Iranian J Publ Health, Vol. 38, No.3, 2009, pp.1-11

Review Article

The Prevalence of Obesity in Iran in Recent Decade; a Systematic Review and Meta-Analysis Study

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(Received 8 Nov 2008; accepted 15 Jul 2009)

Abstract

Background: There is a great deal of descriptive studies on obesity in Iran, mostly assessed the prevalence and its relationship with various risk factors and chronic diseases. In order to obtain/give a better insight into the epidemiology of obesity in Iran in recent years and assess its heterogeneity around the country, we reviewed systematically all available studies and analyzed their findings using Meta-analysis.

Methods: All published papers in Iranian and international journals, final reports of research projects, papers in relevant congresses, proceeding books and dissertations of students were reviewed. Those findings, which published between 1997 and 2007 and met eligible criteria, were entered in meta-analysis (Random Model).

Results: Fifty eight eligible papers (out of 219) including 132864 individuals were entered into analysis. The overall prevalence of obesity for adults (>18 yr) and children (<18y) was 21.5% (CI95% 17.4-25.6) and 5.5% (CI95% 4.5-6.4), respectively. The prevalence of obesity in boys and girls (<18y) was 5.3% (CI95% 4.1-6.4) and 4.8% (CI95% 4.0-5.7), respectively. It increased in both adult men and women to 13.7% (CI95% 10.9-16.7) and 27.3% (CI95% 21.3-33.4), respectively. Meta regression indicated that only age explained a considerable proportion of the observed heterogeneity among women.

Conclusion: In overall, the risk of obesity was greater in women, but even in adults, the prevalence was less than that in developed countries. The percentage of obesity was increased by aging, especially in women. There were large variations in the reported prevalence of obesity in Iran; it is mainly because of the different in the distributions of age and sex among the subjects.

Keywords: *Obesity, Systematic Review, Meta Analysis, Iran*

Introduction

Obesity is the most common nutritional disorder in the developed countries and is assuming to become a health problem in developing countries (1). Obesity is a global problem, affecting an estimated 300 million people worldwide and it has long been observed that obesity is associated with an increased in mortality and reduced life expectancy (2).

The prevalence of obesity varies considerably throughout the world. Education and socio-economic status affect the prevalence of obesity, but the effects may be diametrically opposite in different populations around the world. Urbanization, less physical activity, increased energy intake, and the modern life style are important risk factors in obesity. As the results of these changes, obesity is going be a major public health problem in most developing countries in near future (3). It is known that prevalence of obesity is influenced by population characteristics such as age, race, gender and socio economic status (4). Iran is a wide country located in Middle East with around 70 million population of different ethnicities (Turkish in Northwest, Kurdish in west, Arab in south and southwest, Fars in center, Turkmen in northeast, and Baluch in East) with quite different cultures, life styles and socio economical status which might cause variation in the prevalence of obesity (5). In addition, Iran experiences a profound economical growth after a social revolution and long war with Iraq. This improvement might have an impact on health, and accordingly on the prevalence of common preventable diseases such as obesity.

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We found many small to large-scale studies around the country, which estimated the prevalence of obesity. Hence, we believe that valuable information can be extracted from these studies if we explore their findings deeply.
Even without any statistical analysis, it is reasonable to believe that the reported prevalence of obesity has a considerable variation in different studies. They recruited different target groups with quite different age and sex distributions. Therefore, in this study we not only assessed the degree of heterogeneity using statistical test, but also explored the potential sources of heterogeneity.
According to the above explanation, the main objective of this study was to review systematically all available studies and to combine their results to estimate the overall prevalence of obesity in Iran, and more importantly to explore the potential sources of heterogeneity.

Materials and Methods

Search Strategy

We searched the English- language medical literature published between January 1997 and December 2007 using the Medline database of the National Library of Medicine, EMBASE database and the Iranian Digital Library. The medical subject headings (Mesh) were "obesity", "body mass index" combined with prevalence and Iran including all subheadings. In addition all abstracts, conference proceeding, titles of thesis, dissertations and reports in other databases in Persian (Farsi) language such as Iranmedex, Irandoc, Scientific Information Systems (SID), Iranian National Library (INL) were searched with similar strategy; the Persian keywords were equivalent to their English words. Moreover, all the submitted Scientific Journals of Iranian Medical Universities being published since 2007 reviewed by hand searching. The references of selected articles were checked to maximize the sensitivity of our search.

Obesity Definition

We included those studies that determined obesity based on anthropometric measures (Height and Weight) in order to calculate body mass index (BMI). In adults (at least 18 yr old), all the papers determined the obesity as BMI$\geq$ 30 kg/m^2. Most of the recent papers verified the obesity among children based on three different standards including Iranian reference (6), CDC 2000 (7) and IOTF 2000 (International Obesity Task Force) (8). We included only the papers choose the above definitions of adult and child obesity.

Study selection

In the second step, all citations that reported the prevalence of obesity were reviewed. Then we critically appraised all the papers, deeply and independently. We generated a simple checklist to evaluate the main issues in descriptive studies such as the sampling method, and the validity of measurements. The checklist was reported in the appendixes. Those studies having the quality score less than 5 were excluded. In addition, we excluded those studies that estimated the prevalence of obesity in a non-random sample or in a small sample (less than 100 individuals). Moreover, we excluded duplicated citations and those studies that did not mention the data collection date or location.

Data extraction

We classified citations into two groups based on the age of subjects: less than 18 and greater than 18 yr old. Most of citations were reported the prevalence of obesity in more than one age group; therefore, we entered age-specific prevalence of these studies in our meta-analysis. In addition, the publication date, sample size (classified by sex) and the location were recorded.

Statistical analysis

The variance of obesity prevalence in each study was computed using the binomial distribution formula. After checking the heterogeneity of the prevalence among studies, we decided to apply random effect model to estimate the overall prevalence of obesity. In addition, in order to minimize the random variation between point estimations of studies, we adjusted all findings of studies using Bayesian method. In this adjustment, the

overall point estimation based on the random effect model was used as prior prevalence. In the next step, we used meta-regression method to check the effect of age, sex, data collection and publication date as possible sources of the heterogeneity among study findings and to estimate the stratum specific prevalence. We estimated tau-square (t^2) using restricted likelihood method, as an indicator of heterogeneity. All of the analysis was conducted in Stata version 10.

Results

Only 58 studies out of 219 had eligible criteria and their results were included in our analysis. Totally, the findings of 132864 individuals aged from 2 to 81 yr old were included. Twenty eight (45.9%) studies defined obesity based on BMI more than the 95th percentile; 27 (44.3%) studies defined as BMI more than 30 kg m^{-2} and 6 (9.8%) studies chose the cutoff point using NCHS criteria (Table 1).

We explored the prevalence of obesity classified by their definitions in Table 2. As you can see, Percentile 95% and NCHS were the only diagnostic methods being used for samples under 18 yr old. Nevertheless, there was no significant difference between the weighted prevalence of obesity defined by these two methods (P> 0.05).

The overall prevalence of obesity for adults (18 yr old or more) and children (under 18y) were 21.5% (CI95% 17.4-25.6) and 5.5% (CI95% 4.5-6.4), respectively. The prevalence of obesity for boys and girls (<18y) was 5.3% (CI95% 4.1-6.4) and 4.8% (CI95% 4.0-5.7), respectively. It increased in both adult men and women to 13.7% (CI95% 10.9-16.7) and 27.3% (CI95% 21.3-33.4), respectively (Fig. 1).

The results of meta-regression showed that in crude model, age and diagnostic criteria of obesity were the main sources of heterogeneity in both sex (P< 0.01) (Table 3); After adjustment, the only significant factor for heterogeneity was the age of the samples and only was seen in women (P< 0.01). In the model, the year of data collection and the quality score of the articles were not statistically significant.

Table 1: The description of studies that met our eligibility criteria

First Author	Yr of data collection	Province	Sample Size			Yr of Publication	Prevalence (%)			Obesity Definition	Age (Yr Old)	Score *
			Total	Male	Female		Total	Male	Female			
A.Barzigar(9)	1996	Gilan	2423	973	1357	1997	24.6	11.5	34.0	BMI>30	>25	5
R.Ghorbani(10)	1996-1997	Semnan	1921	975	946	1999	19.8	12.6	27.1	BMI>30	20-55	5
H.Mozaffari(11)	1998	Yazd	463	230	233	1999	3.9	4.3	3.4	BMI>P95	7-11	7
J.Soheilifar(12)	1998	Hamadan	2000	1000	1000	2000	5.6	4.0	7.2	NCHS	6-11	7
S.Allahverdian(13)	1998-2002	Tehran	421	177	244	2000	3.8	5.1	2.8	BMI>P95	10-19	7
M.Mojibian(14)	1999-2000	Yazd	570		570	2001	16.3		16.3	BMI>30	15-65	6
H.Sezavar(15)	2001	Ardabil	384	200	184	2001	15.9	13.5	19.0	BMI>30	20-80	5
AR.Dorosty(16)	1995	Gilan,Systan	1755	881	847	2002	8.0	8.7	7.5	BMI>P95	4-5	6
AR.Dorosty(16)	1995	Gilan,Systan	2560	1283	1277	2002	6.4	7.6	5.2	BMI>P95	2-3	6
F.Azizi(17)	1999-2002	Tehran	1766	911	855	2002	46.9	43.6	51.7	BMI>30	>60	6
Z.Mortazavi(18)	2000-2001	Sistan & Blochestan	720	292	428	2002	1.3	1.0	1.4	BMI>30	18-43	6
H.Fakhrzadeh(19)	2000-2001	Booshehr	1437	1437		2002		10.2		BMI>30	>18	6
F.Kavian(20)	2001	Tehran	503		503	2002			11.0	BMI>30	25-45	6
B.Pourghasem(21)	2001-2002	E.Azerbayjan	1518		1518	2002			3.6	BMI>P95	14-18	6
F.Taheri(22)	2002	S.Khorasan	1772	979	793	2002	3.3	2.5	4.3	BMI>P95	7-12	5

First Author	Yr of data collection	Province	Sample Size			Yr of Publication	Prevalence (%)			Obesity Definition	Age (Yr Old)	Score *
			Total	Male	Female		Total	Male	Female			
A.Akhavantabib(23)	2000-2001	Isfahan, Markazi,Najafabad	12514	6141	6373	2003	15.5	9.3	23.4	BMI>30	>19	7
R.Kelishadi(24)	2001	Isfahan, Markazi	2000	1000	1000	2003		1.87	2.9	BMI>P95	11-18	7
N.Shahgholian(25)	2001	Chaharmal	2772			2003	9.9			BMI>P95	7-14	6
S.Akbari(26)	2002	Lorestan	986		986	2003			7.3	BMI>30	14-18	6
M.Tabatabaei(27)	2003	Khozestan	3482	1843	1639	2003	10.9			BMI>P95	6-12	7
Sh.Gheibi(28)	2003-2004	Urmia	584		584	2003			4.0	BMI>P95	10-15	5
P.Mirmiran(29)	1999	Tehran	732	339	393	2004	4.5	5.5	3.7	BMI>P95	6-16	7
P.Mirmiran(29)	2002	Tehran	673	312	361	2004	5.7	6.3	5.2	BMI>P95	6-16	7
M.Jamshidian(30)	2000	Tehran	749		749	2004			41.4	BMI>30	40-60	6
M.Karandish(31)	2000-2001	Tehran	2321	1068	1253	2004	7.8	7.3	8.3	BMI>P95	11-16	7
P.Mirmiran(32)	1998-2002	Tehran	3265	1541	1724	2004	5.4	6.9	4.0	BMI>P95	10-19	7
F.Rahmati(33)	2003	Tehran	3931	1548	2360	2004	3.2	4.2	2.5	BMI>30	17-48	5
H.Mozaffari(34)	2003	Yazd	4755	2948	1807	2004	3.5	1.0	7.6	NCHS	6-12	7
N.Shahidi(35)	2003	E.Azarbaijan	341	341		2004		4.0		NCHS	14-16	5
GH.Vaghari(36)	2003	Golestan	2854		2854	2004			16.4	BMI>30	>18	6
R.Heshmat(37)	2003	Tehran	1573	615	958	2004	30.6	18.6	38.3	BMI>30	25-64	7
T.Azizi(38)	1999-2002	Tehran	7033	2992	4041	2005	27.5	16.3	35.8	BMI>30	30-69	6
M.Bazhen(39)	2000-2001	Gilan	400		400	2005			5.3	BMI>P95	14-17	5
R.Kelishadi(40)	2001	Isfahan,Najafabad	2000	1000	1000	2005	2.2	2.3	2.0	BMI>P95	11-18	7
SH.Asar(41)	2001	Khozestan	4793	2293	2500	2005	2.2	2.0	2.5	BMI>P95	7-14	7
AR.Dorosti(42)	2002	Tehran	835		835	2005			6.6	BMI>P95	8-10	6
F.Azizi(43)	1998-1999	Tehran	2102	808	1294	2005		16.5	32.7	BMI>30	20-80	7
F.Azizi(43)	2001-2002	Tehran	2102	808	1294	2005		20.8	40.3	BMI>30	20-80	7
H.Mostafavi(44)	2002-2003	Fars	803	377	426	2005	2.9	2.6	3.2	BMI>P95	13-18	7
H.Mostafavi(44)	2002-2003	Fars	3245	1305	1940	2005	11.7	7.3	14.8	BMI>30	>18	7
N.Agheli(45)	2003	Gilan	550	285	265	2005		19.4	52.8	BMI>30	>30	6
N.Agheli(45)	2003	Gazvin	550	274	276	2005		21.0	47.4	BMI>30	>30	6
F.Rahmani Nia (46)	2003-2004	Gilan	728	728		2005		6.5		BMI>P95	12-17	6
M.Valizadeh(47)	2004-2005	Zanjan	1010		1010	2005			4.5	BMI>P95	12-14.5	7
SM. Safari(48)	2001	National Survey	8800			2006	21.7	12.9	30.5	BMI>30	45-60	7
M.Karaji Bani(49)	2002	Sistan&Blochestan	2067		2067	2006			1.4	BMI>P95	11	6
A.Khaji(50)	2003-2004	Tehran	2766	1159	1607	2006	6.3	6.9	7.1	BMI>P95	<10	7
Alavi Naieiny (51)	2004	Isfahan	1700	731	963	2006	21.6	12.0	28.9	BMI>30	>60	5
M.Mozafari(52)	2004	Ilam	420		420	2006			22.3	BMI>30	15-49	5
S.Mazloomzadeh(53)	2004	Zanjan	2492	1251	1241	2006	15.0	8.9	21.3	BMI>30	15-64	7
H.Bahrami(54)	2002-2005	Golestan	8998	3787	5212	2006	28.4	17.0	36.7	BMI>30	35-81	7
F.Montazerifar(55)	2004-2005	Sistan&Blochestan	687		687	2006			1.7	BMI>P95	11-14	7
S.Golchin(56)	2005	Semnan	300	150	150	2006	5.5	8.0	3.0	NCHS	11-14	6

First Author	Yr of data collection	Province	Sample Size			Yr of Publication	Prevalence (%)			Obesity Definition	Age (Yr Old)	Score *
			Total	Male	Female		Total	Male	Female			
M.Sharabi(57)	2005	Tehran	1042	568	474	2006	6.5	7.0	6.0	NCHS	2-6	5
M.Safarian(58)	2005	R.Khorasan	1171		1171	2006			5.1	BMI>P95	<18	6
GH.Vaghari(59)	2005	Golestan	2875			2006	4.0			NCHS	<5	7
H.Farshidi(60)	2006	Hormozgan	2087	681	1397	2006	12.2	7.0	14.7	BMI>30	<63	6
H.Mozaffari(61)	2001	Tehran	1800		1800	2007			7.7	BMI>P95	7-12	7
Z.Karamsoltani(62)	2005	Yazd	3245	1587	1658	2007	13.3			BMI>P95	9-11	7
M.Hajifaraji(63)	2006	Tehran	780	392	388	2007	13.0	15.4	10.8	BMI>P95	11-18	6
K.Hajian(64)	2004	Mazandaran	3600	1800	1800	2007	18.8	9.9	27.8	BMI>30	20-70	6
Jafari Rad(65)	2003	Mazandaran	240		240	2007			3.3		14-18	7

The articles were sorted by year of data collection.
* Score: Quality score-all the papers with the quality score of 5 or more (out of 7) were included.
BMI: Body Mass Index calculated by weight (kg)/height^2 (m); P95: Percentile 95%; NCHS: National Center for Health Statistics

Table 2: The weighted point estimates with their 95% confidence intervals of obesity prevalence classified by their obesity definition

Diagnostic Methods for Obesity	Less than 18y		
	Boys	Girls	Total
Percentile 95th	5.52 [4.16-6.89]	4.58 [3.71-5.45]	5.62 [4.47-6.76]
NCHS	4.47 [1.91-7.02]	6.27 [4.62-7.92]	4.72 [3.74-5.71]

There were no significant differences in obesity prevalence between the different diagnostic methods. [ ] included Confidence Interval 95%.
Test for heterogeneity was significant (*P*= 0.000), so we reported Random effects estimations

Table 3: The crude and adjusted effects of potentail infuentail factors on the obesity prevalence; the results of meta regression model

Predictors	Male				Female			
	Crude		Adjusted		Crude		Adjusted	
	Coefficient	*P*	Coefficient	*P*	Coefficient	*P*	Coefficient	*P*
Year of data collection	-0.01	0.98	-0.08	0.84	-0.26	0.74	-0.24	0.64
Age Group[1]	8.4*	0.00	7.57	0.15	22.33*	0.00	23.55*	0.00
Diagnostic Criteria of Obesity	-5.66*	0.00	-0.72	0.84	-15.54*	0.00	0.67	0.88
Quality Score	-1.15	0.93	.09	0.95	-2.52	0.34	1.42	0.44

[1] More than 18 yr versus under 18y
* Significant coefficients
Meta regression with empirical Bayes using iterative procedure.

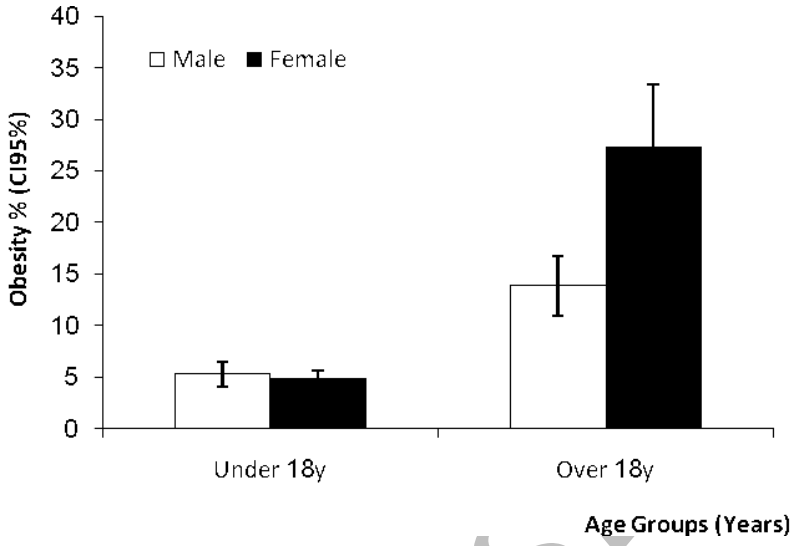

Fig. 1: The prevalence of obesity by sex and age groups. The estimates were calculated by Random effect model

Discussion

Different age and sex groups lead to large variations in the prevalence of obesity in Iran. The prevalence of obesity in those less than 18 yr olds were about 5.5% and 21.5% in the older group. In adults, women reported higher prevalence of obesity in compare to men. The difference between women and men regarding obesity prevalence was increased by age.

Based on available data, the world-wide prevalence of obesity varies from less than 5% in rural China, Japan and some African countries to levels as high as 75% of the adult population in urban Samoa (66, 67). Obesity levels also vary depending on ethnic origin. In the USA, there were considerable variations in the prevalence of obesity particularly among women from the different ethnic groups (68). In the same way, we found large variations in the reported obesity prevalence. Indeed, having such variations in Iran is inevitable due to the population more than 70 millions living in 30 provinces with different socioeconomic, life styles and health statues (5). The other main factors contributing in this variation are the different participants and classifications (for obesity definitions) applied in the surveys.

As mentioned in the material and method section, different cut off points have been used as the 95th percentile of BMI for child obesity (6-8). The new WHO Child Growth Standards include BMI charts for infants and young children up to age 5(69). However, measuring overweight and obesity in children aged 5 to 14 yr is challenging. WHO is currently developing an international growth reference for school-age children and adolescents (70).

We reported the age and sex specific obesity prevalence. Since the diagnostic methods were almost the same in these subgroups, the dissimilarity of findings by different diagnostic methods was not considerable.

Based on the finding, the prevalence of obesity in children in both sex, was nearly 5%. According to the reported statistics for the whole developing courtiers, such prevalence varies from %2 to 10% (71). In developed countries, the normal pattern shows an increase in body weight with ageing, at least up to 50-60 yr old (in both sexes). The relationship between obesity and age is similar in developing countries, but the maximum prevalence of obesity tends to be reached at an earlier age (e.g. 40 yr old). The decline in prevalence after this peak is thought to be partly attributed to lower survival rate of obese individuals. Clear gender difference was seen in most countries with more women than men being obese

(72). In Iran, the prevalence of obesity raised about 2 or 3 times in those more than 30 yr olds (8.1-12.5%) in compare with the younger groups, less than 30 yr (2.2-3.3%). In the married group such prevalence was doubled from 3.1% to 7.4% (33). It is obvious from our study that women are in higher risk for developing obesity even more than men develop and this risk increases by ageing. This difference partly might be attributed to the sedentary life style of the women in Iran. They frequently work as housewives with less physical activities in compare with other employed jobs. The other explanation is the sampling bias, which happened in most household surveys in Iran. Because the most participants in such studies are those who are working at home during the day and mostly they are housewives.

Popkin and Doak used data from eight mid- and low income countries that had at least two surveys to estimate trends, reporting increases of 2.3% to 19.6% in obesity (BMI ≥ 30 kg/m^2) prevalence over a 10-y period (73). In our study, the prevalence of obesity in the adults was about 19% which in compare to other mid-to low income countries. It could be strongly indicated that that our population is at risk of obesity, too.

Limitation

Although age was the main source of heterogeneity, we classified our studies in two age-groups. It was because of the quite different age distributions of subjects in eligible studies. In addition, we could not use the finding of a considerable part of studies just because the authors did not present the characteristics of their subjects such as the study location. Moreover, most of the studies calculated the BMI for both sex and all age groups in order to determine the obesity prevalence. In other words, they did not choose a distinct strategy, such as WHO criteria (8) which persuaded us to exclude some of the studies and report their findings separately. Moreover, in many studies the cut off points for 95th percentile (P95) of BMI was not reported and it make us limited to reported such obesity definitions as the percentile equal or more than P95. The lack of agreement in child and adolescents obesity has made it difficult to estimate the prevalence of obesity in such groups.

In conclusion, there were large variations in the reported prevalence of obesity in Iran; it's mainly because of the different in the distributions of age and sex among the subjects. Some groups, adult women, are at risk of obesity more than the others are. Overall, in compare with reports from developed countries, we had a lower prevalence of obesity, but it does not mean obesity is not a public health problem in our country with a very young population structure.

Acknowledgements

This project was supported by Kerman University of Medical Sciences.

The authors declare that there is no conflict of interests.

References

1. Caballero B (2005). A Nutrition Paradox- Underweight and Obesity in Developing Countries. *N Engl J Med*, 352: 1514-16.
2. Fontaine KR, Redden DT, Wang C, Westfall AO, Allison DB (2003). Years of Life Lost Due to Obesity. *JAMA*, 289: 187-93.
3. World Health Organization (2000). Obesity: preventing and managing the global epidemic. *WHO Technical Report Series*: 894. WHO, Geneva, p 265.
4. Urek R, Crncevic-Urek M, Cubrilo-Turek M (2007). Obesity- a global public health problem. *Acta Med Croatica*, 61:161-64.
5. The Statistical Center of Iran (2006). Iran Statistical Year Book. The Statistical Center of Iran, Tehran.
6. Hosseini M, Carpenter RG, Mohammad K (1998). Growth charts for Iran. *Ann Hum Biol*, 25: 237-47.
7. Kuczmarski RJ, Ogden CL, Grummer-Strawn LM, Flegal KM, Guo SS, Wei R, Mei Z, Curtin LR, Roche AF, Johnson CL

(2000). CDC growth charts: United States. Adv Data: 1-27.
8. Cole TJ, Bellizzi MC, Flegal KM, Dietz WH (2000). Establishing a standard definition for child overweight and obesity worldwide: international survey. *BMJ*, 320: 1240-43.
9. Barzigar A, Shojaei Tehrani H (1997). Prevalence of atherosclerosis risk factors in Sowme Sara district of Gilan in 1996. *J Kerman Univ Med Sci*, 4: 182-89.
10. Ghorbani R, Nazari A (1999). Prevalence of obesity and some factors associated with in Semnan population aged 20-55 years. *Koomesh, J Semnan Univ Med Sci*, 1: 19-24.
11. Mozaffari H, Keshavars SA, Dehkordi H, Hossein Zadeh GA (1999). The prevalence of obesity among primary school students and its relationship to their parents' obesity. *J Shahid-Sadoughi Univ Med Sci & Health Services*, 2: 17-24.
12. Sohailifar J, Sadri GH (2000). Prevalence of obesity in Hamadan primary schools' students in 1998. *Scientific J Hamadan Univ Med Sci*, 7: 15-20.
13. Allahverdian S, Mirmiran P, Rahmani M, Mohammadi Nasrabadi F, Azizi F (2000). Assessment of nutrient intake and obesity in a group of Tehranian adolescents; Tehran Lipid & Glucose Study. *Iran J Endocrinology & Metabolism*, 7: 175-85.
14. Mojibian M, Ghilian Z (2001). Prevalence of obesity among women in Yazd city in 2000. *J Shahid-Sadoughi Univ Med Sci & Health Services*, 9: 36-42.
15. Sezavar H, Mohammadi MA (2001). Prevalence of obesity and its association with cardiovascular risk factors in Ardabil city in 2000. *Scientific J Ardabil Univ Med Sci*, 2: 21-26.
16. Dorosty AR, Siassi F, Reilly JJ, Rona RJ, Chinn S (2002). Obesity in Iranian children. *Arch Dis Child*, 87: 388-91.
17. Azizi F, Emami H, Salehi P, Ghanbarian A, Mirmiran P, Mirboloki M (2002). Risk factors of cardiovascular diseases among elderly in Tehran (Tehran Lipid and Glucose Study). *Iran J Endocrinology & Metabolism*, 5: 3-14.
18. Mortazavi Z, Shahrakipoor M (2002). Body Mass Index in Zahedan University of Medical Sciences Students. *Tabib-e-Shargh*, 4: 81-6.
19. Fakhrzadeh H, Batoei M, Faridnia P, Taeb M (2002). Overweight and obesity in oil industry workers on Kharg Island. *Iran South Med J*, 1: 73-81.
20. Kavian F, Kimiagar M, Golestan B, Hoshiar Rad A (2002). The prevalence of obesity and body fat distribution among females workers in Shaheed Beheshti University of Medical Sciences. *Pajouhandeh*, 25: 459-63.
21. Pourghassem Gargari B, Hamed Behzad M, Ghassab Pour Asl S, Ayat A (2002). The prevalence of over-weight and obesity in high school girls in Tabriz in 2001. *Scientific J Tabriz Univ Med Sci*, 36(56): 34-39.
22. Taheri F (2002). Epidemiologic study of obesity in school age children in Birjand. *J Birjand Univ Med Sci*, 9: 18-22.
23. Akhavan Tabib A, Kelishadi R, Sadri G, Sabet B, Toluei H, Baghaei A (2003). Healthy Heart Program: Obesity in center of Iran. *J Qazvin Univ Med Sci*, 7(2): 27-35.
24. Kelishadi R, Hashemi Pour M, Sarraf-zadegan N, Sadry G, Ansari R, Alikhassy H, Bashardoust N (2003). Obesity and associated modifiable environmental factors in Iranian adolescents: Isfahan Healthy Heart Program-Heart Health Promotion from Childhood. *Pediatrics International*, 45:435-42.
25. Shahgholian N, Aein F, Deris F (2003). 90th percentile of body mass index (BMI) and some obesity risk factors among 7-12 years old school children, Chaharmahal & Bakhtiari, 2002. *Shahrekord Univ Med Sci J*, 5: 42-48.

26. Akbari S (2003). The prevalence of obesity and its association with unovolation in female students of KhoramAbad high-schools. *Yafteh*, 4: 33-38.
27. Tabatabaei M, Dorosti A, Siassi F, Rahimi A (2003). Using different reference values to determine prevalence of obesity among school children in Ahwaz. *J School of public health & institude of publich health research*, 2: 11-18.
28. Gheibi SS, Fakoor Z, Alizadegan M, Pashapour N, Hamzenejad A, Mohadesi H, Nouri S (2003). The prevalence of obesity among girl students in Urmia in 2002-3. *Iran J Pediatr*, 13: 1-8.
29. Mirmiran P, Mohamadi F, Mehrabi Y, Azizi F (2004). Alarming trend of waist circumference in Tehranian children and adolescents: Tehran Lipid and Glucose Study. *Iran J Endocrinology & Metabolism*, 6: 249-55.
30. Jamshidian Tehrani M, Kalantari N, Azad Bakht L, Esmail Zadeh A, Rajaei A, Houshiar Rad A, Golestan B, Kamali Z (2004). Osteoporosis risk factors in Tehrani women aged 40-60 years. *Iran J Endocrinology & Metabolism*, 6: 139-45.
31. Karandish M, Mohammad Pour Ahranjani B, Kalantari N, Eshraghian MR, Rashidi A (2004). Prevalence of overweight and obesity among adolescent students, 1999-2000 in Tehran. *Hakim*, 3: 38-43.
32. Mirmiran P, Mir Bolooki MR, Mohammadi Nasrabadi F, Azizi F (2004). Prevalence of thinness, overweight and obesity in Tehran adolescents: Tehran Lipid and Glucose Study. *Iran J Endocrinology & Metabolism*, 5(4): 371-77.
33. Rahmati F, MoghadasTabrizi Y, Shidfar F, Jafari M (2004). Prevalence of obesity and hypertension among Tehran university students. *Payesh*, 3: 123-30.
34. Mozaffari H, Dehghani A, Afkhami M, Rajabiun H (2004). The prevalence of obesity in primary school students in Yazd province. The 8th Congress of Nutrition in Iran.
35. Shahidi N, Mirmiran P, Amikhani F (2004). The prevalence of obesity and abdominal obesity and its association to nutritional happibts in aduloscense in high-school boys in Tabriz city. *Scientific J Shahid-Beheshti Univ Med Sci*, 4: 255-63.
36. Vaghari GR (2004). Obesity among mothers in rural Golestan. *J School of Public Health & Institude of Public Health Research*, 3: 21-28.
37. Heshmat R, Fakhr Zadeh H, Pour-Ebrahim R, Nouri M, Aala Adini F (2004). Cardiovascular risk factors study in the inhibitants of Tehran University of Medical Sciences population lab: statistical design and sampling. *Iran J Diabetes & Lipid Disorders*, 3: 21-26.
38. Azizi T, Harati H, Mir Bolooki M, Saadat N, Azizi F (2005). Association of different anthropometric measures and type 2 diabetes in an Iranian urban population. *Iran J Endocrinology & Metabolism*, 7: 103-10.
39. Bazhan M, Kalantari N, Ghaffar Poor M, Houshyar Rad A, Alavi Majd H (2005). Prevalence of obesity, fat distribution and its relationship with food consumption pattern in secondary school girls in Lahijan. *Iran J Endocrinology & Metabolism*, 7: 37-46.
40. Kelishadi R, Sadri G, Tavasoli A, Kahbazi M, Roohafza H, Sadeghi M, Khosravi A, Sabet B, Amani A, Ansari R, Alikhassy H (2005). Cumulative prevalence of risk factors for atherosclerotic cardiovascular diseases in Iranian adolescents: IHHP-HHPC. *Journal de Pediatria*, 81: 447-53.
41. Asar S, Asghari S (2005). Prevalence of obesity & overweight among 7-14 years old students in the city of Ahwaz. *Scientific Med J Ahvaz Univ Med Sci*, 44: 11-20.

42. Dorosty Motlagh AR, Hodjat P (2005). The prevalence of obesity and its association with the parents obesity in primary school girls in Tehran in 2002. *Scientific J Tehran Univ Med Sci*, 62: 942-47.
43. Azizi F, Azadbakht L, Mirmiran P (2005). Trends in Overweight, Obesity and Central Fat Accumulation among Tehranian Adults between 1998-1999 and 2001-2002: Tehran Lipid & Glucose Study. *Ann Nutr Metab*, 49: 3-8.
44. Mostafavi H, Dabagh Manesh M, Zare N (2005). Prevalence of obesity and over weight in adolescents and adult population in Shiraz. *Iran J Endocrinology & Metabolism*, 25: 57-66.
45. Agheli N, Assef Zadeh S, Rajabi M (2005). The prevalence of cardiovascular risk factors among population aged over 30 years in Rasht and Qazvin. *J Qazvin Univ of Med Sci*, 35: 59-65.
46. Rahmani Nia F, Daneshmandi H, Darbani H (2005). Determination of overweight and obesity prevalence among male students and its relationship with physical activity-level. *Harkat*, 23: 47-60.
47. Valizadeh M, Sohbatlou F, Mosavi Nasab N (2005). The anthropometric measures (weight, height and body mass index) of middle school girls in Zanjan 2004-5. *Scientific J Zanjan Med Uni*, 13: 30-36.
48. Safari S, Sheikh Aleslam R, Abdolahi Z, Naghavi M, Sadeghi S (2006). The prevelance of over-weight and obesity among elderly individuals in spring 2001. The 9th congress of nutrition in Iran.
49. Karaji Bani M, Montazeri Far F, Mohammadi M, Dashi Pour A (2006). The prevalence of obesity and wasting in primary school girls in the city of Zahedan. *Tabib-e-Shargh*, 4: 289-96.
50. Khaji A, Khodaei S, Kar Bakhsh M, Faeghi A, Azizi S, Firoozian A, Jafari J (2006). Blood pressure and obesity in young adolescents in Tehran. *Iran J Pediatr*, 16: 45-50.
51. Alavi Naieny AM, Dorosti motlagh AR, Aghdak P (2006). Survey of obesity, underweight and associated factors in elderly people, using some of anthropometric indices in Isfahan city, 2004. *J Mazandaran Univ Med Sci*, 16: 117-23.
52. Mozafari M, Nosrati S, Purmansour G, Rezaei M (2006). Factors affecting the prevalence of obesity among 15-49 years old women referred to urban health clinics in Ilam in 2004. *J Ilam Univ Med Sci*, 14: 8-17.
53. Mazloomzadeh S, Moosavi Viri A, Dinmohamadi H (2004). Epidemiology of overweight and obesity in Zanjan province in 2005. *Scientific J Zanjan Med Uni*, 14: 57-64.
54. Bahrami H, Sadatsafavi M, Pourshams A, Kamangar F, Nouraei M, Semnani S, Brennan P, Boffetta P, Malekzadeh R (2006). Obesity and hypertension in an Iranian cohort study; Iranian women experience higher rates of obesity and hypertension than American women. *BMC Public Health*, 6: 1-9.
55. Montazerifar F, Karajibani M, Dashipour A (2006). The prevalence of obesity and wasting and their correlation with food intake in female junior school students in Zahedan, 2004. *Iran South Med J*, 1: 66-76.
56. Golchin S, Fallah H (2006). Height, weight, BMI and nutrient intake among 11-14 year-old adolescent in nongovernmental schools, Dameghan. The 9th congress of nutrition in Iran.
57. Sharabi M, Safavi M, Zarezadeh M, Nasiri N, Madani L, Minai M (2006). Prevalence of over-weight and obesity among children aged 2-6 years in kindergartens. The 9th congress of nutrition in Iran.
58. Safarian M, Moradi R, Shakeri MT, Abasalati Z (2006). Prevalence of over-weight and obesity in adolescent girls in Mashahd. The 9th congress of nutrition in Iran.

59. Vaghari GR, Marjani AJ, Kordjazi ML (2006). Prevalence of obesity in inder 5-year-old children in rural areas of Gorgan. The 9th congress of nutrition in Iran
60. Farshidi H, Zare S, Booshehri E (2006). Association of different anthropometric measures and blood pressure in adult population of Bandar-abbas city. *Hormozgan Med J*, 10: 111-18.
61. Mozaffari H, Nabaei B (2007). Obesity and related risk factors. *Indian J Pediatr*, 74: 265-67.
62. Karam soltani Z, Dorosty motlagh A, Eshraghian MR, Siassi F, Djazayeri A (2007). Obesity prevalence and food insecurity in Yazd primary school pupils, 1384. *Tehran Uni Med J*, 7: 68-76.
63. Haji Faraji M, Esfarjani F, Roustaee R, Khoshfetrat M, Kamrani Z (2007). Assessment of Anthropometric Status of Adolescents in Public Guidance Schools in East Tehran, 2006. *Iran J Nutrition Sciences & Food Technology*, 2: 37-43.
64. Hajian K, Heidari B (2007). Prevalence of obesity, central obesity and the associated factors in urban population aged 20-70 years, in the north of Iran: a population-based study and regression approach. *Obesity reviews*, 8: 3-10.
65. Jafari Rad S, Keshavars SA, Dorosti AR (2007). The nutritional factors by body mass index in young women in high school in Sari, 2003. *Iran Nutritional & Food Industry J*, 2: 51-56.
66. Caballero B (2005). A Nutrition Paradox- Underweight and Obesity in Developing Countries. *N Engl J Med*, 352: 1514-16.
67. Caballero B (2001). Symposium: Obesity in Developing Countries: Biological and Ecological Factors. *J Nutr*, 131: 866S-70S.
68. Goulding A, Grant AM, Taylor RW, Williams SM, Parnell WR, Wilson N, Mann J (2007). Ethnic differences in extreme obesity. *J Pediatr*, 151: 542-44.
69. Baerug AB, Tufte E, Norum KR, Bjorneboe GE (2007). [The WHO Child Growth Standards for children under 5 years]. *Tidsskr Nor Laegeforen*, 127: 2390-94.
70. Mei Z, Grummer-Strawn LM (2007). Standard deviation of anthropometric Z-scores as a data quality assessment tool using the 2006 WHO growth standards: a cross-country analysis. *Bull World Health Organ*, 85: 441-48.
71. Hossain P, Kawar B, El Nahas M (2007). Obesity and diabetes in the developing world--a growing challenge. *N Engl J Med*, 356: 213-15.
72. T James WP, Rachel Jackson-Leach, Cliona Ni Mhurchu, Eleni Kalamara, Maryam Shayeghi, Neville J. Rigby, Chizuru Nishida, Rodgers A (2005). Overweight and obesity (high body mass index). Comparative qualification of health risks, World Health Organization.
73. Popkin BM, Doak CM (1998). The obesity epidemic is a worldwide phenomenon. *Nutr*, 56: 106-14.