Original Article

Dietary and Socio-Economic Predictors of Obesity Among 2–5-Year Old in Northwest Iran

Abstract

Background: As a rising epidemic in developing countries, childhood obesity and overweight need particular attention. **Methods:** The sample (n = 2432) was randomly selected among children aged 24–59 months living in West Azerbaijan Province whose information was recorded in SIB software. The survey questionnaire is derived from the Demographic and Health Survey and the Multiple Indicator Cluster Survey questionnaires designed by the WHO 2017 and UNICEF 2017, respectively. **Results:** The prevalence of obesity defined as BMIz (body mass index z-score)> +2 was 1.4% among children. Dietary diversity score (DDS) was high in 59.3% of children, moderate in 36.1%, and low in 4.6%. Socio-economic status (SES) of children families was high, moderate, and low in 34%, 28.9%, and 37.1% of families, respectively. Physical activity hours were over 3 in 85.9% of children. The girls were more likely to be obese than the boys (OR = 0.43, P = 0.016). Those with high and moderate DDS were less likely to be obese than those with low DDS (OR = 0.250 and OR = 0.180, respectively). The likelihood of obesity among children with high and moderate SES were 2.6 and 1.6 times more compared to children with low SES, respectively. **Conclusions:** According to the results, DDS and physical activity levels are related to obesity in children aged 24–59 months. Therefore, establishing proper nutritional behavior and promoting a healthy lifestyle are essential for preventing obesity and non-communicable diseases in this age group.

Keywords: *Child, dietary diversity score, economic and social status, exercise, obesity*

Introduction

The optimal growth and development of children, especially in the first 5 years of a child's life, can be seriously affected by the consequences of malnutrition such as stunting (low height for age), wasting (low weight for age), overweight or obesity. As a rising epidemic in developing countries, childhood obesity and overweight need particular attention.[1-3] Iran as one of the Middle Eastern countries with rapid demographic, economic, and diet transition has experienced a shift in dietary behavior from traditional to western style which is manifested in increased consumption of low nutrient and high-calorie foods, sugar, salt, and processed foods, increased energy intakes and decreased physical activities resulting in higher body mass index (BMI) and fat accumulation. A study conducted on preschool children in Tehran, the capital city, indicates that the prevalence of obesity and overweight in boys and girls were 23.6 and 14.7, respectively.

Dietary intake and nutritional or nutrient adequacy are among the important factors in evaluating children's health. Access to various nutrients from a variety of food items is vital for growth and development in the early years of life. Dietary diversity score (DDS) or the number of food groups consumed over a specific period is one of the important factors in children's nutrient adequacy and optimal nutrition indicators.[4,5] Childhood obesity can predispose obesity in adulthood which is a major risk factor for non-communicable diseases and other associated problems such as Alzheimer's, Parkinson, hyperlipidemia, reduced insulin sensitivity, chronic inflammation, and hypertension in adulthood.[6-9] Studies show that many children are at risk of these problems. The prevalence of metabolic syndrome in Iranian boys and girls is reported to be 10.3% and 9.9%, respectively. Since many eating behaviors and lifestyle habits are established in childhood, this period is highly significant for planning and implementing interventions.[8]

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Policymakers have always been interested in children's health, as one of the development indicators for any country. Because of the limited resources and vulnerability of children, it is important to choose the best strategy to prevent and treat malnutrition in this age group. As to the importance of children's nutritional status and its relevance to other health and development indicators in each population, acquiring relevant data is always a necessity to collect the children's nutritional status data at specific time intervals to be able to respond faster to changing needs.[10,11]

This regional survey aimed to determine the relationship between overweight and obesity status and a child's dietary intakes and determining the relationship between the prevalence of obesity and factors like DDS, socio-economic status (SES), and time spent playing.

Methods

This study used an analytic cross-sectional design drawing samples from the population

Ethics statements

The proposal of this survey is approved by the Research Council of National Nutrition and Food Technology Research Institute and Ethics Committee of National Nutrition and Food Technology Research Institute (reference code: IR.SBMU.NNFTRI.REC.1396.165).

The children's parents were invited by telephone contact to come to the local health center for interviews and measurements on a specific date after verbal explanations. On the interview day in the health center, the outline of research objectives and methodology were presented to them in the written form indicating that they were free to participate in the study or not without any consequences. Then, they were asked to sign a written consent form if they agreed.

Study setting

West Azerbaijan lies in the North West of Iran with a population of more than 3 million, bordering Turkey, Iraq, and the Nakhchivan Autonomous Republic. The region has ethnically a diverse population and is considered relatively affluent. Samples were randomly selected from all children whose data was already recorded in SIB software which is an integrated health record system. With a wide range of demographic information, records of diseases, medical records, and all information affecting individuals' health. It can also communicate with other systems out of the Ministry of Health and Medical Education such as Insurance System, Forensic Medicine, and so on.

Study population and sampling

The base population of this survey consisted of all Iranian children aged 2–5 years old living in West Azerbaijan province. At the time of sampling (October and November 2017), more than 95% of the province's population data were recorded in SIB software. The SIB software can provide the contact information of households with children under 5 years of age. The list was used as a sampling frame for random selection.

Sample size

We used the prevalence of obesity from previous studies to estimate the sample size. The sample size was calculated using ENA (emergency nutrition assessment) software (Alpha 5%, probable prevalence 4%, and acceptable error 0.8%).

A sample of 2509 children in the whole province was studied and eventually, the data for 2432 children were analyzed.

The statistical framework for the random sampling was the information in SIB software in which health network experts across the country record the information needed by all the households in the area covered by the network. Age and sex were considered as weighting variables. Given that access to the age–sex distribution of children across the province was available by the 2016 census, the population distribution of these traits was used for weighting.

Data collection

A protocol was developed to reduce random errors, decrease the inter-rater variation, and eliminating systematic errors (provided as supplementary file).

Questionnaire

The survey questionnaire is derived from the Demographic and Health Survey (DHS) questionnaire designed by the World Health Organization and the Multiple Indicator Cluster Survey (MICS) questionnaires designed by UNICEF. The questionnaire has several sections as follows:
1. General characteristics of the household
2. General characteristics of the child
3. The measured height and weight of the child.
4. The food intake section is based on the standard questionnaire of MICS. Several food items that were not commonly consumed in Iran have been replaced

with local food items. It has been implemented for the first time in Iran.

5. The section on the amount of sleep, play, and child-sitting activities.
6. The socio-economic section consisted mainly of parental literacy and occupation, housing status in terms of occupancy, area, and the number of rooms, and durable living supplies.

Standard indicators and their syntaxes provided by MICS are used to estimate the parameters.[12,13]

Data analysis method

The questionnaires were designed to be read by an optical scanner, then the data were recorded in an Excel file using a specially developed software to reduce both the data entry errors and speed it up. The retrieved Excel data file was examined to find out any missing or odd recordings. If any found it would be compared to the data recorded on the questionnaire.

SES determination

Data on the SES included parents' occupation and literacy, enrollment in aid programs, property ownership, area of residence, the number of rooms, and the existence of durable household equipment and cars. Factor analysis was used to classify households, with all the above variables entered in the model, and a suitable model was designed with varimax rotation. Then, using the score of each household on the first factor, all households were divided into three equal groups so that group one has the lowest score (low socio-economic level) and group three has the highest score (high socio-economic level).

Dietary intake

A report of children's previous 24-h food consumption was asked from their mothers to determine DDS. Reported food items were categorized into seven groups: (1) grains, roots, and tubers, (2) fruits and vegetables rich in vitamin A, (3) other fruits and vegetables, (4) meat, poultry, and fish, (5) eggs, (6) legumes, pulses and nuts, and (7) milk and dairy products. DDS was classified into three levels: high (if six or more food groups consumed), medium (3–5 food groups consumed), and low (<3 food groups consumed).[14]

Results

Table 1 lists the anthropometric status, socio-economic, and dietary diversity indices and physical activity of children aged 2–5 years. The prevalence of obesity or BMIz> +2 was 1.4% among children. More than half of the children (59.3%) had a high dietary score, 36.1% had moderate, and 4.6% had low DDSs. The SES of 34% of children was high, 28.9% moderate, and 37.1% low. Physical activity and playing hours in 14.1% of children were under 3 h while for 85.9% of children, it was over 3 h.

Figure 1 shows the number and percentage of children who consumed different food groups in the past 24 h. In this

Table 1: Dietary diversity, anthropometry and SES and physical activity in 24-59 months children

Variables	Frequency	Percentage
Sex		
Girl	1204	49.5
Boy	1228	50.5
Non-obese	2394	89.6
Obese	34	1.4
DDS		
Low	112	4.6
Medium	879	36.1
High	1441	59.3
SES		
Low	903	37.1
Medium	703	28.9
High	826	34.0
Playing hours		
>3 h	343	14.1
>3 h	2089	85.9

DDS=Dietary diversity score, SES=Socio-economic status

study, 99% of children aged 2–5 years consumed grains, roots, and tubers. Legumes and nuts were consumed by 75% of children in the previous 24 h. About 94% of children consumed from the dairy group and 81% of children reported consumption of meat, poultry, fish, and processed meat the day before. In all, 57% of children had consumed eggs in the past day. Vitamin-A-rich fruits and vegetables were consumed by 67% of the children, and other fruit and vegetables were consumed by 88% of children.

Table 2 shows the odds ratio of obesity-related factors in children 24–59 months old. In this study, the likelihood of obesity and overweight in girls was almost half (0.43) of the boys.

The likelihood of obesity and overweight in children with a high DDS compared to those who had a moderate DDS was 0.25 times lower, and in those with a moderate DDS compared to the ones with a low dietary score, it was 0.18 times lower.

SES was also significantly associated with being overweight and obese, thus children with high and moderate SES were, respectively, 2.6 and 1.6 times more likely to be obese than the children with low SES. The number of hours of physical activity (playing) was significantly correlated with the child's weight. Children who played 3 h or more per day were 0.17 times less likely to be obese than those who played <3 h/day.

Discussion

In recent decades, rapid lifestyle changes and industrialization trends in developing societies have led to an increase in the prevalence of obesity and non-communicable diseases. Researchers have hence

Table 2: Odds ratio of factors related to obesity in 2-5 years children

| Variables	Total *n* (%)	Obese *n* (%)	Adjusted OR	95% CI	*P*
Sex					
Boy	1228 (50.5)	22 (1.8)	Baseline	-	-
Girl	1204 (49.5)	12 (1.0)	0.428	0.215-0.851	0.016
Dietary diversity					
Low	112 (4.6)	4 (3.6)	Baseline	-	-
Medium	879 (36.1)	9 (1.0)	0.180	0.061-0.530	0.002
High	1441 (59.3)	21 (1.5)	0.250	0.092-0.683	0.007
Socio-economic status					
Low	903 (37.1)	6 (0.7)	Baseline	-	-
Medium	703 (28.9)	10 (1.4)	1.588	0.615-4.103	0.340
High	826 (34.0)	18 (2.2)	2.644	1.090-6.413	0.032
Playing hours					
>3 h	343 (14.1)	10 (2.9)	Baseline	-	-
≥3 h	2089 (85.9)	24 (1.2)	0.168	0.110-0.256	0.000
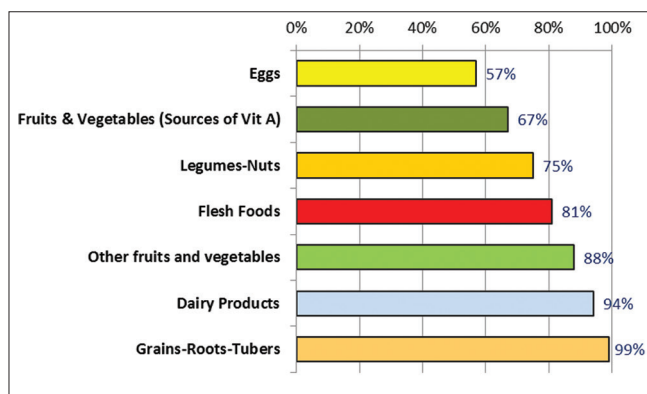
Figure 1: Dietary group consumption by 24–59 months children in the past 24 h

designed different interventions to prevent the rising prevalence and especially the childhood period has been investigated.[15,16] This study aimed to evaluate the status of obesity and its associated risk factors such as nutritional status and physical activity in 2–5 years old children in West Azerbaijan, Iran.

Among 2432 children aged 2–5 years old study, the prevalence of obesity was 1.4% which was lower in comparison to other provinces in Iran. According to a study by Kelishadi *et al*., (2014), the prevalence of obesity and overweight was 10.5% in girls and 14.3% in boys from 2000 to 2010. In general, boys and girls aged 2–6 had higher BMI in the western part of Iran compared to the eastern part.[17] A study conducted in West Azerbaijan Province from 2009 to 2011 showed that the prevalence of obesity and overweight in primary school children increased from 59.45 per 1000 children in 2009 to 77.58 in 2011. The study showed an increasing trend in obesity for these 2 years in all primary, secondary, and high school children and adolescents.[18]

In rich countries, the prevalence of obesity or BMI ≥30 is higher among poorer households, and in low-income countries, the prevalence of obesity and overweight is higher among affluent people. Urbanization, industrialization, and economical improvements along with nutritional transitions and availability of cheap high-calorie foods could lead to a higher prevalence of obesity in developing countries. Such high-calorie diets combined with a sedentary lifestyle have led to an increasing trend in BMI in developing countries.[19] The increase in the prevalence of obesity in Iranian children is also attributed to the low birth weight of Iranian children. Low birth weight is associated with a growth spurt in childhood. When nutritional behavior is not appropriate, children are prone to weight gain and are more likely to develop NCDs later in life.[20]

In the present study, the results show that children with lower DDSs were more likely to be obese than children with moderate and high DDSs. This finding was in line with the study by Sorrie *et al*. in northern Ethiopia possibly because preschoolers' favorite high-fat and sweet foods are usually offered in higher portions and size in their diet, and this reduces the intake of other food groups. Besides, Due to its low price and high availability, sweet foods (generally cereal-based foods) serve as a reward for this age group, and their consumption will result in high-energy intake, fat accumulation, and obesity.[14]

In the present study, on the one hand, children with higher SES were 2.6 times more likely to be obese than children with lower SES, and, on the other hand, obesity was more likely in a group with a low diet diversity score. These results are in line with the study by Salehi-Abargouei *et al*. that showed obese children with better SES living in urban areas had lower DDS evidence shows that in developing countries the higher prevalence of obesity is seen in groups with higher SES while in developed countries it is the opposite, that is, the lower the SES is, the higher the prevalence of obesity and overweight.[20] SES has different components that can have different effects on the childhood obesity in different countries.[21-23]

In this study, the probability of being obese in children with higher physical activity and playing time (>3 h/day) was 0.16 compared to the children with less physical activity and playing l <3 h/day.

Some studies show that sleep duration and sedentary activities are associated with obesity.[24,25] Talarico *et al.* discussed that adding 18 min/day to intense physical activity, 21 min/day to light physical activity and 67 min/day to sleep time while decreasing sedentariness by 87 min/day, reduces BMI z-score by 0.1 unit. Various forums including AAP, AHA, and National Association for Sport and Physical Education (NASPE) recommends that children between 3 and 5 years of age should have at least 30–60 min of continuous and planned physical activity. It is also recommended that children should not spend <60 min in sedentary mode except for bedtime, and using computers and television should be limited to <2 h/day.[26] Most studies, as well as our study, suggest an inverse association between obesity and a child's physical activity. This may be because of spending more time watching television, playing computer games, and eating junk foods. Imbalance of energy intake and expenditure can lead to fat accumulation and obesity over time.[24,25]

Conclusions

In this study, over 80% of children aged 2–5 years had normal BMIz, 4.7% were obese, 9.8% were overweight, and 8.6% were prone to obesity. Children's DDS was positively correlated with children's weight status so that the children with lower diet diversity scores were more likely to be obese. The SES of children was also associated with being obese, that is, the higher the SES was, the greater the likelihood of being obese. Children who played 3 h or more per day were less likely to be obese. Iran, as one of the developing countries, requires community-wide policymaking and planning for the preschool age group due to the high prevalence of overweight. In this stage of life, intervention plays an important role in establishing healthy eating habits and improving lifestyles to prevent obesity and non-communicable diseases later in life.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Conflicts of interest

There are no conflicts of interest.

References

1. Davoudi-Kiakalayeh A, Mohammadi R, Pourfathollah AA, Siery Z, Davoudi-Kiakalayeh S. Alloimmunization in thalassemia patients: New insight for healthcare. Int J Prev Med 2017;8:1–5.

2. Vitolo MR, Gama CM, Bortolini GA, Campagnolo PDB, Drachler MDL. Some risk factors associated with overweight, stunting and wasting among children under 5 years old. J Pediatr (Rio J) 2008;84:251–7.

3. Derso T, Tariku A, Biks GA, Wassie MM. Stunting, wasting and associated factors among children aged 6-24 months in Dabat health and demographic surveillance system site: A community based cross-sectional study in Ethiopia. BMC Pediatr 2017;17:1–9.

4. Rakotonirainy NH, Razafindratovo V, Remonja CR, Rasoloarijaona R, Piola P, Raharintsoa C, *et al*. Dietary diversity of 6- to 59-month-old children in rural areas of Moramanga and Morondava districts, Madagascar. PLoS One 2018;13:1–14.

5. Ahmadi D, Amarnani E, Sen A, Ebadi N, Cortbaoui P, Melgar-Quiñonez H. Determinants of child anthropometric indicators in Ethiopia. BMC Public Health 2018;18:1–9.

6. Haghifar S, Naeini YJ, Akbari ME, Abdollahi M, Shadnoush M, Ajami M, *et al*. Relationship between diet diversity score and breast cancer risk. Tehran Univ Med J 2018;76:550-7.

7. Agha-Alinejad H, Farzad B, Salari M, Kamjoo S, Lee Harbaugh B, Peeri M. Prevalence of overweight and obesity among iranian preschoolers: Interrelationship with physical fitness. J Res Med Sci 2015;20:334–41.

8. Albataineh SR, Badran EF, Tayyem RF. Dietary factors and their association with childhood obesity in the Middle East: A systematic review. Nutr Health 2019;25:53–60.

9. Mirmiran P, Sherafat-Kazemzadeh R, Jalali-Farahani S, Azizi F. Childhood obesity in the middle east: A review. East Mediterr Health J 2010;16:1009-17.

10. de Onis M, Blössner M. The World Health Organization Global Database on Child Growth and Malnutrition: Methodology and applications. Int J Epidemiol 2003;32:518–26.

11. Prista A, Maia JAR, Damasceno A, Beunen G. Anthropometric indicators of nutritional status: Implications for fitness, activity, and health in school-age children and adolescents from Maputo, Mozambique. Am J Clin Nutr 2003;77:952–9.

12. Fabic MS, Choi YJ, Bird S. Revisión sistemática de las encuestas demográficas y de salud: Disponibilidad de los datos y su uso en investigaciones. Bull World Health Organ 2012;90:604–12.

13. UNICEF. Fieldwork teams are trained and deployed to sampled clusters of households [Internet] 2017. [Last cited on 2020 Oct 17]. Available from: http://mics.unicef.org/tools#data-collection.

14. Sorrie MB, Yesuf ME, Gebremichael TGG. Overweight/Obesity

and associated factors among preschool children in Gondar City, Northwest Ethiopia: A cross-sectional study. PLoS One 2017;12:1–13.

15. Poobalan A, Aucott L. Obesity among young adults in developing countries: A systematic overview. Curr Obes Rep 2016;5:2–13.

16. Fox A, Feng W, Asal V. What is driving global obesity trends? Globalization or "modernization"? Global Health 2019;15:1–16.

17. Kelishadi R, Haghdoost AA, Sadeghirad B, Khajehkazemi R. Trend in the prevalence of obesity and overweight among Iranian children and adolescents: A systematic review and meta-analysis. Nutrition 2014;30:393–400.

18. Saeidlou SN, Rezaiegoyjeloo F, Ayremlou P, Babaie F. Trend of overweight and obesity, based on population study among school children in North West of Iran: Implications for when to intervene. Maedica 2015;10:214–20.

19. Wang Y, Lim H. The global childhood obesity epidemic and the association between socio-economic status and childhood obesity. Int Rev Psychiatry 2012;24:176–88.

20. Salehi-Abargouei A, Esmaillzadeh A, Azadbakht L, Keshteli AH, Feizi A, Feinle-Bisset C, *et al*. Nutrient patterns and their relation to general and abdominal obesity in Iranian adults: Findings from the SEPAHAN study. Eur J Nutr 2016;55:505–18.

21. Abdollahi M, Salehi F, Kalantari N, Asadilari M, Khoshfetrat MR, Ajami M. A comparison of food pattern, macro- and some micronutrients density of the diet across different socio-economic zones of Tehran. Med J Islam Repub Iran 2016;30:340.

22. Poterico JA, Stanojevic S, Ruiz-Grosso P, Bernabe-Ortiz A, Miranda JJ. The association between socioeconomic status and obesity in Peruvian women. Obesity 2012;20:2283–9.

23. Roudsari AH, Vedadhir A, Amiri P, Kalantari N, Omidvar N, Eini-Zinab H, *et al*. Psycho-socio-cultural determinants of food choice: A qualitative study on adults in social and cultural context. Iran J Psychiatry 2017;12:238–47.

24. Cameron AJ, Spence AC, Laws R, Hesketh KD, Lioret S, Campbell KJ. A review of the relationship between socioeconomic position and the early-life predictors of obesity. Curr Obes Rep 2015;4:350–62.

25. Talarico R, Janssen I. Compositional associations of time spent in sleep, sedentary behavior and physical activity with obesity measures in children. Int J Obes 2018;42:1508–14.

26. Ahmed H, Khalid MM, Osman O, Ballal M, Al-Hashem F. The association between physical activity and overweight and obesity in a population of children at high and low altitudes in Southwestern Saudi Arabia. J Fam Community Med 2016;23:82-7.