Comparing the role of standard references on the prevalence of Iranian children and adolescents' overweight and obesity: A systematic review and meta-analysis

Saeed Ghanbari, Seyyed Mohammad Taghi Ayatollahi

Department of Biostatistics, School of Medicine, Shiraz University of Medical Sciences, Shiraz, Iran

Background: Obesity is a major risk factor for chronic diseases and has a role on high blood pressure, diabetes type II, etc., This review assesses the prevalence of Iranian children obesity and overweight for different age categories and compares the three standard definitions of obesity. **Materials and Methods:** To retrieve desirable studies concerning childhood anthropometric data from different area of Iran, the MEDLINE, Scopus, and different local databases such as Scientific Information database were used. The studies reported the prevalence of obesity or overweight of children < 6, 6–12, and 12–20 years old, despite differences between definitions of childhood obesity, were included in the study. We combined the reported prevalence of the overweight and obesity with regard to age and gender, and also by the different standard references which are the Centers for Disease Control and Prevention (CDC), the World Health Organization (WHO) definition, and the International Obesity Task Force (IOTF) references. The analysis was carried out using STATA software. **Results:** Our review covered 75 articles reported the prevalence of overweight or obesity among children and adolescents for different age groups in Iran. Our meta-regression analysis showed that the prevalence of obesity and overweight did not vary significantly in gender and age categories, but different definitions provide different prevalence of overweight and obesity. **Conclusion:** The effective factors on obesity and overweight included administration policy and organizational, interpersonal, intrapersonal, and social factors. CDC and WHO references intended in monitoring children's growth and the IOTF cutoffs would rather provide a common set of definitions that researchers and policymakers could use for descriptive and comparative purposes.

Key words: Children, Iran, meta-analysis, obesity, overweight, prevalence

INTRODUCTION

Obesity and overweight have been considered as susceptible factors that affect individual and public health level. Similar to several medical terms, obesity is the result of interplay between genetic and environmental factors. Studies that have focused on inheritance patterns rather than on specific genes have found that 80% of the offspring of two obese parents were also obese, in contrast, <10% of the offspring of two parents who were of normal weight.[1,2] There are substantial evidences that show the prevalence of obesity and overweight has been significantly increased among children in recent years. Childhood obesity has been rising in both the developing country and developed country. Rates of obesity in Canadian boys have increased from 11% in the 1980s to over 30% in the 1990s, while during the same time increased from 4 to 14% in Brazilian children.[3] The statistics states that there are 155 million (1 in 10) overweighed children, and around 30–45 million classified as obese worldwide.[4] The problem is no more limited to high-income countries and is rapidly growing in low- and middle-income countries. Overweight or obese children are at risk for high blood pressure, dyslipidemia, and diabetes type II and may become overweight or obese adults in the end.[5] Prevention, screening, and early control of increased weight and related risk factors

Address for correspondence: Prof. Seyyed Mohammad Taghi Ayatollahi, Department of Biostatistics, School of Medicine, Shiraz University of Medical Sciences, Shiraz, Iran. E-mail: ayatolahim@sums.ac.ir

might help create desire intervention strategies against the rising burden of noncommunicable diseases. Diet programs may produce weight loss over the short-term, and all types of low-carbohydrate and low-fat diets appear equally beneficial; however, maintaining weight loss is frequently difficult and often requires making exercise which is a permanent part of a person's lifestyle.[6-8] The World Health Organization (WHO) estimates that three-quarters of all deaths in the developing world by the year 2020 will be due to noncommunicable diseases, so is working to implement the Global Strategy on Diet, Physical Activity and Health to encounter childhood obesity.[9,10] Definitions of overweight and obesity are similar in sense and they are based on body mass index (BMI), and despite this underlying similarity, they have considerable differences. The different standard definitions for obesity and overweight are the Centers for Disease Control and Prevention (CDC) reference, the WHO definition, and the International Obesity Task Force (IOTF) reference. In the United States, the CDC 2000 growth charts for the US were developed from five nationally representative survey data sets (The National Health Examination Surveys II and III in the 1960s, the National Health and Nutrition Examination Survey [NHANES] I and II in the 1970s, and NHANES III, 1988–1994). The IOTF reference gave lower estimates for young children and higher estimates for older children than the CDC references.[4,11] In 2006, the WHO released a new set of growth charts for children from birth through 5 years of age based on data from the multicenter Growth Reference Study conducted by the WHO.[12] Hence, for calculating prevalence estimates of obesity or overweight, which reference should be used? As a result, there are numerous analyses comparing the use of different definitions with the same population. As seen repeatedly, the various definitions do not give the same results and prevalence of overweight and obesity and may be used interchangeably or contrasted with each other. Since Iran is the 18th largest country in the world, with an area of 1,648,195 km^2, and a population of around 78 million, about 1.11% of the world population,[13,14] in order to achieve a general perception about overweight and obesity among Iranian children and adolescents, we attempt to provide a brief outline of the prevalence of obesity and overweight for different age categories of Iranian children and adolescent, and compare the different standard definitions, age categories, and gender categories in a meta-regression analysis.

MATERIALS AND METHODS

We retrieved surveys concerning children's anthropometric data from different regions of Iran.

Search strategy
An extensive literature review was performed to retrieve desirable studies concerning childhood anthropometric data from different areas of Iran and using the MEDLINE,

Scopus, Google Scholar search engine, and different local databases such as Scientific Information Database. All paper headings pertaining to children and adolescents' obesity and overweight related to Iran which had been published in English and Persian up to December 30, 2015, were assessed. To retrieve related studies, the search joining keywords and thesaurus terms with the following concepts, children, adolescents, prevalence, obesity, overweight, Iran, and related Medical Subject Headings terms. In addition, to find more related studies, the reference list of all systematic review which found was screened.

Study selection and exclusion criteria
This article included the studies which were reported the prevalence of obesity and/or overweight of children and adolescents up to 20 years old, children <6 years, between 6 and 12 years, and 12–20 years old separately by gender or totally, in different regions of Iran. The different reference values currently used as the standards to assess children's obesity and overweight, the CDC reference uses BMI percentiles for ages 2–20 years, Overweight: BMI <85th and <95th percentile and obese: BMI <95th percentile. WHO Child Growth Standards (birth to age 5), obese: BMI >3 standard deviations above the WHO growth standard median and overweight: BMI >2 standard deviations above the WHO growth standard median. WHO Reference 2007 (ages 5–19), obese: BMI >2 standard deviations above the WHO growth standard median and overweight: BMI >1 standard deviation above the WHO growth standard median. The reference values include age- and sex-specific data from the first NHANES I collected in 1971–74 in the United States.[4,9,11] The Childhood Obesity Working Group of the IOTF provides international BMI cut points by age and sex for overweight and obesity for children age 2–18 reference uses sex- and age-specific BMI cutoffs that correspond to BMI 25 kg/m^2 for overweight and 30 kg/m^2 for obesity.[15,16] Studies were excluded if they did not report the prevalence of obesity or overweight separately for different age categories, provide prevalence of obesity or overweight without reporting the sample size, the studies did not specify the reference of obesity or overweight and the studies reported a combined prevalence of obesity and overweight.

Quality assessment and data extraction
Papers that had inclusion criteria of our review were appraised by two researchers independently in a qualitative manner. Furthermore, the Strengthening the Reporting of Observational Studies in Epidemiology statement was used for quality assessment.

Statistical analysis
The suitable studies were entered for meta-analysis. Separate meta-analysis has been done to estimate the overall

obesity and overweight prevalence's as well as age-sex and age-sex-definition specific. Heterogeneity among studies was tested by I^2; for no heterogeneity, the fixed model was used and in other respects random effects model used. Moreover, meta-regression was used to assess the association of prevalence of obesity and overweight with age, sex and definition. All statistical analyses were carried out By STATA version 10 software.

RESULTS

Two thousand one-hundred and two papers were found in electronic search of which 852 remain after removing duplicated articles. Six hundred twenty-five articles were excluded because of no relevant in titles and abstracts. Finally, 75 studies were included in this systematic review and meta-analysis. Flowchart of selecting studies is presented in Figure 1. A total number of 155,839 children and adolescents up to 20 years old were included from the selected studies.[9-11,13,14,17-86] Comparison of the overall estimates in different age group represents that the
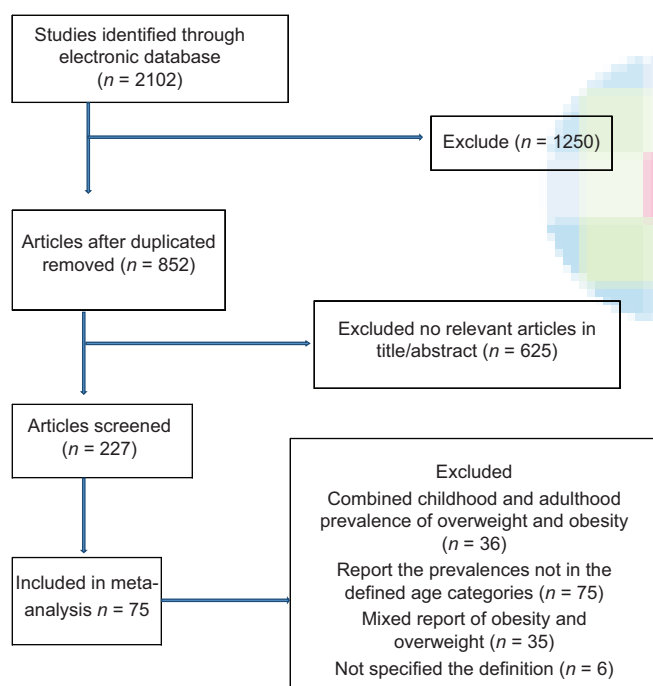
overweight and obesity prevalence for children between 6- and 12-year-old is minimum for boys and girls, but in all age categories the overweight girls prevalence are higher than boys while the obesity boys prevalence are higher than girls [Table 1].

Comparison of the overall estimate of overweight and obesity prevalence in different definition and age categories for boys, girls and totally are shown in Table 2. It seems that the pooled estimate of overweight prevalence is higher for the studies using IOTF reference than others and the studies were used CDC definition to illustrate higher pooled proportion of obese children and adolescent. The most reported articles on prevalence of overweight and obesity in Iranian children and adolescents used the CDC reference. Our findings in Table 3 for meta-regression analysis show the effect of gender (boy, girl), different standard definitions (CDC, IOTF, and WHO) and age (<6-year-old, 6–12-year-old, and 12–20-year-old) on the prevalence of obesity and overweight.

According to Table 3, there is no significant different on prevalence of overweight and obesity between gender categories (P = 0.892 and 0.767, respectively), and also between age categories (P = 0.062 and 0.407, respectively), but prevalence of overweight and obesity is different significantly in different standard definitions (P = 0.011 and <0.001, respectively).

DISCUSSION

Overweight and obesity is becoming an increasingly prevalent problem in both developing country and developed country, and is one of the most serious public health challenges of the 21st century. This systematic review and meta-analysis has provided an accurate estimation for the prevalence of overweight and obesity by standard age group and sex in Iranian children and adolescents. These findings may suggest that the prevalence of overweight in girls is higher than boys for all age categories and the boys are more obese, but our meta-regression analysis showed that the prevalence of obesity and overweight did not vary significantly in girls and boys and also there is no significant difference between age categories. According to Table 3, results show that there are significant differences between

Figure 1: Flowchart of study selection

Studies identified through electronic database (n = 2102)

Exclude (n = 1250)

Articles after duplicated removed (n = 852)

Excluded no relevant articles in title/abstract (n = 625)

Articles screened (n = 227)

Excluded
Combined childhood and adulthood prevalence of overweight and obesity (n = 36)
Report the prevalences not in the defined age categories (n = 75)
Mixed report of obesity and overweight (n = 35)
Not specified the definition (n = 6)

Included in meta-analysis n = 75

Table 1: The overall estimations of overweight and obesity with respect to gender and age

	Pooled estimate (95% CI) %		Pooled estimate (95% CI) %		Pooled estimate (95% CI) %	
	Boy (OW)	Boy (Ob)	Girl (OW)	Girl (Ob)	Totally (OW)	Totally (Ob)
<6, %	10.6 (0.100-0.113)	8.6 (0.080-0.092)	12.8 (0.119-0.136)	4.3 (0.038-0.048)	15.1 (0.145-0.158)	5.4 (0.051-0.058)
Number of studies (I^2)	8 (96.8)	8 (97.8)	8 (97.3)	8 (96.6)	8 (98.3)	8 (97.5)
6–12, %	7.2 (0.068-0.076)	4.8 (0.045-0.051)	9.8 (0.095-0.102)	2.5 (0.023-0.027)	4.6 (0.044-0.047)	3.9 (0.038-0.041)
Number of studies (I^2)	17 (99)	19 (98.9)	20 (98.5)	22 (99)	31 (99)	35 (99)
12–20, %	7.8 (0.073-0.083)	5.7 (0.053-0.061)	10 (0.096-0.104)	3.5 (0.033-0.037)	9.1 (0.088-0.094)	4.2 (0.040-0.044)
Number study (I^2)	12 (97.7)	13 (96.9)	25 (94.6)	23 (96.5)	16 (98.3)	19 (98.2)

OW = Overweight; Ob = Obesity; CI = Confidence interval

Table 2: Overall estimate and 95% confidence interval for the prevalence of overweight and obesity among Iranian children and adolescents with respect to age, gender and standard definitions

| | Age | | | | | | | | |
| | <6 years old Pooled estimate (95% CI) (%) | | | 6-12 years old Pooled estimate (95% CI) (%) | | | 12-20 years old Pooled estimate (95% CI) (%) | | |
	CDC	IOTF	WHO	CDC	IOTF	WHO	CDC	IOTF	WHO
OW									
Boy, %	9 (0.08-0.10)	18.2 (0.17-0.20)	4.9 (0.03-0.07)	5.8 (0.05-0.06)	19.4 (0.18-0.21)	10.2 (0.09-0.11)	9.5 (0.09-0.10)	5.2 (0.04-0.06)	9.2 (0.08-0.10)
Number of studies (I^2)	4 (4.4)	3 (96)	1	10 (99)	2 (96.4)	5 (99.4)	6 (61.3)	3 (99.2)	3 (98.7)
Girl, %	11.3 (0.09-0.13)	18.4 (0.17-0.19)	3.1 (0.015-0.05)	9.9 (0.09-0.10)	10.9 (0.10-0.12)	7.7 (0.06-0.09)	8.4 (0.08-0.09)	11.5 (0.11-0.12)	10.4 (0.01-0.11)
Number of studies (I^2)	3 (0.0)	4 (87.3)	1	12 (97.5)	4 (99.2)	4 (99.4)	9 (95)	8 (95.7)	8 (89.4)
Totally, %	10.8 (0.09-0.12)	22.2 (0.21-0.23)	4 (0.03-0.05)	7.6 (0.07-0.08)	2.2 (0.02-0.024)	10 (0.09-0.11)	7.5 (0.07-0.08)	8.2 (0.075-0.09)	13.5 (0.13-0.14)
Number of studies (I^2)	3 (0.0)	4 (88.7)	1	20 (98.8)	6 (99.6)	5 (99.7)	7 (95.4)	4 (97.2)	6 (98.9)
Ob									
Boy, %	13 (0.12-0.14)	8.8 (0.08-0.10)	1.6 (0.004-0.03)	5.6 (0.05-0.06)	4.1 (0.03-0.05)	2.8 (0.02-0.03)	6.3 (0.06-0.07)	5.8 (0.05-0.07)	4.4 (0.04-0.05)
Number of studies (I^2)	4 (96.2)	3 (72.4)	1	12 (99.3)	2 (96.8)	5 (95.6)	7 (98.2)	3 (33.3)	3 (93.4)
Girl, %	6.7 (0.05-0.08)	7.4 (0.07-0.08)	0.7 (0.001-0.015)	7.8 (0.07-0.08)	2.4 (0.02-0.03)	0.3 (0.001-0.006)	5.6 (0.05-0.06)	3.5 (0.03-0.04)	2.3 (0.02-0.03)
Number of studies (I^2)	3 (89.2)	4 (91.1)	1	14 (99.2)	4 (98.3)	4 (95.6)	9 (97.5)	7 (95.5)	8 (91.6)
Totally, %	7.4 (0.06-0.09)	8 (0.074-0.085)	1.7 (0.01-0.023)	5.5 (0.053-0.057)	3.1 (0.028-0.033)	1.8 (0.015-0.02)	4.8 (0.045-0.051)	2.9 (0.025-0.033)	4.3 (0.04-0.05)
Number of studies (I^2)	3 (95.8)	4 (91.1)	2 (95.7)	23 (99.5)	7 (98)	6 (96.6)	9 (98.8)	4 (95.9)	6 (97)

CI = Confidence interval; CDC = Centers for Disease Control and Prevention; IOTF = International Obesity Task Force; WHO = World Health Organization

Table 3: The results of meta-regression on prevalence of overweight and obesity

Variables	β	SE (β)	P	95% CI	I^2 (%)
Prevalence of OW					
Age	−0.0213	0.0113	0.062	−0.04-0.001	98.97
Gender	0.0013	0.010	0.892	−0.018-0.021	
Definition	0.025	0.009	0.011	0.0058-0.044	
Constant	0.132	0.036	0.000	0.06-0.20	
Prevalence of Ob					
Age	−0.006	0.008	0.407	−0.023-0.009	98.72
Gender	−0.002	0.007	0.767	−0.016-0.012	
Definition	−0.036	0.007	0.000	−0.050--0.022	
Constant	0.167	0.026	0.000	0.115-0.220	

SE = Standard error; CI = Confidence interval; OW = Overweight; Ob = Obesity

prevalence of overweight and obesity in different definitions. As illustrated in Table 2, the studies used IOTF references report higher overweight prevalence and the ones used CDC, report higher prevalence of obesity. Most definitions of childhood overweight and obesity are similar in the sense that they are based on BMI. Despite this underlying similarity, the results present some differences. Definitions of overweight and obesity are used for several purposes. For international comparisons of prevalence, the same definition should be used across countries. However, it is not yet clear that any one definition is better than another for this purpose.[9,12] A given definition may be more suitable for one country than others. The IOTF cutoffs were not intended as clinical definitions, but provide a common set of definitions that researchers and policy makers in different countries could use internationally for descriptive and comparative purposes. The 2000 CDC Growth Charts and the WHO charts are intended for clinical use in monitoring children's growth. The use of selected percentiles of such charts to define overweight and obesity is a secondary purpose.[12] There is a wide variety of national and international reference data sets used to establish criteria. The selection of cutoff values is generally based on statistical considerations rather than on clear relations to health risks or the degree of body fatness. BMI is a screening tool, however, not a diagnostic tool. Children with a BMI over these cutoffs do not necessarily have clinical complications or health risks related to over-fatness.[12] Taking into account all available studies we can discuss about the main influencing factors on increase of obesity and overweight in children addition to genetic factors. The first is the administration policy which includes physical education guidelines and effects of media (the high cost and insignificant accessibility of physical activity facilities, fast food supply and availability of ready-to-eat meals at lower cost than healthy foods were frequent quoted as the result of poor public policy).[13] The second includes social factors such as social restrictions on girls and women (social and cultural influences within Iranian communities were highlighted). The third is interpersonal, misperception regarding healthy eating and parents as role models (limited

and inaccurate health information for parents, in addition it was noted that a considerable percentage of mothers in large cities work and fathers have multiple jobs which result in using fast food rather healthy foods, social pressures, and weak relationship between families and school) and finally intrapersonal factors like preference for certain foods (children's preferences for unhealthy foods such as snakes and computer playing and activities and recently being addicted to the internet were seen as a cause of overweight and obesity).[13] In general, the other point that should be considered for the developing countries such as Iran is that their people tend to follow the western people lifestyle. To decrease the rate of obesity and overweight, more physical education class along with providing suitable places and standard facilities, family education to raising health information and familiarize children in school to harms of unhealthy foods are recommended by the nutrition experts.

CONCLUSIONS

The only significant factor on prevalence of obesity and overweight is definitions of this criteria. Different references are used for different purposes. Using a given reference may be more suitable for one country than others. The IOTF cutoffs is used by researchers and policy makers in different countries for descriptive and comparative purposes but The 2000 CDC Growth Charts, and the WHO charts are intended for clinical use in monitoring children's growth. So the importance of using the references depends on the purposes.

Conflicts of interest
The authors have no conflicts of interest.

AUTHORS' CONTRIBUTION

SMT A contributed in the conception of the work, conducting the study, revising the draft, approval of the final version of the manuscript, and agreed for all aspects of the work. S Gh contributed in the conception of the work, revising the draft, approval of the final version of the manuscript, and agreed for all aspects of the work.

REFERENCES

1. Poirier P, Giles TD, Bray GA, Hong Y, Stern JS, Pi-Sunyer FX, *et al.* Obesity and cardiovascular disease: Pathophysiology, evaluation, and effect of weight loss: An update of the 1997 American Heart Association Scientific Statement on Obesity and Heart Disease from the Obesity Committee of the Council on Nutrition, Physical Activity, and Metabolism. Circulation 2006;113:898-918.
2. Loos RJ, Bouchard C. FTO: The first gene contributing to common

forms of human obesity. Obes Rev 2008;9:246-50.

3. Flynn MA, McNeil DA, Maloff B, Mutasingwa D, Wu M, Ford C, *et al.* Reducing obesity and related chronic disease risk in children and youth: A synthesis of evidence with 'best practice' recommendations. Obes Rev 2006;7 Suppl 1:7-66.

4. 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.

5. Kelishadi R, Cook SR, Amra B, Adibi A. Factors associated with insulin resistance and non-alcoholic fatty liver disease among youths. Atherosclerosis 2009;204:538-43.

6. Strychar I. Diet in the management of weight loss. CMAJ 2006;174:56-63.

7. Mozaffarian D, Hao T, Rimm EB, Willett WC, Hu FB. Changes in diet and lifestyle and long-term weight gain in women and men. N Engl J Med 2011;364:2392-404.

8. Naude CE, Schoonees A, Senekal M, Young T, Garner P, Volmink J. Low carbohydrate versus isoenergetic balanced diets for reducing weight and cardiovascular risk: A systematic review and meta-analysis. PLoS One 2014;9:e100652.

9. 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.

10. Faghih S, Taleban F, Abadi A, Ansari N. Trends of overweight and obesity among 14-18 years old urban adolescent girls among senior high schools, Ahvaz, Iran. Iran J Diabetes Lipid Disorders 2009;3:19-25.

11. Mirmohammadi SJ, Hafezi R, Mehrparvar AH, Rezaeian B, Akbari H. Prevalence of overweight and obesity among Iranian school children in different ethnicities. Iran J Pediatr 2011;21:514-20.

12. Flegal KM, Ogden CL. Childhood obesity: Are we all speaking the same language? Adv Nutr 2011;2:159S-66S.

13. Asar S, Asghari S. Prevalence of obesity & overweight among 7-14 years old students in the city of Ahwaz. Sci Med J Ahvaz Univ Med Sci 2005;44:11-20.

14. Mohammadpour-Ahranjani B, Pallan MJ, Rashidi A, Adab P. Contributors to childhood obesity in Iran: The views of parents and school staff. Public Health 2014;128:83-90.

15. Sweeting HN. Measurement and definitions of obesity in childhood and adolescence: A field guide for the uninitiated. Nutr J 2007;6:32.

16. Endres J. Overweight and Obesity in Madison County Strategies to Build a Healthier Community 2009; 1:1-85.

17. Golestan M, Akhavan KS, Falah TM, Sharaf AM. Prevalence of obesity, overweight and underweight in guidance school students 2008;16:31-35.

18. Haeri Behbahani B, Dorosty AR, Eshraghian MR. Assessment of obesity in children: Fat mass index versus body mass index. Tehran Univ Med J 2009;67:408-14.

19. Khabazkhoob M, Fotouhi A, Moradi A, Mohammad K. Thinness and obesity based on body mass index in Dezfool schoolchildren in 2004. Iran J Epidemiol 2008;3:35-43.

20. Montazerifar F, Karajibani M, Dashipour A. Paper: The Prevalence of Obesity Wasting and their Correlation with Food Intake in Female Junior School Students in Zahedan; 2004.

21. Seyfhashemi M, Ghorbani R, Mehralizadeh S, Movafaghi K. Prevalence of obesity and its associated factors in Iranian primary school children. J Bahrain Med Soc 2013;24:121-24.

22. Zareie M, Hamedinia M, Haghighi A, Chamari M, Broughani M. The Epidemiology of Obesity and Underweight and their Associations with Physical Activity and Diet Patterns among 12-14 Years-Old Adolescent Boys in Sabzevar, Iran; 2011.

23. Sadeghi M, Alizadeh F. Association between dental caries and body mass index-for-age among 6-11-year-old children in Isfahan in 2007. J Dent Res Dent Clin Dent Prospects 2007;1:119-24.

24. Ahmadi A, Gharipour M, Nouri F, Kelishadi R, Sadeghi M, Sarrafzadegan N. Association between adolescence obesity and metabolic syndrome: Evidence from Isfahan Healthy Heart Program. Indian J Endocrinol Metab 2014;18:569-73.

25. Heshmat R, Kelishadi R, Motamed-Gorji N, Motlagh ME, Ardalan G, Arifirad T, *et al.* Association between body mass index and perceived weight status with self-rated health and life satisfaction in Iranian children and adolescents: The CASPIAN-III study. Qual Life Res 2015;24:263-72.

26. Mirhosseini NZ, Shahar S, Ghayour-Mobarhan M, Parizadeh MR, Yusoff NA, Shakeri MT. Body fat distribution and its association with cardiovascular risk factors in adolescent Iranian girls. Iran J Pediatr 2012;22:197-204.

27. Doost Mohammadian A, Keshavarz S, Dorosti A. Comparison of body mass index and the intake of energy and some nutrients with reference values in female secondary school students in Semnan. Payesh 2005;4:237-45.

28. Hajian-Tilaki K, Heidari B. Childhood obesity, overweight, socio-demographic and life style determinants among preschool children in Babol, Northern Iran. Iran J Public Health 2013;42:1283-91.

29. Kavehmanesh Z, Saburi A, Maavaiyan A. Comparison of body mass index on children with functional constipation and healthy controls. J Family Med Prim Care 2013;2:222-6.

30. Mahmudi A, Tajedini F, Ranjbar H, Moghimi-Dehkordi B. Determinants of overweight and obesity in the middle school students of Pakdasht city, Tehran province. J Kermanshah Univ Med Sci 2014;18:329-38.

31. Aminzadeh M, Hosseinzadeh M, Nikfar R, Ghaderian M, Mohsenpourian S. Incidence in overweight and obesity among schoolchildren, Ahvaz-2010. Jundishapur Sci Med J 2013;12:1-7.

32. Nouri Saeidlou S, Babaei F, Ayremlou P. Malnutrition, overweight, and obesity among urban and rural children in north of west Azerbijan, Iran. J Obes 2014;2014:541213.

33. Kelishadi R, Cook SR, Motlagh ME, Gouya MM, Ardalan G, Motaghian M, *et al.* Metabolically obese normal weight and phenotypically obese metabolically normal youths: The CASPIAN Study. J Am Diet Assoc 2008;108:82-90.

34. Maddah M, Nikooyeh B. Obesity among Iranian adolescent girls: Location of residence and parental obesity. J Health Popul Nutr 2010;28:61-6.

35. Hamidi A, Fakhrzadeh H, Moayyeri A, Pourebrahim R, Heshmat R, Noori M, *et al.* Obesity and associated cardiovascular risk factors in Iranian children: A cross-sectional study. Pediatr Int 2006;48:566-71.

36. Kelishadi R, Pour MH, Sarraf-Zadegan N, Sadry GH, Ansari R, Alikhassy H, *et al.* Obesity and associated modifiable environmental factors in Iranian adolescents: Isfahan Healthy Heart Program – Heart Health Promotion from Childhood. Pediatr Int 2003;45:435-42.

37. Behzadnia S, Vahidshahi K, Hamzeh Hosseini S, Anvari S, Ehteshami S. Obesity and related factors in 7-12 year-old elementary school students during 2009-2010 in Sari, Iran. Med Glas (Zenica) 2012;9:86-90.

38. Dorosty AR, Siassi F, Reilly JJ. Obesity in Iranian children. Arch Dis Child 2002;87:388-91.

39. Moayeri H, Rabbani A, Keihanidoust ZT, Bidad K, Anari S. Overweight adolescents: A group at risk for metabolic syndrome (Tehran adolescent obesity study). Arch Iran Med 2008;11:10-5.

40. Jazayeri S. Overweight and obesity among school-aged children of metropolitan Tehran, Iran. Pak J Nutr 2005;4:342-4.

41. Moayeri H, Bidad K, Aghamohammadi A, Rabbani A, Anari S, Nazemi L, *et al.* Overweight and obesity and their associated factors in adolescents in Tehran, Iran, 2004-2005. Eur J Pediatr 2006;165:489-93.

42. Salem Z, Vazirinejad R. Prevalence of obesity and metabolic syndrome in adolescent girls in South East of Iran. Pak J Med Sci

2009;25:196-200.

43. Nabavi M, Karimi B, Ghorbani R, Mazloum JM, Talebi M. Prevalence of obesity and some related factors among students aged 7 to 12 in Semnan, Iran. Payesh 2010;9:443-51.

44. Taheri F, Kazemi T. Prevalence of overweight and obesity in adolescents in Birjand. ARYA Atheroscler Journal 2010; 2:27-30.

45. Shafaghi K, Shariff ZM, Taib MN, Rahman HA, Mobarhan MG, Jabbari H. Parental body mass index is associated with adolescent overweight and obesity in Mashhad, Iran. Asia Pac J Clin Nutr 2014;23:225-31.

46. Akhavan-Karbasi S, Fallah R, Golestan M, Sadr-Bafghi M. Prevalence and risk factors of obesity and overweight among primary school children in Yazd. J Shahid Sadoughi Univ Med Sci Health Serv 2008;16:8-13.

47. Tabesh H, Hosseiny SM, Kompani F, Saki A, Firoozabadi MS, Chenary R, et al. Prevalence and trend of overweight and obesity among schoolchildren in Ahvaz, Southwest of Iran. Glob J Health Sci 2013;6:35-41.

48. Basiratnia M, Derakhshan D, Ajdari S, Saki F. Prevalence of childhood obesity and hypertension in south of Iran. Iran J Kidney Dis 2013;7:282-9.

49. Ahmadi E, Tehrani AR, Ahmadi A. Prevalence of obesity, overweight and underweight among elementary school children in Southern Iran, 2009. Am J Appl Sci 2010;7:1439-42.

50. Rafraf M. Prevalence of overall and abdominal obesity among adolescent high school girls in Tabriz, Iran. Int Med J Malaysia 2013;12:27-32.

51. Mirzaei M, Karimi M. Prevalence of overweight and obesity among the first grade primary students in Yazd. J Ilam Univ Med Sci 2011;18:43-9.

52. Taheri F, Kazemi T. Prevalence of overweight and obesity in 7 to 18 year-old children in Birjand/Iran. Iran J Pediatr 2009;19:135-40.

53. Moghadasi M, Naser K, Shakerian S, Razavi A. Prevalence of overweight, obesity and physical fitness in Shiraz adolescents. Iran J Endocrinol Metab 2011;12:476-82.

54. Ahmadi S, Shahsavari S, Ahmadi H, Tabatabaeifar T. Prevalence of overweight, obesity and underweight among high school students in Sanandaj: 2006-2007. Iran J Endocrinol Metab 2010; 12:153-9.

55. Dorosty AR, Baygi F, Eshraghian M. Prevalence of obesity among school children in Neishabour (2005). J Qazvin Univ Med Sci 2008; 12:73-9.

56. Asadi Noghabi F. Prevalence of obesity and overweight among children in Bandar Abbas. Bimonthly J Hormozgan Univ Med Sci 2011;15:218-26.

57. Amirkhani F, Shahidi N, Mirmiran P, Ardakani H. Prevalence of Obesity, Fat Distribution and Its Relationship with Food Consumption Pattern in Secondary School Boys in Tabriz: Beheshti University; 2001.

58. Bazhan M, Kalantari N, Ghaffarpoor M, Houshiar-Rad A, Alavi Majd H. Prevalence of obesity, fat distribution and its relationship with food consumption pattern in secondary school girls in Lahijan. Iran J Endocrinol Metab 2005;7:37-46.

59. Mohamadpour Koldeh M, Fouladvand MA, Avakh Keysami M. Prevalence of overweight and obesity among Bushehrian high-school girls at aged 14-17 years old. ISMJ 2012;15:221-32.

60. Gargari BP, Behzad MH, Ghassabpour S, Ayat A. Prevalence of overweight and obesity among high-school girls in Tabriz, Iran, in 2001. Food Nutr Bull 2004;25:288-91.

61. Amini M, Omidvar N, Kimiagar M. Prevalence of overweight and obesity among junior high school students in a district of Tehran. J Res Med Sci 2007;12:315-9.

62. Hajian-Tilaki KO, Sajjadi P, Razavi A. Prevalence of overweight and obesity and associated risk factors in urban primary-school children in Babol, Islamic Republic of Iran. East Mediterr Health J 2011;17:109-14.

63. Fatemeh T, Mohammad-Mehdi HT, Toba K, Afsaneh N, Sharifzadeh G; Student Research committee. Prevalence of overweight and obesity in preschool children (2-5 year-olds) in Birjand, Iran. BMC Res Notes 2012;5:529.

64. Amidi Mazaheri M, Hoseini M. Prevalence of underweight, overweight and obesity among high school girls in Isfahan. J Health Syst Res 2010;6:1-6.

65. Montazerifar F, Karajibani M, Rakhshani F, Hashemi M. Prevalence of underweight, overweight and obesity among high-school girls in Sistan vs Baluchistan. East Mediterr Health J 2009;15:1293-300.

66. Gaeini A, Kashef M, Samadi A, Fallahi A. Prevalence of underweight, overweight and obesity in preschool children of Tehran, Iran. J Res Med Sci 2011;16:821-7.

67. Hajian-Tilaki K, Heidari B. Prevalences of overweight and obesity and their association with physical activity pattern among Iranian adolescents aged 12-17 years. Public Health Nutr 2012;15:2246-52.

68. Khodaverdi F, Bahram A, Jafarabadi MA. Quality of life, motor ability, and weight status among school-aged children of Tehran. Iran J Public Health 2012;41:97-102.

69. Mohammadian S, Khoddam H, Kaveh M. Related factors of obesity and overweight among secondary school girls (Gorgan-Iran). J Gorgan Univ Med Sci 2010;12:57-62.

70. Zarrati M, Shidfar F, Moradof M, Nasiri Nejad F, Keyvani H, Rezaei Hemami M, et al. Relationship between breast feeding and obesity in children with low birth weight. Iran Red Crescent Med J 2013;15:676-82.

71. Vafa M, Moslehi N, Afshari S, Hossini A, Eshraghian M. Relationship between breastfeeding and obesity in childhood. J Health Popul Nutr 2012;30:303-10.

72. Kajbaf TZ, Asar S, Alipoor MR. Relationship between obesity and asthma symptoms among children in Ahvaz, Iran: A cross sectional study. Ital J Pediatr 2011;37:1.

73. Amanolahi A, Sohrabi MR, Montazeri A, Abadi AR, Kolahi AA. Study of obesity levels among school students. Payesh 2012; 11:89-95.

74. Ebrahimzadeh B, Kalantari N, Abadi A. The prevalence of obesity and its relative factors among less than 5 years aged children, Bandar Turkmen district, Iran. Journal of Kerman University of Medical Sciences2012;19:384-91.

75. Khodaverdi F, Alhani F, Kazemnejad A, Khodaverdi Z. The relationship between obesity and quality of life in school children. Iran J Public Health 2011;40:96-101.

76. Eftekhari M, Mozaffari-Khosravi H, Shidfar F. The relationship between BMI and iron status in iron-deficient adolescent Iranian girls. Public Health Nutr 2009;12:2377-81.

77. Ayatollahi SM, Mostajabi F. Prevalence of obesity among schoolchildren in Iran. Obes Rev 2007;8:289-91.

78. Jafari-Adli S, Jouyandeh Z, Qorbani M, Soroush A, Larijani B, Hasani-Ranjbar S. Prevalence of obesity and overweight in adults and children in Iran; a systematic review. J Diabetes Metab Disord 2014;13:121.

79. Kelishadi R. Childhood overweight, obesity, and the metabolic syndrome in developing countries. Epidemiol Rev 2007;29:62-76.

80. Kelishadi R, de Ferranti SD, Majdzadeh R, O'Dea JA, Gupta AK, Adeli K. Childhood obesity: Today and tomorrow's health challenge. J Obes 2013;2013:208392.

81. Ziaoddini H, Kelishadi R, Kamsari F, Mirmoghtadaee P, Poursafa P. First nationwide survey of prevalence of weight disorders in Iranian children at school entry. World J Pediatr 2010;6:223-7.

82. Motlagh ME, Kelishadi R, Amirkhani MA, Ziaoddini H, Dashti M, Aminaee T, et al. Double burden of nutritional disorders in young Iranian children: Findings of a nationwide screening survey. Public Health Nutr 2011;14:605-10.

83. Soltani PR, Ghanbari A, Rad AH. Obesity related factors in school-aged children. Iran J Nurs Midwifery Res 2013;18:175-9.

84. Azizi F. Prevention of childhood obesity. Int J Endocrinol Metab 2011;9:246-7.

85. Mobasheri M, Tavassoli E, Ramezankhani A, Mirmiran P, Mehrabi Y, Alidosti M, et al. Improvement of consumption of fruits and vegetables aimed at the prevention of obesity in girl students. Life Sci J 2014;11:454-58.

86. Karimi B, Ghorbani R. Overweight and obesity in the Iranian schoolchildren. Middle East J Rehabil Health 2015;2:e24433.