. 2011 May-Jun;26(3):465-71. doi: 10.1590/S0212-16112011000300006. PMID: 21892562.

34. Hoy D, Brooks P, Woolf A, Blyth F, March L, Bain C, et al. Assessing risk of bias in prevalence studies: Modification of an existing tool and evidence of interrater agreement. J Clin Epidemiol 2012;65:934-9.

35. JM Malekzadeh, E Hatamipour, E Afshoon. Protein-Energy Malnutrition in School Children of Boirahmad Rural Areas, Iran. Iran J Public Health. 1;32(3):41-46.

36. Gholami M, Dehghan A, Kargar N, Mohammadi P, Moosazadeh M, Hadi zadeh H. Prevalence of malnutrition in children 7-12 years old in Kerman, 2013. JCHR 2014; 2 (4): 261-66.

37. Darvishi S, Hazhir M S, Reshadmanesh N, Shahsavari S. Evaluation of malnutrition prevalence and its related factors in primary school students in Kurdistan Province. SJKU 2009; 14 (2):78-87.

38. Hajian K, Sajadi P, Rezvani AR. Prevalence of overweight and underweight among primary school children aged 7-12 years (BABOL 2006). Journal of Babol University of Medical Sciences. 2008 Aug 10;10(3):83-91.

39. Karajibani M, Montazerifar F, Asoudeh H, Asoudeh M, Dashipour A R. Anthropometric Indices in Primary School Children of Iranshahr City, Iran. JNFS 2019; 4(4): 249-55.

40. Esfarjani F, Roustaee R, Mohammadi F, Esmaillzadeh A. Determinants of stunting in school-aged children of tehran, Iran. Int J Prev Med. 2013 Feb;4(2):173-9. PMID: 23543188.

41. Pasdar Y, Mozafari HR, Darbandi M, Niazi P. Educational achievement relationship with nutritional status and primary school children growth in suburb areas of Kermanshah (2012). koomesh. 2014 Jun 10;15(4):541-50.

42. Dehghan A, Ershad Langroudi M, Kamali Sarvestani M, Shahoseini S. Prevalence of malnutrition in primary school students of Larestan in 2010. Journal of North Khorasan University of Medical Sciences, 2010; 2(4): 25-8.

43. Nowrozi H, Kazemi A, Tavakoli M, Alavi S, Bangalah Z. Determination of slimness, low weight and low growth rates in rural and urban schoolboys in Golpayegan. Payavard 2011; 5 (1):40-6.

44. Delvarianzadch M., Sadeghian F. Malnutrition prevalence among rural school students. Payesh, 2006; 5(4). URL: http://payeshjournal.ir/article-1-728-fa.html.

45. Karajibani M, Montazerifar F, Mohamadi SM, Dashipour AR. The prevalence of obesity and wasting in primary school girls in the city of Zahedan. Zahedan Journal of Research in Medical Sciences. 2004 Dec 31;6(4).

46. Veghari G. The relationship of ethnicity, socio-economic factors and malnutrition in primary school children in north of Iran: a cross-sectional study. J Res Health Sci. 2012 May 29;13(1):58-62. PMID: 23772007.

47. World Health Organization. Nutrition in the Eastern Mediterranean Region. Available from:

http://www.emro.who.int/entity/nutrition/.

48. Levels and trends in child malnutrition: UNICEF/WHO/The World Bank Group joint child malnutrition estimates: key findings of the 2021 edition. Available at: file:///C:/Users/saeidim911/Downloads/JME-2021-United-Nations-regions-v2.pdf.

49. Malnutrition, over view. Available from: https://www.who.int/health-topics/malnutrition#tab=tab_1.

50. Gautam, S., Verma, M., Barman, S. and Arya, A., 2018. Nutritional status and its corelates in under five slum children of Kanpur Nagar, India. International Journal of Contemporary Pediatrics, 2018;5(2): 584.

51. Agbozo F, Atito P, Abubakari A. Malnutrition and associated factors in children: a comparative study between public and private schools in Hohoe Municipality, Ghana. BMC Nutrition2016; 2(32). https://doi.org/10.1186/s40795-016-0073-7.

52. Ashok, N.C., H.S. Kavitha and P. Kulkarni, 2014. A comparative study of nutritional status between government and private primary school children of Mysore city. Int. J. Health Allied Sci., 3: 164-69.

53. Adedeji I, John C, Okolo S, Ebonyi A, Abdu H. Bashir M. Malnutrition and the Intelligence Quotient of Primary School Pupils in Jos, Nigeria. Br J Med Med Res 2017;21:1-13.

54. Srivastava A, Mahmood E, Srivastava PM, Shrotriya VP, Kumar B. Nutritional status of school-age children - A scenario of urban slums in India. Archives of public health, 2012; 70 (1): 8.

55. Kyriazis I, Rekleiti M, Saridi M, Beliotis E, Toska A, Souliotis K, Wozniak G. Prevalence of obesity in children aged 6-12 years in Greece: nutritional behaviour and physical activity. Archives of medical science. 2012 Nov 9;8(5):859-64.

56. Shafieian, T., A. Latiff, L., Huang Soo Lee, M., Mazidi, M., Ghayour Mobarhan, M., Tabatabaei, G., Ferns, G. Determinants of Nutritional Status in Children living in Mashhad, Iran. International Journal of Pediatrics, 2013; 1(2): 9-18. doi: 10.22038/ijp.2013.2214

57. Jafari S, Fouladgar M, Naeeni MM, Fakhri M, Fatemi SA, Heidari K, Bagheri S. Body Mass Index, Weight-for-age, and Stature-for-age Indices in Iranian School Children in Relation to Weight and Growth Disorders: A Population-based Survey. Int J Prev Med. 2014 Dec;5(Suppl 2):S133-8. doi: 10.4103/2008-7802.157674. PMID: 26157563; PMCID: PMC4476001.

58. Fotso JC. Urban-rural differentials in child malnutrition: trends and socioeconomic correlates in sub-Saharan Africa. Health Place 2007;13:205-23.

59. Singh S, Srivastava S, Upadhyay AK. Socio-economic inequality in malnutrition among children in India: an analysis of 640 districts from National Family Health Survey (2015–16). Int J Equity Health. 2019;18:203. Medline:31881899 doi:10.1186/ s12939-019-1093-0.

60. Fotso JC. Urban-rural differentials in child malnutrition: trends and socioeconomic correlates in sub-Saharan Africa. Health Place 2007;13:205-23.

61. Smith LC, Ruel MT, Ndiaye A. Why is child malnutrition lower in urban than in rural areas? Evidence from 36 developing countries. World Dev 2005;33:1285-305.

62. Sahn DE, Stifel DC. Urban–rural inequality in living standards in Africa. J Afr Econ 2003;12: 564-97.

63. Akhtar S. Malnutrition in South Asia-a critical reappraisal. Crit Rev Food Sci Nutr 2016;56:2320-30.

64. Akombi B, Agho KE, Hall JJ, Wali N, Renzaho A, Merom D. Stunting, wasting and underweight in sub-saharan Africa: a systematic review. Int J Environ Res Public Health 2017;14:863.

65. 6. Prüss-Üstün, A., Bos, R., Gore, F., Bartram, J. Safer water, better health – Costs, benefits and sustainability of interventions to protect and promote health. World Health Organization (WHO), Geneva, Switzerland, 2008.

66. UNICEF, WHO, World Bank Group. "Levels and trends in child malnutrition" (PDF), 2019. Available from: https://www.unicef.org/reports/joint-child-malnutrition-estimates-levels-and-trends-child-malnutrition-2019.