A Systematic Review on the Prevalence of Overweight and Obesity, in Iranian Children and Adolescents

Shirin Djalalinia,1,2 Roya Kelishadi,3 Mostafa Qorbani,4 Niloofar Peykari,1,2 Amir Kasaeian,1,5 Ensieh Nasli-Esfahani,6 Shohreh Naderimagham,1 Bagher Larijani,7 and Farshad Farzadfar1,7,*

1Non-Communicable Diseases Research Center, Endocrinology and Metabolism Research Institute, Tehran University of Medical Sciences, Tehran, IR Iran
2Development of Research and Technology Center, Deputy of Research and Technology, Ministry of Health and Medical Education, Tehran, IR Iran
3Child Growth and Development Research Center, Isfahan University of Medical Sciences, Isfahan, IR Iran
4Department of Community Medicine, School of Medicine, Alborz University of Medical Sciences, Karaj, IR Iran
5Department of Epidemiology and Biostatistics, School of Public Health, Tehran University of Medical Sciences, Tehran, IR Iran
6Diabetes Researcher Center, Endocrinology and Metabolism Clinical Sciences Institute, Tehran University of Medical Sciences, Tehran, IR Iran
7Endocrinology and Metabolism Research Center, Endocrinology and Metabolism Research Institute, Tehran University of Medical Sciences, Tehran, IR Iran

*Corresponding author: Farshad Farzadfar, Endocrinology and Metabolism Research Center, Endocrinology and Metabolism Research Institute, Tehran University of Medical Sciences, P. O. Box: 1599666615, Tehran, IR Iran. Tel/Fax: +98-2188913543, E-mail: f.farzadfar@tums.ac.ir

Received 2015 May 27; Accepted 2015 November 29.

Abstract

Context: Obesity has now become a common health problem worldwide. To gain insight into the epidemiology of the problem in Iran, we systematically reviewed all available studies on the prevalence of overweight and obesity in the Iranian pediatric population.

Evidence Acquisition: We systematically searched PubMed, ISI, SCOPUS, as well as Iranmedex, Irandoc, and Scientific Information Database (SID) databases. All studies on mean and standard deviation or percentile categories of BMI, WC, WHR, or WHtR or prevalence of obesity/overweight in Iranian child and adolescence, were performed from January 1990 to the end of December 2013. Refining processes were conducted by two independent reviewers. Quality assessment and data extraction followed based on validated form. As, these data were heterogeneous, meta-analysis was not performed.

Results: From 3253 records, through three refining steps, 129 articles were found related to our study. In Iran, national studies are limited and nearly there is no comprehensive study for sub-national trends. Different age and sex groups had large variations in the prevalence of obesity and overweight (from 1% up to 16.1% and from 4.4% up to 42.3% respectively for obesity and overweight).

Conclusions: Related data are very scattered or limited to some specific subgroups in some living areas. For comparing, aggregating, and imputing the information we need more modern practical statistical methods.

Keywords: Obesity, Overweight, Pediatrics, Systematic Review

1. Context

The global burden of disease (GBD) studies in 1990, 2000, and 2013 showed that metabolic risk factors (MRFs) are the most important determinants of emerging non-communicable diseases all over the world (1-8). Obesity has now become a common health problem and its prevalence continues to increase in both developed and developing countries (9-41). The increasing incidence of childhood obesity and its attributed socioeconomic and public health burden is a real threat for developing countries (12). Recent studies reveal the increasing rates of overweight and obesity and their attributed ranges of adverse health outcomes in children and adolescents (13, 14). Most obese children and adolescents already are at high risk for metabolic complications, and for a wide range of morbidities (15, 16). Moreover, there is some evidence on long-term premature mortality and physical morbidity in their adulthood (16, 17).

Despite priority of the problem, there is an evident gap in the related literature on these topics (11, 18). Even though there are a few studies on trend and point estimations of BMI trend and prevalence of obesity in Iranian pediatric population, there are little information about their exposure distribution at sub-national level and no information about their trends and their effects on the health (7, 12, 19). Most of available reports are scattered or limited to specific subgroups of population (9, 12).

Remarkably, the reported basal information on prevalence of overweight and obesity varies considerably from one study to another. They are recruited based on different measures from different target groups of different scopes with quite different age and sex distributions (9, 18), so that there is a growing need to prepare primary data to bridge health research to policy recommendations (18, 20). To address this issue, we need to provide comprehensive scientific evidence for triggering policy actions, controlling the programs, and measuring the effect of interventions (21).

Considering these, the main objective of our study was to systematically review all available studies on the means and standard deviations of anthropometric mea-
Djalalinia S et al.

2. Evidence Acquisition

The design and protocol of the study have been described in more detail earlier (22, 23). Here we refer to some essential points in brief.

2.1. Outcomes Definition

The world health organization (WHO), U.S. centers for disease control and prevention, and international obesity task force each have presented different definitions of overweight and obesity in children and adolescents (24-27) (Table 1).

2.2. Measures Definition

We have included studies that reported mean and standard deviation or percentile categories of BMI, WC, WHR, or WHtR or prevalence of obesity or overweight by sex, age, and year at national and sub-national levels in Iran, based on anthropometric measures. For each measure, the standardized protocols, definition and cut off were considered.

2.3. Search Strategy

To assess papers on obesity and/or overweight of Iranian children and adolescents, we searched PubMed and NLM Gateway (for MEDLINE), Institute of Scientific Information (ISI), and SCOPUS as the main international electronic data sources. Moreover Iranmedex, Irandoc, and scientific information database (SID), considered to the main domestic databases that have systematic search capability and the most coverage of national indexed or even non indexed Iranian scientific journals (Table 2). All Iranian scientific journals of medical universities that are not listed in the domestic electronic databases, governmental reports, projects reports, conferences and reference lists, were reviewed by hand searching. The Endnote version II reference manager software was used to manage the data.

We limited the search to national, provincial, district, community population based studies in Iranian children and adolescents (ages 6 - 18 years) and there was no restriction on language. Databases were searched from January 1990 to the end of December 2013.

2.4. National Data Source

We used the aggregated data of childhood and adolescent surveillance and prevention of adult non-communicable disease (CASPian) study as the main available national data source for the cardio metabolic risk factors of children and adolescents in Iran (28). Data were collected in four different surveys during 2003 to 2012 at the national and sub-national levels in Iran (20, 29-34). We assessed first, third, and fourth rounds data since second rounds of data were not available.

2.5. Study Selection and Eligibility Criteria

We excluded papers on non-population-based studies, or those with duplicate citations. The studies that focused on specific populations (such as school-based studies) were excluded. When there were multiple publications on the same population, only the largest study or the main source of data was included. We used GBD (global burden of diseases) validated quality assessment. Papers that had poor ratings were excluded and data were extracted from moderate and high quality studies. The quality assessment has been followed independently by two research experts and probable discrepancy between them resolved based on third expert opinion. Agreement was assessed using Cohen’s kappa statistic. The kappa statistic for agreement on quality assessment was 0.92.

2.6. Data Extraction

The data extraction sheet contained the following items: general information of study and its citation; population detailed characteristics; methodological information of designing and conduction of study (the study region, scope of study (local study or survey), total sample size, age and sex groups, urban/rural areas, cut-off point of prevalence, reported prevalence and its 95% confidence interval), and study outcomes indicators (age specific prevalence of overweight and/or obesity; body mass index mean; waist circumference mean; waist to hip ratio mean).

3. Results

We refined data for prevalence of obesity and overweight by sex, age, province, and year (n = 22972). Based on our search strategy we found 3253 records; of these 1875 were from international data bases and the remaining 1378 were obtained from national data bases. After removing duplicates, via the refining steps, only 129 articles were found related to our study domain. Figure 1 is a flowchart for the data collection and selection process.

Considering the inclusion and exclusion criteria, 62 articles that met our eligibility criteria were selected. From
Definitions of Overweight and Obesity in Children and Adolescents

| Organization | Definition |
|--------------|------------|
| World health organization | WHO child growth standards (birth to age 5); obesity: body mass index (BMI) > 3 standard deviations above the WHO growth standard median; overweight: BMI > 2 standard deviations above the WHO growth standard median; underweight: BMI < 2 standard deviations below the WHO growth standard median; WHO reference 2007 (ages 5 to 19); obesity: body mass index (BMI) > 2 standard deviations above the WHO growth standard median; overweight: BMI > 1 standard deviation above the WHO growth standard median; underweight: BMI < 2 standard deviations below the WHO growth standard median. |
| U.S. centers for disease control and prevention | In children ages 2 to 19, BMI is assessed by age- and sex-specific percentiles; obesity: BMI 95th percentile ≤; overweight: BMI 85th < and ≤ 95th percentile; normal weight: BMI 5th < and ≤ 85th percentile; underweight: BMI < 5th percentile. |
| International obesity task force | Provides international BMI cut points by age and sex for overweight and obesity for children age 2 to 18. The cut points correspond to an adult BMI of 25 (overweight) or 30 (obesity). |

These, the extracted results of 53 papers are reported in Tables 3 - 10 and the others are shown with related information in Tables 11 - 13.

Tables 3 - 10 shows the prevalence of obesity based on BMI, in eligible population-based studies in Iranian children and adolescents. Also for more precise comparison, the confidence interval for 95% significance level (CI 95%) was calculated for possible cases. We have also included each study designed.

Considering the systematic review results; the number of total population and points of data were 22972 and 29, 38985 and 47 respectively for boys and girls. There were 5 studies that did not report BMI separately for boys and girls. As well as regarding the geographically distribution we found, 9 national, 14 provincial , and 58 district level points of data.

The findings are scattered, with very wide ranges of values for BMI and for rates of obesity and overweight. On the other hand, non-standard classifications of age groups led to greater complexity in estimation of values. For instance, information about elementary school students was provided with at least 6 different age categories including: 6 - 10, 6 - 11, 6 - 12, 6 - 14, 7 - 11, and 7 - 12. The lowest rate of obesity in this age group was 3.5% which was reported in Yazd and Sabzevar (9, 38, 50) and the highest rate of 17.7% was in Ahvaz (42). Similarly there were different reports for 10 - 15 year olds; based on one of them 13% of boys and 6.5% of girls in Tehran province were obese (41), in another study via the refining steps, only 129 articles were found related to our study domain in the same province reported 7.5% and 7.3% respectively for boys and girls (55). In 15 - 19 year old group, the prevalence of obesity was 2.8% for boys and 1.7% for girls (49, 57). In Tables 11 - 13, the WHR, WC, and WHtR mean in population-based studies in Iranian children and adolescents reported based on papers data availability.

Tables 11 - 13 include only 9 papers with information on WHR, WC, or WHtR that met the study eligible criteria. The aggregated data CASPIAN studies are presented as the main source of national data.
Based on the first CASPIAN study in 2004, the national prevalence of abdominal obesity was 9.27 (8.87% - 9.67%) for both sexes, 9.14 (8.60% - 9.69%) for males, and 9.41 (8.84% - 9.99%) for females. In the last estimation for 2012 these were increased respectively to 19.12 (18.22% - 20.02%), 20.41 (19.09% - 23.05%), and 17.79 (16.56% - 19.02%). In similar time period, the national mean of WC from 64.61 (64.46 cm - 64.76 cm) rose to 67.02 (66.57 cm - 67.48 cm).

4. Discussion

This review of our finding, similar to some regional and global studies, provides alarming evidence-based data on the considerable prevalence of childhood and adolescents overweight (9, 12, 16, 17). In Iran national studies, especially in pediatric groups, are limited and nearly there is no comprehensive study for sub-national trends. Considering the results of CASPIAN, as the only valid national study; in 2004, the national prevalence of obesity for 6 - 18
Table 3. The Prevalence of Obesity in Population-Based Studies in Iranian Children and Adolescents (Based on BMI Measure)

| Reference                  | Location                        | Year of Study | Gender | Age range, y | Sample Size, n | BMI Mean | CI 95% | Obesity Definition | Prevalence of Obesity/CI 95% | Over Weight Definition | Prevalence of Over Weight/CI 95% |
|---------------------------|---------------------------------|---------------|--------|--------------|----------------|----------|--------|-------------------|-------------------------------|------------------------|-------------------------------|
| Aazami et al. (2012)      | Kermanshah, local study         | U 2010        | Both   | NA           | 9.3 ± 1.5      | 1610     | ±         | 12.34 - 26.46     | 10.8 (10.39 - 11.40)            | 14.4 (13.78 - 14.65)         |
|                           |                                 |               | Male   | NA           | 9.3 ± 1.5      | 756      | ±         | 17.26 - 27.07     | 13.4 (12.57 - 14.32)            | 12.6 (11.84 - 13.38)          |
|                           |                                 |               | Female | NA           | 9.3 ± 1.4      | 644      | ±         | 16.07 - 27.35     | 11.75 (11.07 - 12.47)           | 11.3 (10.33 - 12.25)          |
| Abdollahi et al. (2010)   | Golestan, provencial study      | U 2005        | Male   | 17 - 70      | 43.4 ± 16.76   | 2500     | ± 4.44   | 28.34 - 36.95     | 20.3 (19.67 - 20.93)            | 40.1 (38.14 - 41.23)          |
|                           |                                 |               | Female | 43.4 ± 13.58 | 2500           | 27.51 ± 5.54 | ± 4.44 | 27.46 - 27.95     | 30.7 (30.47 - 30.97)           | 35 (34.8 - 35.4)              |
| Ahmadi et al. (2010)      | Kerman, local study             | U 2009        | Both   | NA           | 9 ± 1.4        | 1600     | ± 3      | 15.85 - 16.65     | 9.7 (9.27 - 11.03)             | NA                     | NA                           |
|                           |                                 |               | Male   | NA           | 70 ± 1.9       | 770      | ± 3      | 15.79 - 16.20     | NA                            | NA                     | NA                           |
|                           |                                 |               | Female | NA           | 796 ± 1.11     | 68.86 ± 6.32 | ± 1.11 | 68.86 - 6.32     | NA                            | NA                     | NA                           |
| Akhavan-Karbas et al. (2006) | Yazd, local study             | U 2006        | Both   | 6 - 6.9      | NA             | 400      | ±         | 13 ± 31          | 15.1 ± 31 ± 31                 | 4.7 (3.49 - 4.9)             |
|                           |                                 |               | Male   | NA           | 200 ± 4.35     | 200      | ±         | 5.1 ± 3.22       | 3.8 ± 3.22 ± 3.22              | 4.8 ± 3.8 ± 3.8             |
|                           |                                 |               | Female | NA           | 200 ± 2.7      | 200      | ±         | 2 ± 2.27         | 1.3 (1.03 - 1.07)              | 2.1 (1.66 - 2.57)            |
| Mirzaeezadeh et al. (2006) | Yebras, local study            | U 2002        | Both   | 10 - 19      | NA             | 420      | ±         | 14.45 - 4.65     | 14.4 ± 4.65 ± 4.65             | 14.15 (13.7 - 14.6)           |
|                           |                                 |               | Male   | NA           | 177 ± 4.5      | 243      | ±         | 5.1 ± 3.81       | 3.81 ± 3.81 ± 3.81             | NA                     | NA                           |
|                           |                                 |               | Female | NA           | 244 ± 3.4     | 244      | ±         | 2.8 ± 3.34       | 2.8 ± 3.34 ± 3.34             | NA                     | NA                           |

Abbreviation: CI, confidence interval; F, female; M, male; NA, not available; R, rural; R, rural total; T, total; U, urban; UT, urban total; y, year.

Values are expressed as mean (SD).

In Iran there are few national studies and nearly no comprehensive study for sub-national trends (91-93). In comparison with other related studies, compared with the presented data, and some methodological problems, in designing and conducting the related researches, were other sources of diversity (30, 32, 85). There are also some visible data lags in some areas of country or for different target groups that should be more considered for future studies’ plan. For all measures however the reports have significant missing in reporting the confidence intervals for both measures values’ and obesity/overweight rates, which limited our ability to compare and analyze results. On the other hand, most of our efforts to contact study authors for requesting more data and information failed.

Different age and sex groups had large variations in the prevalence of obesity and overweight. As a considerable point; there are also a lot of missing data for different sub groups which is leading from the misclassification or other limitation of research papers’ data presentation (89, 90). Some of these diversities are attributed to the geographical scopes of studies; some estimations belong to local level studies, some others estimate district level and others are designed for national estimations. Moreover, the quality of year olds male and female was respectively 3.34 (3% - 3.69%) and 3.50 (3.15% - 3.87%). In 2010 these estimations respectively rose to 13.58 (12.59% - 14.63%), and 7.68 (6.71% - 8.72%). In the last estimation for 2012 these were increased to; 13.58 (12.59% - 14.63%), and 10.15 (9.27% - 11.09%).
Table 4. [Part 2] The Prevalence of Obesity in Population-Based Studies in Iranian Children and Adolescents (Based on BMI Measure)

| Reference                      | Location         | Urban/Rural | Year of Study | Gender | Age-group, y | Sample Size, n | BMIa CI 95% | Obesity Definition | Prevalence of Obesity/CI 95% | Over Weight Definition | Prevalence of Over Weight/CI 95% |
|--------------------------------|------------------|-------------|---------------|--------|--------------|----------------|-------------|------------------|--------------------------|------------------------|--------------------------|
| Amanolahi et al. (2012)        | Tehran, local    | NA          | Urban         | NA     | 10.6 ± 0.71  | 4040           | NA          | NA               | CDC 2000                 | NA                     | CDC 2000                 |
| Amidimazaheri et al. (2010)    | Isfahan          | NA          | Rural         | Female | 14 - 18      | 384           | NA          | NA               | CDC 2000                 | 1.03 (0.93 - 1.13)       | CDC 2000                 |
| Amini et al. (2007)            | Tehran           | U           | 2004          | Both   | 10 - 15      | 396           | 19.8 ± 3.8  | 19.4 - 20.17     | 10 (9.81 - 10.88)         | 10 (9.68 - 10.72)        |
| Aminzadeh et al. (2005)        | Ahvaz            | U           | 2010          | Both   | 6 - 10       | 5394          | NA          | NA               | CDC 2000                 | 17.7 (16.55 - 18.88)      |
| Asadi Noghabi et al. (2011)    | Bandarabbas,     | NA          | NA            | Male   | 15 - 20      | 280           | 20.64 ± 3.45 | 20.24 - 20.84   | 10 (9.45 - 10.82)         | 10 (9.36 - 10.76)        |
| Azimi-Nezhad et al. (2009)     | Khorasan-Razavi, | Both        | 2004          | Both   | 15 - 20      | 260           | 20.47 ± 3.34 | 20.06 - 20.90   | 10 (9.77 - 10.65)         | 10 (9.57 - 10.95)        |

Abbreviation: CI, confidence interval; F, female; M, male; NA, not available; R, rural; R, rural total; U, urban; UT, urban total; y, year.
aValues are expressed as mean (SD).

GBD studies with overall 102 points of data, we benefit from more data driven estimations rather than the model driven results. We will provide more data points that lead to higher quality of estimation (1, 4-8, 19). This is the first comprehensive systematic approach to search and data gathering, during which we benefited from the highest level of access to the published, available unpublished and grey literature through the comprehensive hand searching process. We had access to main national sources of CASPIAN study (30, 32, 85).

Considering previous studies, the present study has several achievements. This study presents the most scientific evidences for the prevalence and trends of obesity and overweight in pediatric population from 1990 to 2013. We benefited from all available sources of data alongside the advanced comprehensive search strategies. All of domestic data bases were searched exactly with all of English/Persian equivalent search terms.

Because of scarcity of data, variations in groups studied, differences in living areas (urban/rural), discrepancy of the measures, for comparing and aggregating the information, we need more modern practical statistical methods (9, 12). These methods are advanced regression models, using existing data, benefit from models for age, hierarchical pattern of data, spatial and temporal pattern of data, and covariates (94, 95).

The present study summarized the information of studies on mean and standard deviation of different measures including BMI, WC, WHR, or WHtR and reported prevalence of obesity or overweight by sex, age, and year at national and sub-national levels from 1990 to 2013 in Iranian children and adolescents.
Obesity seems to be one of the major public health problems. Considering that, several methods have been proposed in the field of medical and surgical treatments. In this context, recent promising approaches emphasize on the population based interventions impacts (96). Aiming that, we call for a sustained valid data sources to monitor, prevent, and control of pediatric overweight and obesity. These processes should be followed through ongoing community-based lifestyle intervention on diet, physical activity promotion, and other local and national experiences (31, 56, 87, 97). Evidences reveal that for more effectiveness, these interventions should be started and exactly followed from the adolescence (12, 23, 96).

Health researchers, professionals and policy-makers should focus on more evidence based policies which require more reliable data. Aiming that, all processes of designing; conducting; monitoring; and distribution of data should be managed based on advanced scientific methods (18, 98).

Table 5. [Part 3] The Prevalence of Obesity in Population-Based Studies in Iranian Children and Adolescents (Based on BMI Measure)

| Reference              | Location      | Gender | Age-group, y | Sample Size, n | BMIa CI 95% | Obesity Definition  | Prevalence of Obesity(95%) | Prevalence of Over Weight(95%) |
|------------------------|---------------|--------|--------------|----------------|-------------|---------------------|---------------------------|-------------------------------|
| Bazhan et al. (2005)   | Lahijan, local study | Female | 14 - 17 | 400 | 21.8 ± 1.5 | 21.06 - 22.24 | CDC 2000 | 5.3 (4.81 - 5.79) |
|                        |               |        |              |                |             |                     |                           | CDC 2000                      |
|                        |               |        |              |                |             |                     |                           | 14.8 (13.56 - 16.04)          |
| Bidad et al. (2008)    | Tehran, local study | Female | 11 - 17 | 400 | 20.6 ± 1.7 | 20.16 - 21.08 | CDC 2000 | 5.0 (4.56 - 5.48) |
|                        |               |        |              |                |             |                     |                           | CDC 2000                      |
|                        |               |        |              |                |             |                     |                           | 14.2 (12.83 - 15.62)          |
| Baygi et al. (2010)    | Neishabour, local study | Both | 6 - 12 | NA | 1471 | 4.6 (4.38 - 4.82) | NA |                           | NA |
| Gargari et al. (2004)  | Tabriz, local study | Female | 14 - 17.9 | 1618 | 21.3 ± 3.6 | 21.12 - 21.48 | CDC 2000 | NA |
|                        |               |        |              |                |             |                     |                           | CDC 2000                      |
| Gharakhanlou et al.    | National study | Male | 15 - 19 | 139 | 20.88 - 21.92 | 2.8 (2.35 - 3.25) | NA | 6.7 (6.09 - 7.31) |
|                        |               |        |              |                |             |                     |                           | CDC 2000                      |
|                        |               |        |              |                |             |                     |                           | 14.6 (13.38 - 15.82)          |
| Haeri Behbahani et al. | Sabzevar, local study | Both | 6 - 11 | 960 | 16.6 ± 2.8 | 16.42 - 16.78 | CDC 2000 | 6 (4.5 - 7.8) |
|                        |               |        |              |                |             |                     |                           | CDC 2000                      |
|                        |               |        |              |                |             |                     |                           | 8 (5.7 - 10.2)                |
| Hajian et al. (2008)   | Babol, local study | Female | 7 - 12 | 1000 | 16.3 ± 2.6 | 16.12 - 16.48 | CDC 2000 | 5.8 (5.46 - 6.14) |
|                        |               |        |              |                |             |                     |                           | CDC 2000                      |
|                        |               |        |              |                |             |                     |                           | 12 (11.01 - 13.97)            |
| Hajian-Tilaki et al.  | Babol, local study | Male | 7 - 12 | 9.3 ± 1.5 | 1000 | NA | 5.8 (4.5 - 6.48 - 7.3) | NA | 23 (21.63 - 24.90) |
|                        |               |        |              |                |             |                     |                           | CDC 2000                      |
|                        |               |        |              |                |             |                     |                           | 12.5 (11.81 - 13.20)          |
|                        |               |        |              |                |             |                     |                           | (7 - 9 years: 22.29)          |
|                        |               |        |              |                |             |                     |                           | (10 - 12 years: 22.56)        |
|                        |               |        |              |                |             |                     |                           | (7 - 9 years: 22.29)          |

Abbreviation: CI, confidence interval; F, female; M, male; NA, not available; R, rural; R, rural total; T, total; U, urban; UT, urban total; y, year.

*Values are expressed as mean(SD).*
### 4. Conclusions

In conclusion, the present findings could provide practical information on children and adolescents’ overweight and obesity for better health policy and more detailed design studies in this area. Because of the importance of application of researches’ data more policy attention should be considered for more efficient papers’ data presentation. The presented results also could be used for future complementary sub-national, national or even global related studies.
Table 7. [Part 5] The Prevalence of Obesity in Population-Based Studies in Iranian Children and Adolescents (Based on BMI Measure)

| Reference                | Location                   | Gender | Age (y) | Sample Size, n | BMI Mean ± SD | CI 95% | Obesity Definition Prevalence of Obesity/CI 95% | Over Weight Definition Prevalence of Over Weight/CI 95% |
|--------------------------|----------------------------|--------|---------|----------------|---------------|--------|-----------------------------------------------|--------------------------------------------------|
| Mehrkash et al. (2010)   | Gorgan, local study        | Both   | 15-18   | 450           | NA            | NA     | NA                                            | NA                                               |
|                          |                            | Male   | 15.66 ± 0.68 | 225         | 20.14 ± 3.95  | 20.79 - 21.69 | NA                                            | NA                                               |
|                          |                            | Female | 16.34 ± 0.77 | 225         | 22.46 ± 4.32  | 21.85 - 22.97 | NA                                            | NA                                               |
| Mirhosseini et al. (2009) | Mashhad, local study      | Both   | 15-17   | 622           | NA            | NA     | NA                                            | NA                                               |
| Mirman et al. (2008)     | Tehran, local study       | Both   | 6-16    | 730           | NA            | NA     | CDC 2000                                      | 6.5 (4.19 - 9.04)                                |
|                          |                            | Male   | 13.9     | 339           | NA            | NA     | CDC 2000                                      | NA                                               |
|                          |                            | Female | 383     | NA            | 5.5 (4.05 - 6.95) | NA     | NA                                            | NA                                               |
| Montazerifar et al. (2008) | Sistan va Baluchestan, local study | Both   | 11-18   | 2880          | NA            | NA     | CDC 2000                                      | 7.1 (6.72 - 7.46)                                |
|                          |                            | Female | 312     | NA            | 6.3 (5.64 - 6.94) | NA     | NA                                            | NA                                               |
| Mohammadpour et al. (2010) | Tehran, local study   | Both   | 11-16   | 13.7 ± 1.54  | 1068          | NA     | CDC 2000                                      | 7.8 (7.34 - 8.09)                                |
|                          |                            | Male   | 13.7 ± 1.54 | 1068        | 19.8 ± 3.95  | 18.56 - 20.04 | 7.3 (6.89 - 7.73) | 18.8 (17.88 - 19.72) |
|                          |                            | Female | 125     | 20.8 ± 4.11  | 20.37 - 20.63 | NA     | 8.3 (7.88 - 8.72)                            | 23.2 (22.62 - 24.80)                             |
| Najafian et al. (2007)   | Zahedan, local study      | Both   | 16-18   | 16.6 ± 1.3   | 752           | 20 ± 1.45 | NA                                            | 8.3 (8.04 - 9.51)                                |
|                          |                            | Female | 11-14   | 13 ± 0.99    | 687           | 17 ± 1.84 | 8.7 (8.18 - 9.29)                            |                                                  |

Abbreviation: CI, confidence interval; F, female; M, male; NA, not available; R, rural; R, rural total; T, total; U, urban; UT, urban total; y, year.

Values are expressed as mean (SD).
Table 8. [Part 6] The Prevalence of Obesity in Population-Based Studies in Iranian Children and Adolescents (Based on BMI Measure)

| Reference            | Location          | Year of Study | Gender | Age Group, y | Sample Size, n | BMIa CI 95% | Obesity Definition Prevalence of Obesity/CI 95% | Over Weight Definition Prevalence of Over Weight/CI 95% |
|----------------------|-------------------|---------------|--------|--------------|---------------|-------------|-----------------------------------------------|-----------------------------------------------------|
| Montazerifar et al.  | Yazd, local study | 1999          | Both   | 7 - 11       | NA 483        | 3.8 (3.56 - 4.24) | NA                               | NA                                           |
|                      |                   |               | Male   | NA           | 250           | 4.3 (3.77 - 4.83) | NA                               | NA                                           |
|                      |                   |               | Female | NA           | 223           | 3.4 (3.08 - 3.82) | NA                               | NA                                           |
| Mostafavi et al.     | Shiraz, local study | 2002         | Both   | 11 - 18      | NA 803        | 2.8 (2.51 - 3.29) | 8.3 (5.95 - 10.99) | NA                                           |
|                      |                   |               | Male   | NA           | NA            | 19.4 ± 3.4     | 18.91 - 19.87 | NA                                           | NA                                           |
|                      |                   |               | Female | NA           | NA            | 20.6 ± 3.6     | 20.07 - 21.01 | NA                                           | NA                                           |
| Mozaffari et al.     | Tehran, local study | 2002         | Female | 7 - 12       | 1060          | 3.7 (3.61 - 3.83) | 7.7 (7.3 - 8.2) | 13.3 (12.7 - 13.8) |
| Mozaffari et al.     | Yazd, local study | 2003          | Both   | 6 - 12       | NA 4755       | 3.5 (3.40 - 3.60) | NA                               | NA                                           |
|                      |                   |               | Male   | NA           | NA            | 2.9 (2.86 - 3.04) | NA                               | NA                                           |
|                      |                   |               | Female | NA           | NA            | 7.6 (7.2 - 8.0)  | NA                               | NA                                           |
| Pourghasem et al.    | Tabriz, local study | 2002         | Female | 14 - 18      | NA 807        | 1.0 (0.98 - 1.04) | NA                               | NA                                           |
| Rashidi et al.       | Tehran, local study | 2001         | Male   | 11 - 16      | NA 1068       | 7.3 (6.89 - 7.70) | 18.8 (17.8 - 19.7) | 7.3 (6.89 - 7.70) |
|                      |                   |               | Female | 13.4 ± 1.64 | 1253          | 8.3 (7.87 - 8.72) | 23.1 (22.1 - 24.0) | 8.3 (7.87 - 8.72) |
| Salem et al.         | Kerman, local study | 2007         | Female | 11 - 18      | 1221          | 2.4 (2.27 - 2.52) | 11.2 (10.6 - 11.9) | 2.4 (2.27 - 2.52) |

Abbreviation: CI, confidence interval; F, female; M, male; NA, not available; R, rural; R, rural total; T, total; U, urban; UT, urban total; y, year.

Values are expressed as mean [SD].
Table 9. [Part 7] The Prevalence of Obesity in Population-Based Studies in Iranian Children and Adolescents (Based on BMI Measure)

| Reference          | Location                     | Urban/Rural | Year of Study | Gender | Age-group, y | Sample Size, n | BMIa, CI 95% | Agea | Sample Size, n | BMIa, CI 95% | Obesity Definition | Prevalence of Obesity(95%) | Over Weight Definition | Prevalence of Over Weight(95%) |
|--------------------|------------------------------|-------------|---------------|--------|--------------|----------------|--------------|------|----------------|--------------|----------------------|--------------------------|--------------------------|--------------------------|
| Salem et al. (2011) | Kerman, local study          | U           | 2009          | Male   | NA           | NA             | 16.78 ± 3.76  | 16.45 - 17.11 | NA   | NA             | NA           | CDC 2000              | 10.2 (9.40 - 11.00)      | NA                       | 8.9 (8.33 - 9.47)       |
|                     | Female                       | NA          | 16.25 ± 3.33  | 17.02 - 17.48 | NA          | NA             | 10.9 (9.51 - 12.33) | NA | NA             | CDC 2000              | NA                       | 8.9 (8.33 - 9.47)       |
| Saffari et al. (2011) | Qazvin, local study          | U           | 2010          | Female | 0 - 14       | 2201           | 17.8 ± 3.7    | 16.90 - 18.80 | CDC 2000 | NA             | 9.8 (9.3 - 10.3)      | NA                       | 7.3 (6.8 - 7.8)         |
|                     |                              | Female      | 17.02 - 17.48 | NA     | 17.02 - 17.48 | NA             | 8.5 (7.9 - 9.1) | NA | CDC 2000              | 8.9 (8.33 - 9.47)       | NA | NA                       | 7.3 (6.8 - 7.8)         |
| Sohailifar et al. (2000) | Hamadan, local study        | U           | 1998          | Both   | 0 - 16       | 2000           | 17.9 ± 3.7    | CDC 2000 | NA             | 9.8 (9.3 - 10.3)      | NA | NA                       | 7.3 (6.8 - 7.8)         |
|                     |                              | Male        | 18.10 ± 3.7   | 16.90 - 18.80 | CDC 2000 | 8.5 (7.9 - 9.1) | NA | CDC 2000              | 8.9 (8.33 - 9.47)       | NA | NA                       | 7.3 (6.8 - 7.8)         |
|                     | Female                       | NA          | 18.10 ± 3.7   | 16.90 - 18.80 | CDC 2000 | 8.5 (7.9 - 9.1) | NA | CDC 2000              | 8.9 (8.33 - 9.47)       | NA | NA                       | 7.3 (6.8 - 7.8)         |
| Sotoodeh et al. (1997) | Hassanabad Khaleghi of Es- lamshahr, local study | R           | 1994          | Female | 0 - 19       | 35             | 22.5 ± 4.0    | NA | CDC 2000              | 9.8 (9.3 - 10.3)      | NA | NA                       | 7.3 (6.8 - 7.8)         |
| Taheri et al. (2009) | Birjand, local study        | U           | 2005          | Both   | 15 - 18      | 2230           | 18.1 ± 3.7    | NA | NA             | 9.8 (9.3 - 10.3)      | NA | NA                       | 7.3 (6.8 - 7.8)         |
|                     |                              | Male        | 18.1 ± 3.7    | 16.90 - 18.80 | CDC 2000 | 9.8 (9.3 - 10.3) | NA | CDC 2000              | 9.8 (9.3 - 10.3)      | NA | NA                       | 7.3 (6.8 - 7.8)         |
|                     | Female                       | NA          | 18.1 ± 3.7    | 16.90 - 18.80 | CDC 2000 | 9.8 (9.3 - 10.3) | NA | CDC 2000              | 9.8 (9.3 - 10.3)      | NA | NA                       | 7.3 (6.8 - 7.8)         |
| Taheri et al. (2005) | Birjand, local study        | U           | 2002          | Both   | 6 - 11       | 499            | 22.8 ± 4.0    | NA | CDC 2000              | 9.8 (9.3 - 10.3)      | NA | NA                       | 7.3 (6.8 - 7.8)         |
|                     |                              | Male        | 22.8 ± 4.0    | 16.90 - 18.80 | CDC 2000 | 9.8 (9.3 - 10.3) | NA | CDC 2000              | 9.8 (9.3 - 10.3)      | NA | NA                       | 7.3 (6.8 - 7.8)         |
|                     | Female                       | NA          | 22.8 ± 4.0    | 16.90 - 18.80 | CDC 2000 | 9.8 (9.3 - 10.3) | NA | CDC 2000              | 9.8 (9.3 - 10.3)      | NA | NA                       | 7.3 (6.8 - 7.8)         |
| Vehari et al. (2008) | Gonavan, local study        | Both        | 2006          | Both   | 0 - 24       | 499            | 22.8 ± 4.0    | 22.3 - 23.4 | CDC 2000 | 9.8 (9.3 - 10.3)      | NA | NA                       | 7.3 (6.8 - 7.8)         |

Abbreviation: CI, confidence interval; F, female; M, male; NA, not available; R, rural; R, rural total; U, urban; UT, urban total; y, year.

aValues are expressed as mean (SD).
Table 10. [Part 8] The Prevalence of Obesity in Population-Based Studies in Iranian Children and Adolescents (Based on BMI Measure)

| Reference           | Location          | Urban/Rural Year of Study | Gender | Age-group, y | Age | Sample Size, n | BMI CI 95% | BMI Mean | BMI Definition | Prevalence of Obesity/CI 95% | Over Weight Definition | Prevalence of Over Weight/CI 95% |
|---------------------|-------------------|---------------------------|--------|--------------|-----|----------------|------------|----------|----------------|-------------------------------|-------------------------|-------------------------------|
| Veghari et al. (2012) (84) Golestan, local study | Both | 2008 | CDC 2000 | | | | Both | 10.6 ± 14.3 | 6449 | NA | NA | 22 (21.38 - 23.01) | 31.5 (30.78 - 32.2) |
|                      |                   | Both | 2008 | CDC 2000 | | | Male | NA | 3245 | 25 ± 4.8 | 24.88 - 25.62 | 14.1 (13.64 - 14.52) | 32.4 (31.65 - 33.05) |
|                      |                   | Female | 2008 | CDC 2000 | | | Female | NA | 3244 | 27.5 ± 6.1 | 27.29 - 27.73 | 26.8 (26.27 - 27.33) | 30.5 (29.98 - 31.02) |
| Kelishadi et al. (85) CASPIAN I, national study | Both | 2004 | CDC 2000 | | | | Both | 12.27 ± 3.32 | 20,966 | 10.42 ± 3.87 | 10.42 - 3.8 | 3.42 (3.17 - 3.67) | 10.66 (10.54 - 10.8) |
|                      |                   | Male | 2004 | CDC 2000 | | | Male | 12.27 ± 3.3 | 10,793 | 10.28 ± 3.83 | 10.28 - 3.83 | 3.24 (3.00 - 3.49) | 10.70 (10.44 - 10.97) |
|                      |                   | Female | 2004 | CDC 2000 | | | Female | 12.27 ± 3.34 | 10,173 | 10.60 ± 3.90 | 10.60 - 3.90 | 3.50 (3.15 - 3.87) | 12.30 (12.06 - 12.54) |
| Kelishadi et al. (86) CASPIAN III, national study | Both | 2010 | CDC 2000 | | | | Both | 14.27 ± 2.4 | 5625 | 19.42 ± 4.09 | 19.31 - 19.53 | 8.91 (8.17 - 9.68) | 8.02 (7.32 - 8.75) |
|                      |                   | Male | 2010 | CDC 2000 | | | Male | 14.27 ± 2.4 | 2824 | 19.61 ± 4.32 | 19.45 - 19.79 | 10.15 (9.63 - 10.69) | 9.38 (8.83 - 9.95) |
|                      |                   | Female | 2010 | CDC 2000 | | | Female | 14.27 ± 2.4 | 2801 | 19.23 ± 4.66 | 19.08 - 19.38 | 7.68 (7.37 - 8.02) | 6.84 (6.74 - 7.92) |
| Khashayar et al. (2013) (86) CASPIAN IV, national study | Both | 2012 | CDC 2000 | | | | Both | 12.47 ± 3.36 | 13,350 | 18.85 ± 4.42 | 18.70 - 19.99 | 11.69 (10.82 - 12.59) | 9.66 (9.35 - 10.02) |
|                      |                   | Male | 2012 | CDC 2000 | | | Male | 12.47 ± 3.36 | 6777 | 18.73 ± 4.42 | 18.53 - 18.94 | 13.18 (12.19 - 14.15) | 9.27 (8.18 - 10.20) |
|                      |                   | Female | 2012 | CDC 2000 | | | Female | 12.47 ± 3.36 | 6573 | 18.97 ± 4.38 | 18.76 - 19.17 | 10.35 (9.27 - 11.40) | 10.06 (9.10 - 10.96) |

Abbreviation: CI, confidence interval; F, female; M, male; NA, not available; R, rural; R, rural total; T, total; U, urban; UT, urban total; y, year.

Values are expressed as mean (SD).
Table 11. The WHR, WC, and WHtR Mean and Abdominal Obesity in Population-Based Studies in Iranian Children and Adolescents

| Reference                | Location | Urban/Rural | Year of Study | Gender | Age group, y | Sample Size, n | WHR Mean | CI 95% | WHR Mean | CI 95% | WHtR Mean | CI 95% | Prevalence of Abdominal Obesity, % |
|--------------------------|----------|-------------|---------------|--------|--------------|----------------|----------|--------|----------|--------|------------|--------|---------------------------------|
| Amini et al. (2007)      | Tehran   | Urban       | 2001          | Both   | 10 - 15      | 12.6 ± 0.9     | 105      | 0.8 ± 0.07 | 0.79 - 0.81 | NA     | NA         | NA     | NA                              |
|                          |          | Rural       |               | Male   | 12.7 ± 0.8   | 157            | 0.83 ± 0.06 | 0.82 - 0.84 | NA     | NA         | NA     | NA                              |
|                          |          | Urban       |               | Female | 12.5 ± 0.9   | 188            | 0.77 ± 0.06 | 0.76 - 0.78 | NA     | NA         | NA     | NA                              |
| Azimi-Nezhad et al. (2009)| Khorasan-| Rural       | 2004          | Male   | 15 - 20      | NA             | 110    | 0.9 ± 0.04 | 0.89 - 0.91 | NA     | NA         | NA     | 74.63 ± 12.2                 |
|                          | Razavi   |             |               | Female | NA           | 260            | NA     | 0.8 ± 0.04 | 0.79 - 0.81 | NA     | NA         | NA     | 73.16 - 76.12            |
| Gharakhanlou et al. (2012)| National | Urban       | 2011          | Male   | 15 - 19      | NA             | 139    | 0.82 ± 0.05 | 0.81 - 0.83 | NA     | NA         | NA     | 74.3 ± 7.52                |
|                          | Study    |             |               | Female | NA           | 145            | 0.78 ± 0.05 | 0.77 - 0.79 | NA     | NA         | NA     | 72.7 ± 6.92               |
| Hosseini-Esfahani et al. (2008)| Tehran | Urban       | 2001          | Male   | 10 - 14      | 12.8 ± 1       | 698    | 0.9 ± 0.07 | 0.89 - 0.97 | NA     | NA         | NA     | 64.9 ± 117               |
|                          |          |             |               | Female | 10 - 14      | 675            | NA     | 0.9 ± 0.07 | 0.89 - 0.97 | NA     | NA         | NA     | 65.2 ± 117                |
|                          |          |             |               | Male   | 15 - 19      | 12.8 ± 1       | 734    | 0.9 ± 0.07 | 0.89 - 0.97 | NA     | NA         | NA     | 74.3 ± 7.52               |
|                          |          |             |               | Female | 15 - 19      | 12.8 ± 1       | 207    | 0.9 ± 0.07 | 0.89 - 0.97 | NA     | NA         | NA     | 74.3 ± 7.52               |
|                          |          |             |               | Male   | 10 - 14      | 12.3 ± 1       | 983    | 0.9 ± 0.07 | 0.89 - 0.97 | NA     | NA         | NA     | 72.5 ± 9                  |
|                          |          |             |               | Female | 10 - 14      | 12.3 ± 1       | 475    | 0.9 ± 0.07 | 0.89 - 0.97 | NA     | NA         | NA     | 66.9 ± 9                  |
|                          |          |             |               | Male   | 15 - 19      | 12.3 ± 1       | 214    | 0.9 ± 0.07 | 0.89 - 0.97 | NA     | NA         | NA     | 64.5 ± 10                 |
|                          |          |             |               | Female | 15 - 19      | 12.3 ± 1       | 357    | 0.9 ± 0.07 | 0.89 - 0.97 | NA     | NA         | NA     | 73.3 ± 9                  |
|                          |          |             |               | Male   | 10 - 14      | 12.3 ± 1       | 231    | 0.9 ± 0.07 | 0.89 - 0.97 | NA     | NA         | NA     | 64.9 ± 10                 |
|                          |          |             |               | Female | 10 - 14      | 12.3 ± 1       | 151    | 0.9 ± 0.07 | 0.89 - 0.97 | NA     | NA         | NA     | 73.3 ± 9                  |
|                          |          |             |               | Male   | 15 - 19      | 12.3 ± 1       | 151    | 0.9 ± 0.07 | 0.89 - 0.97 | NA     | NA         | NA     | 73.3 ± 9                  |

Abbreviations: CI, confidence interval; F, female; M, male; NA, not available; R, rural; R, rural total; T, total; U, urban; UT, urban total; y, year.

*Values are expressed as mean(SD).
Table 12. [Part 2] The WHR, WC, and WHtR Mean and Abdominal Obesity in Population-Based Studies in Iranian Children and Adolescents

| Reference | Location       | Urban/Rural | Year of Study | Gender | Age-group, y | Age | Sample Size, n | WHR CI 95% Mean | WHtR CI 95% Mean | Prevalence of Abdominal Obesity, % | WC CI 95% Mean | WHR CI 95% Mean |
|-----------|----------------|-------------|---------------|--------|--------------|-----|----------------|-----------------|-----------------|-----------------------------------|----------------|----------------|
| Janghorbani et al. (1998) | Kerman U | Female | 1995 | 14 - 18 | 16.2 ± 1.3 | 1000 | 0.8 ± 0.06 | 0.8 - 0.81 | NA | NA | 70.2 ± 9.0 | 70 - 71.0 | NA |
| Janghorbani et al. (2007) | National | Both | 2005 | Male | 15 - 24 | 20.8 ± 0.65 | V | NA | NA | 3.2 | NA | NA | NA | NA |
| Mirhosseini et al. (2009) | Mashhad, Local study | Both | NA | NA | 16.4 ± 0.09 | 225 | NA | NA | NA | NA | NA | 74.24 ± 0.16 | 74.62-75.04 | NA |
| Mirhosseini et al. (2009) | Naif, Local study | U | NA | Female | 15 - 17 | 16.4 ± 0.09 | 225 | 0.7 ± 0.04 | 0.69 - 0.70 | 9.5 | NA | 69 ± 7.8 | 68.10-69.14 | NA |
| Sotoutbeh et al. (2010) | Hassanieh, Local study | U | NA | Female | 15 - 19 | 205 | 0.78 | NA | NA | NA | NA | NA | NA | NA |

Abbreviations: CI, confidence interval; F, female; M, male; NA, not available; R, rural; R, rural total; T, total; U, urban; UT, urban total; y, year

*Values are expressed as mean [SD]
Table 13. [Part 3] The WHR, WC, and WHtR Mean and Abdominal Obesity in Population-Based Studies in Iranian Children and Adolescents

| Reference | Location | Urban/Rural | Year of Study | Gender | Age-group, y | Age | Sample Size, n | WHR | CI 95% | WHR Mean | Prevalence of Abdominal Obesity, % | WC | CI 95% | WC Mean | WHtR | CI 95% | WHtR Mean |
|-----------|----------|-------------|---------------|---------|--------------|-----|----------------|-----|--------|----------|-----------------------------------|-----|--------|----------|------|--------|-----------|
| Kelishadi et al. (1997) | (85) | CASPIAN I, National study | Both | Both | 6 - 18 | 12.27 ± 3.32 | 20,866 | 0.42 ± 0.06 | 0.429 - 0.431 | 8.37 (8.87 - 9.87) | 64.61 ± 10.91 | 64.46 - 64.76 | 0.80 ± 0.08 | 0.805 - 0.807 |
| | | | 2004 | Male | NA | 12.27 ± 3.3 | 10,793 | 0.43 ± 0.06 | 0.427 - 0.439 | 9.48 (8.60 - 9.50) | 64.99 ± 11.41 | 64.78 - 65.20 | 0.82 ± 0.09 | 0.817 - 0.821 |
| | | | 2004 | Female | NA | 12.27 ± 3.4 | 10,173 | 0.44 ± 0.06 | 0.431 - 0.433 | 9.14 (8.60 - 9.69) | 64.21 ± 10.34 | 64.01 - 64.41 | 0.79 ± 0.08 | 0.781 - 0.794 |
| Kelishadi et al. (2012) | (30) | CASPIAN III, National study | Both | Both | 10 - 18 | 14.27 ± 2.4 | 5625 | 0.44 ± 0.13 | 0.442 - 0.448 | NA | 68.72 ± 20.67 | 68.1 - 69.2 | NA | NA |
| | | | 2010 | Male | NA | 14.56 ± 2.4 | 2824 | 0.44 ± 0.14 | 0.449 | NA | 67.59 ± 22.16 | 66.7 - 68.4 | NA | NA |
| | | | 2010 | Female | NA | 14.76 ± 2.3 | 2801 | 0.44 ± 0.12 | 0.450 | NA | 69.86 ± 18.99 | 69.1 - 70.5 | NA | NA |
| Khashayar et al. (2013) | (86) | CASPIAN IV, National study | Both | Both | 6 - 18 | 12.47 ± 3.36 | 13,350 | 0.45 ± 0.06 | 0.454 - 0.460 | 19.82 (18.22 - 20.06) | 67.02 ± 11.96 | 66.57 - 67.48 | 0.18 ± 0.03 | 0.184 - 0.187 |
| | | | 2012 | Male | 12.36 ± 3.9 | 6777 | 0.46 ± 0.06 | 0.456 - 0.468 | 20.48 (19.09 - 21.79) | 67.83 ± 12.84 | 67.15 - 68.51 | 0.19 ± 0.03 | 0.189 - 0.192 |
| | | | 2012 | Female | 12.58 ± 3.2 | 6573 | 0.45 ± 0.06 | 0.452 - 0.457 | 18.79 (16.56 - 20.03) | 66.99 ± 10.92 | 65.64 - 68.78 | 0.18 ± 0.03 | 0.179 - 0.183 |

Abbreviation: CI, confidence interval; F, female; M, male; NA, not available; R, rural; R, rural total; T, total; U, urban; UT, urban total; y, year.
a Values are expressed as mean (SD).
Acknowledgments

The study is granted by Setad-e-Ejraie Farmane Imam and ministry of health and medical education of Islamic Republic of Iran.

Footnote

Authors’ Contribution: Shirin Djalalinia and Mostafa Qorbani had equal contribution in designing the paper, acquisition of data and data analysis, and interpretation. Nilofar Peykari, Ensieh Nasli-Esfahani, and Shohreh Naderimaghdam had cooperation in drafting of the manuscript and Roya Kelishadi, Bagher Larijani, and Farshad Farzadfar supervised the project and had critical revision of the manuscript and approval of the article. All authors have given approval to the final version of manuscript.

References

1. Lim SS, Vos T, Flaxman AD, Danaei G, Shibuya K, Adair-Rohani H, et al. A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990-2010: a systematic analysis for the Global Burden of Disease Study 2010. Lancet. 2012;380(9859):2224–60. [PubMed: 22445609].
2. Murray CJ, Ezzati M, Flaxman AD, Lim S, Lozano R, Michaud C, et al. GBD 2010: a multi-investigator collaboration for global comparative descriptive epidemiology. Lancet. 2012;380(9859):2055–8. [PubMed: 22445598].
3. Murray CJ, Lopez AD. Alternative projections of mortality and disability by cause 1990-2020: Global Burden of Disease Study. Lancet. 1997;349(9064):1269-76. [PubMed: 9167458].
4. Murray CJ, Lopez AD. Global mortality, disability, and the contribution of risk factors: Global Burden of Disease Study. Lancet. 1997;349(9063):1241-59. [PubMed: 9164377].
5. Lopez AD. The evolution of the Global Burden of Disease framework for disease, injury and risk factor quantification: developing the evidence base for national, regional and global public health action. Global Health. 2005;1(5):31-8.
6. Ezzati M, Lopez AD, Rodgers A, Vander Hoorn S, Murray CJ, Comparative Risk Assessment Collaborating G. Selected major risk factors and global and regional burden of disease. Lancet. 2002;360(9344):1347-60. [PubMed: 12429880].
7. Finucane MM, Stevens GA, Cowan MJ, Danaei G, Lin JK, Paciorek CJ, et al. National, regional, and global trends in body-mass index since 1980: systematic analysis of health examination surveys and epidemiological studies with 960 country-years and 9.1 million participants. Lancet. 2011;377(9765):557-67. [PubMed: 21958641].
8. Stevens GA, Singh GM, Lu Y, Danaei G, Lin JK, Finucane MM, et al. National, regional, and global trends in adult overweight and obesity prevalences. Popul Health Metr. 2012;10(1):22. [PubMed: 23167948].
9. Mirrazzadeh A, Sadeghiraad B, Haghdoot AA, Bahreini F, Rezaazadeh Kermani M. The prevalence of obesity in Iran in recent decade; a systematic review and meta-analysis study. Iran J Public Health. 2009;38(3):1-11.
10. Dastgiri S, Madhavi R, TuTunchi H, Faramazri E. Prevalence of obesity, food choices and socio-economic status: a cross-sectional study in the north-west of Iran. Public Health Nutr. 2006;9(6):996-1000. [PubMed: 17125562].
11. Musaiger AO. Overweight and obesity in eastern mediterranean region: prevalence and possible causes. J Obes. 2011;2011:407237. [PubMed: 21948385].
12. Djalalinia S, Moghaddam SS, Peykari N, Kaseaen A, Sheidaei A, Mansouri A, et al. Mortality Attributable to Excess Body Mass Index in Iran: Implementation of the Comparative Risk Assessment Methodology. Int J Prev Med. 2015;6(10):107. [PubMed: 26644966].
13. Bann D, Wills A, Cooper R, Hardy R, Aihie Sayer A, Adams J, et al. Birth weight and growth from infancy to late adolescence in relation to fat and lean mass in early old age: findings from the MRC National Survey of Health and Development. Int J Obes (Lond). 2014;38(1):69-75. [PubMed: 23779050].
14. Peykari N, Tehrani FR, Eftekhari MB, Malekafzali H, Dejman M, Neot R, et al. A peer-based study on adolescence nutritional health: a lesson learned from Iran. J Pak Med Assoc. 2012;62(6):549-54. [PubMed: 22204208].
15. Cali AM, Caprio S. Obesity in children and adolescents. J Clin Endocrinol Metab. 2008;93(11 Suppl 1):S31–6. [PubMed: 18987268].
16. Djalalinia S, Qorbani M, Peykari N, Kelishadi R. Health impacts of Obesity. Pak J Med Sci. 2015;31(3):239-42. [PubMed: 25876654].
17. Reilly JJ, Kelly J. Long-term impact of overweight and obesity in childhood and adolescence on morbidity and premature mortality in adulthood: systematic review. Int J Obes (Lond). 2013;37(5):839-81. [PubMed: 20997725].
18. Mier N, Smith ML, Irizarry D, Carrillo-Zuniga G, Lee C, Trevino L, et al. Bridging research and policy to address childhood obesity among border Hispanics: a pilot study. Am J Prev Med. 2013;44(3 Suppl 3):S520-8. [PubMed: 23451858].
19. Farzadfar F, Danaei G, Namdaritabar H, Rajaratnam JK, Marcus JR, Khorsavi A, et al. National and subnational mortality effects of metabolic risk factors and smoking in Iran: a comparative risk assessment. Popul Health Metr. 2011;9(1):55. [PubMed: 21989074].
20. Kelishadi R, Ardalan G, Gheiratmand M, Ghoora MM, Razaghi EM, Delavar A, et al. Association of physical activity and dietary behaviours in relation to the body mass index in a national sample of Iranian children and adolescents: CASPIAN Study. Bull World Health Organ. 2007;85(5):296-303. [PubMed: 17242754].
21. W. H. O. Expert Consultation. Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. Lancet. 2004;363(9405):157-63. [PubMed: 14726771].
22. Farzadfar F, Delavari A, Malekzadeh R, Mesdaghinia A, Jamshidi HR, Sayyar AY, et al. NASBOD 2012: design, definitions, and metrics. Arch Iran Med. 2014;17(7):17-15. [PubMed: 24444058].
23. Kelishadi R, Hospeivan S, Qorbani M, Jamshidi F, Fallah Z, Djalalinia S, et al. National and sub-national prevalence, trend, and burden of cardio-metabolic risk factors in Iranian children and adolescents, 1990 - 2013. Arch Iran Med. 2014;17(7):91-80. [PubMed: 24444066].
24. Rao S, Simmer K. World Health Organization growth charts for monitoring the growth of Australian children: time to begin the debate. J Paediatr Child Health. 2012;48(2):E34–90. [PubMed: 22050470].
25. de Onis M, Onyango A, Borghi E, Siyam A, Blossner M, Lutter C. Worldwide implementation of the WHO child growth standards. Public Health Nutr. 2012;15(09):1603-10.
26. Ogden CL, Carroll MD, Kit BK, Flegal KM. Prevalence of obesity and trends in body mass index among US children and adolescents, 1999-2010. JAMA. 2012;307(5):483-90. [PubMed: 22253634].
27. Grummer-Strawng LM, Reinold C, Krebs NF, Centers for Disease C. Use of World Health Organization and CDC growth charts for children aged 0-59 months in the United States. MMWR Recomm Rep. 2010;59(RR-9):1-15. [PubMed: 20829749].
28. Motlagh ME, Kelishadi R, Ardalan G, Heiratmand R, Majdzaadeh R, Heidarzadeh A, et al. Rationale, methods and first results of the Iranian national programme for prevention of chronic diseases from childhood: CASPIAN Study. East Mediterr Health J. 2009;15(2):302-14. [PubMed: 19554976].

16 Iran J Pediatr. 2016; 26(3):e2599.
29. Kelishadi R, Gheiratmand R, Ardalan G, Adeli K, Mehdi Gouya M, Mohammad Razaghi E, et al. Association of anthropometric indices with cardiovascular disease risk factors among children and adolescents: CASPAN Study. Int J Cardiol. 2007;107(1):340–8. [PubMed: 16860401].
30. Kelishadi R, Heshmat R, Motlagh ME, Majddezadeh R, Keramatian K, Qorbani M, et al. Methodology and Early Findings of the Third Survey of CASPAN Study: A National School-based Surveillance of Students’ High Risk Behaviors. Int J Prev Med. 2012;3(6):394–401. [PubMed: 22783465].
31. Kelishadi R, Majddezadeh R, Motlagh ME, Heshmat R, Aminne A, Ardalan G, et al. Development and Evaluation of a Questionnaire for Assessment of Determinants of Weight Disorders among Children and Adolescents: The Caspian-IV Study. Int J Prev Med. 2012;3(10):699–705. [PubMed: 2312896].
32. Kelishadi R, Ardalan G, Qorbani M, Ataei-Jafari A, Bahreynian M, Taslimi M, et al. Methodology and Early Findings of the Four Survey of Childhood and Adolescence Surveillance and Prevention of Adult Non-Communicable Disease in Iran: The CASPAN-IV Study. Int J Prev Med. 2013;4(12):1541–60. [PubMed: 24498502].
33. Djalalinia S, Kelishadi R, Qorbani M, Peykar N, Kasaee A, Saeedi Moghaddam S, et al. Suggestions for better data presentation in papers: an experience from a comprehensive study on national and sub-national trends of overweight and obesity. Arch Iran Med. 2014;17(12):830–6. [PubMed: 2548332].
34. Amirkhani A, Motlagh ME, Sedaghat M. Health status of Iranian students according to the health-risk behaviors survey 2006-2007. ; .
35. Aazami M, Akbari M, Heshmat B, Ali Khani M. The Growth Pattern Among Elementary School Students in Kermanshah, Iran. J Isfahan Med Sch. 2012;30(18).
36. Abdollahi AA, Vagari G. The correlation between age, gender and education with obesity in urban population of Golestan province. Iran J Endocr Metab. 2010;2(2):276–82.
37. 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(11):1439–42.
38. Akhavan-Karbas S, Fallah R, Golestan M, Sadr-Balgh M. Prevalence and risk factors of obesity and overweight among primary school children in Yazd. J Shahid Sadoughi Uni Med Sci Health Serv. 2009;16(5):3-8.
39. Amanolahi A, Sohrabi MR, Montazeri A, Abadi AR, Kolahi AA. Study of dietary intakes of adolescent girls in relation to weight status. J Res Public Health. 2010;5(2):126–35. [PubMed: 2223196].
40. Haeri Behbahani B, Dorosty AR, Esraghian MR. Assessment of obesity in children: Fat mass index versus body mass index. Tehran Univ Med J. 2009;67(6):408–14.
41. Hajian KA, Sadjadi P, Rezvani AR. Prevalence of overweight and under-weight among primary school children aged 7-12 years (Babol; 2006). J Babol Uni Med Sci. 2008;10(3):83–91.
42. Hadian-Tilaki KO, Sajjadi P, Raizavi 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(2):209–14. [PubMed: 21759944].
43. Hadian-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(12):2246–52. [PubMed: 2258779].
44. Janghorbani M, Parvin F. Prevalence of overweight and thinness in high-school girls in Kerman, Iran. J Int Obs Relat Metab Disord. 1998;24(7):629–33. [PubMed: 9705021].
45. Karandish M, Mohammadpour Ahranjani B, Kalantari N, Esraghian M, Rashidi MA. Prevalence of overweight and obesity among adolescent students, 1999-2000 in Tehran. Hakim. 2004;7(1):38–43.
46. Kelishadi R, Pour MH, Sarraf-Zadegan N, Sadry GH, Ansari R, Ali Khass 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(4):435–42. [PubMed: 1291464].
47. Khadivzadeh T, Parsai S, MZoom S. Body mass index and percent of ideal body weight in women of reproductive age in Mashad, 1997-98. J Mashhad Sch Nurs Midwif. 2002;13(4):138–9.
48. Maddah M. Overweight and obesity among Iranian female adolescents in Rashit: more overweight in the lower social group. Public Health Nutr. 2007;10(5):450–3. [PubMed: 1741464].
49. Maddah M, Nikooyeh B. Factors associated with overweight in children in Rashit, Iran: gender, maternal education, skipping breakfast and parental obesity. Public Health Nutr. 2003;23(1):2396–2400. [PubMed: 145447].
50. Maddah M, Shahraki T, Shahraki M. Underweight and overweight among children in Zahedan, south-east Iran. Public Health Nutr. 2010;13(10):1559–21. [PubMed: 2035365].
51. Mehrkash M, Kelishadi R, Mohammadian S, Mousavi-Sanasi F, Qorbani M, Hashemi ME, et al. Obesity and metabolic syndrome among a representative sample of Iranian adolescents. Southeast Asian J Trop Public Health. 2012;4(3):756–63. [PubMed: 2307785].
52. Mirhosseini NZ, Yusoff NA, Shahar S, Parizadeh SM, Mobarehn MG, Shakeri MT. Prevalence of the metabolic syndrome and its influencing factors among adolescent girls in Mashhad, Iran. Asia Pac J Clin Nutr. 2009;18(1):131–6. [PubMed: 19329406].
53. Mirravan P, Esmaillzadeh A, Azizi F. Dietary intake and body mass index: an inverse relationship. Int J Obes (Lond). 2005;29(1):315–21. [PubMed: 1554686].
54. Moayyeri H, Bidad K, Ahmamohammadi A, Rabhihi 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(7):489–93. [PubMed: 16718476].
55. Mohammadpour-Ahranjani B, Rashidi A, Karandish M, Esraghian MR, Kalantari N. Prevalence of overweight and obesity in adolescent Tehran students, 2000-2001: an epidemic health problem. Public
