Investigation of the Prevalence of Obesity in Iran: a Systematic Review and Meta-Analysis Study

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Abstract- Obesity is one of the main public health problems which underlie many chronic illnesses and socioeconomic difficulties. According to the literature review, there are limited data on the prevalence of obesity in different parts of Iran as well as its trend and prevalence among different age and gender groups. The aim of this study was to estimate the obesity prevalence in Iran using meta-analysis. All the corresponding articles published in the external and internal journals, final reports of research projects, articles of related congresses and the reference index of the correlated papers published between 1995 and 2010 were collected via the electronic research engines (PubMed, Scopus, SID, Magiran, IranMedex). Data were analyzed using meta-analysis (random effects model) and meta-regression). A total of 144 articles with the sample size of 377858 people (134588 males and 164858 females) were enrolled in the study. The prevalence of obesity in populations above the age of 18 was estimated as 21.7% (CI 95%: 18.5% - 25%) and in populations below 18 as 6.1% (CI 95%: 6.8%-5.4%). Meta-regression analysis showed an ascending trend in the prevalence of obesity in Iran. The prevalence rates of obesity according to the BMI index, NCHC and percentile above 95 were 17.4%, 7.6% and7.4%, respectively. The BMI mean was 19.3 in populations below the age of 18 (CI 95%: 17-21.6) and 25.2 in those above the age of 18 (CI 95%: 27.1-23.3). Considering the increasing rate of obesity in Iran and its effects on the public health, corresponding health authorities should revise the obesity preventive programs and, using public health interventions, reduce the rate of obesity in the country.

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Keywords: Iran; Meta-analysis; Obesity; Overweight; Prevalence

Introduction

Obesity and overweight are the world's fifth cause of mortality, and 2.6 million people annually die due to this disorder. Moreover, 44% of cases of diabetes, 23% of ischemic heart diseases and ~ 7-41% of cancers have been attributed to obesity and overweight (1). Obesity is currently the most common metabolic disorder in many countries (2-4). Therefore, obesity prevention has turned into an important health priority. Obesity affects both high-income and low- and medium-income countries (5,6), and almost all age, gender, ethnic, and socioeconomic groups (7). Obesity is a multi-factorial disorder (10-12), but nutritional shift to high fat and energy foods and low physical activity as a result of increased urbanization and industrialization are among the factors contributing the increase in the rate of obesity in many countries (10-12). Obesity is also a major health problem in Iran. Approximately 70% (385,000) of all recorded mortalities in 2002 in Iran have been attributed to chronic diseases, the most important reason of which is obesity and overweight (7,8). Considering the accelerated nutritional transition and growing prevalence of obesity in Iran, having precise, updated data about the prevalence of obesity in the country may help health researcher and policy makers to initiate appropriate

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studies and policies to prevent obesity or its complications. There is another meta-analysis of obesity in Iran using articles published by the end of 2007 (13). Since then several other relevant articles have been published. In this study, we report a meta-analysis of obesity prevalence in Iran using articles published up to July 2011.

Materials and Methods

Literature search method

To identify articles published between 1990 and 2011 reporting on prevalence of obesity in Iran, we searched the Pubmed, Google Scholar, Scopus, Scientific Information Database (SID; a database for articles published by Iranian investigators), and Magiran (another Iranian database) using a combination of Iran and the following terms: obesity, body mass index, epidemiology, risk factors, and obesity prevalence. We also manually searched the bibliographies of the relevant original and review

Definition of obesity

The articles that determined obesity based on anthropometric measures (height and weight) were included in this study. The index used in the articles, according to the definition of the World Health Organization, was defined as BMI≥30 for adult populations (at least 18 years of age). For people under 18, most articles used the criteria of Centre for Disease Control (CDC 2000) and International Obesity Task Force which defined obesity according to the BMI≥ percentile 95th of the BMI in the respective population.

Data extraction

All the articles reporting the obesity prevalence were reviewed by two independent reviewers. All the articles that did not have the required quality, those that assessed the obesity prevalence in a non- randomly sample, had a small study population (less than 100 people) or did not mention the place and time of data collection were excluded from the study. Data on first author, year of study, study area, age range of participants, number participants (also by sex), and BMI (overall and by sex and age group) were extracted by two reviewers and verified by a third reviewer. Age groups were divided into 2 groups: age under 18 ≤ years and above 18 years old.

Data analysis

The variance of each study for the prevalence of obesity (percent of obesity (yes/no)) was computed using binomial distributions, respectively. Based on obesity prevalence or mean BMI, study sample size and variance of each article was weighted and the prevalence rates were then combined using the random effects models. The heterogeneity among articles was assessed by the I2 and Q2 statistics. Subgroups analyzes were conducted by age group, sex, the method of definition of obesity. Two-sided $P<0.05$ was considered as statistically significant. To assess the obesity trend and the inconsistency of the articles results, the Empirical Bayesian model of meta-regression method was employed.

Results

A total number of 144 articles, with 377,858 participants (164,216 women and 134,588 men) were included in this study (Table 1). The sample size of these articles varied between 110 people and 89,404 and was above 1000 people in 50% of the studies. The obesity prevalence and sample size were reported for women in 99 articles and for men in 74 articles. Prevalence of obesity for children and adolescents (age≤ 18 years) was reported in 70 articles (53.8%), while in 41 articles (31.5%) the age of study participants was> 18 years. In the rest of the articles, results were reported for a combination of these age groups. Overall, the reported obesity rate in the included articles varied between 1.1% and 67%. Using random effects models, the percentage of individuals with obesity in Iran (1995–2011) was estimated at 12.3 (95% CI: 11.0 – 13.7) (Table 2).

This percentage (95% CI) was in women, 14 (11.6 – 16.4), 10.7 (8.8 – 12.5) in men, 6.1 (4.5–6.8) in age≤18 years, and 21.7 (18.5–25) in age>18 years. In meta-regression models, the correlation between year of study and percentage of obesity in Iran between 1995 and 2011 (% obesity = –2.15 + 0.001 year) was not statically significant ($P=0.74$). This correlation is shown in Figure 1. The percentage of obesity in 66 articles according to BMI > percentile 95th was 7.4 (6.5-8.3), in 61 articles with BMI>30, 17.4 (15.0–20.0). In adjusted meta-regression models, from year of data collection, age group, the method used to define obesity, and sample size, only age group showed a statistically significant association with percentage of obesity in women ($P=0.001$). There was also a correlation between age group and obesity in men, but this was not statistically significant (Table 4). The correlation between study size and percentage of obesity is shown in Figure 2.

Table 1. Characteristics of retrieved articles*

First author, year of	Region	BMI	Age	Sample size			% Obese		
				Women	Men	Total	Women	Men	Total (95% CI)
Dorosti, 1995	Gilan, Sistan	>P_{95}	4-5	881	847	1755	8.7	7.5	8 (7-9)
Dorosti, 1995	Gilan, Sistan	>P_{95}	2-3	1283	1277	2560	7.6	5.2	6.4 (5-7)
Barzigar, 1996	Gilan	>30	>25	973	1357	2423	11.5	34	24.6 (23-26)
Ghorbani, 1996	Semnan	>30	2-55	975	946	1921	12.6	27.1	19.8 (18-22)
Allahverdian, 1998	Tehran	>P_{95}	10-19	177	244	421	5.1	2.8	3.8 (2-6)
Azizi, 1998	Tehran	>30	20-80	808	1294	2102	16.5	32.7	26.9 (25-29)
Mirmiran, 1998	Tehran	>P_{95}	10-19	1541	1724	3199	6.9	4	5.4 (5-6)
Mozafari, 1998	Yazd	>P_{95}	7-11	230	233	463	4.3	3.4	3.9 (2-6)
Nasr Abadi, 1998	Iran		>2	6083	7960	14043	9.9	26.7	14.4 (19-20)
Soheylifar, 1998	Hamedan	NECH	6-11	1000	1000	2000			3.5 (3-4)
Azad Bakht, 1999	Tehran	>30	20-70	4168	5820	9984	29.1	14.2	20.41(20-21)
Azizi, 1999	Tehran	>30	>60	911	855	1766	43.6	51.7	46.9 (45-49)
Azizi, 1999	Tehran	>30	30-69	2992	4041	7033	16.3	35.8	27.5 (26-29)
Mirmiran, 1999	Tehran	>P_{95}	6-16	339	393	732	5.5	3.7	4.5 (3-6)
Mojibian, 1999	Yazd	>30	15-65		570	570		16.3	16.3 (13-19)
Akhavantayyeb, 2000	Esfahan	>30	>19	6141	6373	12514	9.3	23.4	15.5 (15-16)
Bazan, 2000	Gilan	>P_{95}	14-17		400	400		5.3	5.3 (3-7)
Fakhrzade, 2000	Boshehr	>30	>18	1437		1437	10.2		10.2 (9-21)
Gamshidian, 2000	Tehran	>30	40-60		749	749		41.4	41.4 (38-45)
Hoshyar Rad, 2000	Iran	NECH	<5	1248	1221	2505			5.2 (4-6)
Karandish, 2000	Tehran	>P_{95}	11-16	1068	1253	2321	7.3	8.3	7.8 (7-9)
Mortazavi, 2000	Sistan Balochestan	>30	18-43	292	428	720	1	1.4	1.3 (0-2)
Akbari, 2001	Lorestan	>30	14-18		986	986		7.3	7.3 (6-9)
Asar, 2001	Khozestan	>P_{95}	7-14	2293	2500	4793	2	2.5	2.2 (2-3)
Azizi, 2001	Tehran	>30	20-80	808	1294	2102	20.8	20.3	20.5 (19-22)
Kalishadi, 2001	Esfahan	>P_{95}	11-18	1000	1000	2000	1.9	2.9	2.4 (2-13)
Karajibani, 2001		>30	11		2067	2067		1.4	1.4 (1-2)
Kavian, 2001	Tehran	>30	25-45		503	503		11	11 (8-14)
Kelishadi, 2001	Esfahan	>P_{95}	11-18	1000	1000	2000	2.3	2	2.2 (2-3)
Khabazkhob, 2001	Tehran	>P_{95}		1869	2583	4452	9	18.4	13.6 (13-15)
Khoshfetrat, 2001	Zarrinshahr	>P_{95}	14-16			348			5 (3-7)
Mozafari, 2001	Tehran	>P_{95}	7-12	1800		1800		7.7	7.7 (6-9)
Poorghasem, 2001	Azarbayjan	>P_{95}	14-18		1518	1518		3.6	3.6 (3-5)
Safari, 2001	Systan	>30	45-60			8800	12.9	30.5	21.7 (21-23)
Sezavar, 2001	Ardebil	>30	20-80	200	184	384	13.5	19	15.9 (12-20)
Shahgholian, 2001	Charmahal	>P_{95}	7-14			27.72			9.9 (9-11)
Dorosti, 2002	Tehran	>P_{95}	8-10		835	835		6.6	6.6 (5-8)
Mirmiran, 2002	Tehran	>P_{95}	6-16	312	361	673	6.3	5.2	5.7 (4-7)
Montazeri, 2002	Sistan Balochestan	>30	11-14		687	687		1.7	1.7 (1-3)

Continues of table 1. Characteristics of retrieved articles

First author, year of	Region	BMI	Age	Sample size			% Obese		
				Women	Men	Total	Women	Men	Total (95% CI)
Taheri, 2005	Birjand	>P_{95}	15-18			2230	2.8	1.8	8.3 (2-3)
Vaghari, 2005	Golestan	NCHS	<5			2875			4 (3-5)
Zare, 2005	Shiraz	>P_{95}	17-47		920	920		14	14 (12-16)
Ahmadi, 2006	Sannandaj	>P_{95}				694	18.2	10.7	3.2 (2-5)
Amidi, 2006	Esfahan		14-18		384	384		1.0	1.0 (0-2)
Farshidi, 2006	Hormozgan	>30	<63	681	1397	2087	7	14.7	12.2 (11-14)
Haji Faraji, 2006	Tehran	>P_{95}	13.3	388	392	780			13 (11-15)
Hajian, 2006	Mazandaran	>P_{95}	7-12	400	600	1000	8.8	3.8	5.8 (4-7)
Hajian, 2006	Babol	>P_{95}	7-12			1000		3.8	5.8 (4-7)
Hajifaraji, 2006	Tehran	>P_{95}	11-18	392	388	780	15.4	10.8	13 (11-15)
Najafi, 2006	Khorramabad	>30	25-64	478	532	1010	8.1	24.9	11.4 (9-13)
Sarshar, 2006	Gonabad	>30	15-65			440			14.5 (11-18)
Sarvghadi, 2006	Tehran	>30	>50	1566	1825	3331			29.2 (28-31)
Akhi, 2007	Sari	NECH	6-18	1320		1320		4.2	4.2 (3-5)
Behbahani, 2007	Tehran	>P_{95}	6-11	960	840	1800	6	3.5	4.8 (4-6)
Brzin, 2007	Tehran	>30	18-25	643		643	9.5		9.5 (7-12)
Dahri, 2007	Mashhad	>P_{95}	11-15		1300	1300		10.3	10.3 (9-12)
Esteghamati, 2007	Iran	>30	15-64			5287			22.3 (21-23)
Golestan, 2007	Yazd	>30	11-13	395	399	794	8.8	¾	6.5 (5-8)
Mohammadian, 2007	Gorgan	>P_{95}	11-13		884	884		6.3	6.3 (5-8)
Reza Zade, 2007	Tehran	>30	20-50		460	460		8.0	8.0 (6-11)
Salem, 2007	Rafsanjan	>30		126	568	694			1.4 (1-2)
Seyyed Amini, 2007	Gorgan	>P_{95}	7-11		300	300		3.6	3.6 (1-6)
Amir Khizi, 2008	Tabriz	>30	14-18			370			15.9 (12-20)
Barzin, 2008	Tehran	>30	18-25		926	926		3.1	3.1 (2-4)
Delvarian Zadeh, 2008	Shahrod	>P_{95}	11-14		418	418		1.7	1.7 (0-3)
Hakim, 2008	Dezfol	>P_{95}				400			12 (9-15)
Mohammadi, 2008	Navahi Markazi	>30		6081	6335	12416	40.7	44	22.2 (21-23)
Mollaee, 2008	Gorgan	>30	>18	86	120	207			19.8 (14-25)
Saberi, 2008	Kashan		30-39			429			23.1 (19-27)
Salem, 2008	Kerman	>P_{95}	7-12			1275			9.2 (8-11)
Tohidi, 2008	Shiraz	>30	19-95			855	10.5	21.9	17.9 (15-2)
Azad Bakht, 2009	Esfahan	>30	18-28		289	289			9.24 (6-13)
Damirchi, 2009	Tehran	>30	21-71			1218			40.6 (38-43)
Nabavi, 2009	Semnan	>P_{95}	7-12	193	207	400	17.9	10.4	14.3 (11-18)
Naghashpoor, 2009	Khozestan	>30	18-80	68	184	252	17.9	30.8	32.7 (27-38)
Sotodeh, 2009	Tehran	>30	20-65		704	704		67	67 (64-7)
Zarei, 2009	Sabzevar	>P_{95}	12-14	650		650	7.1		7.1 (5-9)
Abedi, 2010	Mazandaran	>30			116	116		6.9	6.9 (2-12)
Vafa, 2010	Tehran	>30	7	236	277	513	18.6	19.1	11.7 (9-14)
Amini 2000	Tehran	>30	10-15			398	6.5	13	10 (7-13)

Continues of table 1. Characteristics of retrieved articles

First author, year of	Region	BMI	Age	Sample size			% Obese		
				Women	Men	Total	Women	Men	Total (95% CI)
Azarbayjani 2009					325	325		13	13 (9-17)
Dorosti 2008	Iran	>P_{95}	7-12			6700			6.3 (6-7)
Fallah 2005	Damghan	>P_{95}				150	3	3	4 (2-7)
Far Bakhsh 2004	Tehran	>30	15-44			2969			4.6 (4-5)
Behzadnia 2012	Sari	>P_{95}	7-12	356	297	653			12 (9-15)
Kakhak 2010	Sabzevar	>P_{95}	12-14			368			3.7 (2-6)
Karbasi 2005	Yazd	>P_{95}	<6	200	200	400	5.5	2	3.8 (2-6)
Mir Miran 2003	Tehran	>30	10-69	565	725	1290			14.1 (12-16)
Mirzaee 2010	Yazd		6-7			2768	2.6	2.3	2.4 (8-1)
Mirzaeian 2010	Najaf Abad	>30	15-18		550	550		6	6 (4-8)
Moghadasi 2010	Shiraz	>P_{95}	14-16			808			6.0 (4-8)
Mohamad 1999	Tehran	>30	15-49			2859			16.4 (15-18)
Mostafavi 2005	Fars	>P_{95}	13-18	377	426	803	2.6	3.2	2.9 (2-4)
Navaee 1990		>30				2033			31 (29-33)
Saberi 2008		>30	30-39			429			23.1 (19-27)
Shamsi 2009	Sabzevar	>P_{95}	<35			382			48.1 (43-53)
Soleymani 2007	Bam	>30		139	188	327			2.1 (1-4)
Taghi Heydari 2011	Tehran	>30				288	2.6	2.2	2.4 (1-4)
Vahidi Nia 2011	Hamedan	>P_{95}	>2			614			5.2 (3-7)

BMI: body mass index (kg/m^2); CI:confidence interval; NCHS: National Center for Health statistics; P_{95}: percentile 95th
* Age is in years unless indicated as months (Mo.). Iran in the Region column refers to studies in the entire country. 95% CIs were rounded to the nearest integer

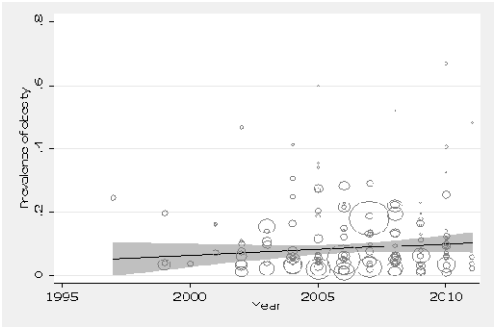

Figure 1. Trend of prevalence of obesity in Iran, 1995 – 2011

Table 2. The weighted point estimates (95% CI) for percentage of individuals with obesity in Iran (1995 – 2011) by sex and age

	No of studies	% of obesity (95% CI)
Total	144	12.3 (11.0 – 13.7)
Sex		
Women	96	14 (11.6 – 16.4)
Men	72	10.7 (8.8 – 12.5)
Age		
≤ 18 years	73	6.1 (5.4 – 6.8)
> 18 years	46	21.7(18.5-25)

BMI, body mass index (kg/m2); CI, confidence interval; NCHS: National Center for Health statistics

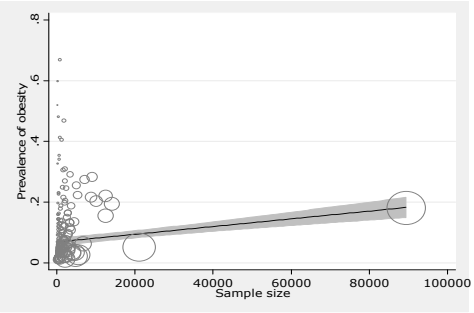

Figure 2. Prevalence of obesity in Iran, 1995 – 2011, by study size

Table 3. The weighted point estimates (95% CI) for percentage of individuals with obesity in Iran (1995 – 2011) by age and definition of obesity

Definition of obesity	No of studies	% of obesity (95% CI)	No of studies	% of obesity (95% CI)
		Women		**Men**
BMI > percentile 95th	39	6.1(4.8 – 7.5)	28	6.1(5-7.3)
NCHS	2	6(4.4 – 7.5)	-	-
BMI > 30	41	23.3(18 – 26.6)	30	14.8(11.8 – 17.8)
Other indices	4	11(1-26.6)	1	9.9(9.1 – 10.7)
Age ≤ 18 years		**Girls**		**Boys**
BMI > percentile 95th	35	4.8 (3.7 – 5.8)	25	5.6 (4.5 – 6.7)
NCHS	2	6(4.4 – 7.5)	-	-
BMI > 30	5	5.8(2.9 – 8.7)	3	10.8 (5.4 – 16.2)
Age > 18 years		**Women**		**Men**
BMI > percentile 95th	2	18.4(9.7 – 29.7)	1	12(9.6 – 14.4)
BMI > 30	29	25.2 (19.8 – 30.4)	22	15.0 (11.6 – 18.4)

BMI: body mass index (kg/m^2); CI: confidence interval; NCHS: National Center for Health statistics

Table 4. The unadjusted and adjusted regression coefficients and corresponding *P* values for correlation between potentials influential factors and obesity prevalence using meta-regression models

	Women				**Men**			
Factors	**Unadjusted**	***P***	**Adjusted**	***P***	**Unadjusted**	***P***	**Adjusted**	***P***
Year of data collection	0.00047	0.97	0.0036	0.43	0.0002	0.44	0.0037	0.25
Age group	0.18	<0.001	0.17	<0.001	0.072	<0.001	0.040	0.20
Definition of obesity	0.12	<0.001	0.022	0.48	0.083	<0.001	0.046	0.17
Sample size	0.00000485	0.13	0.00000491	0.70	0. 0000011	0.56	– 0.00076	0.36

Discussion

Considering the growing rate of obesity prevalence in Iran, and the increasing rate of health and socio-economic problems as its consequences, study on obesity and accessing comprehensive and precise data are critical to comment on the public health status and to determine the relevant health policies and obesity preventive procedures. In this regards, the World Health Organization is persistently encouraging countries to calculate the burden of disease in the national level as the best guidance for policy-making means in the health system. In this study, the total rate of obesity in Iran was estimated as 12.3% which was calculated as 21.7% for people above 18 and as 6.5% for people less than 18 years of age. In the review study of Amirzade who had analyzed the obesity data until 2005, the rate of obesity among people above 18 was estimated as 21.5% and in those under 18 as 4.5% (13). This difference was due to the data extent and the three folds increase in the sample

size of the current study compared to the previous study. However, given this three folds increase in the sample size, the rate of obesity among people under 18 was still higher than the previous study (6.5%ve *vs.* 5.5%) which is considerable. In the study of Steghamati and others in 2005, the obesity rate was estimated as 14.6% for males and 30.6% for females. The study of Rashidi *et al*., in 2005, however, the obesity rate was estimated between 22% and 45% in the age range of 15-70 years (13) and the study of NHANES in America reported the obesity rate for the age range of 20-74 years as being 34% for females and 31.7% for males (14).

In a review study in America, the rate of obesity prevalence among American children and adults has doubled from 1970 till 2007, so that 66% of adults and 16% of children were obese and 34% of children were at the risk of being overweight (15). According to an European review study, the obesity rate has been reported between 7% in Sweden and 45% in Lithuanian women so that this rate has been calculated as 4% to 28.3% in males and 6.2% to 36.5% in females (16).The rate of obesity during 2007-2008, however, has been reported as 35.5% among American women and 32.2% among American males. These results were higher than those estimated for males and females in Canada and most European regions (17). Different obesity rates are dependent upon age, gender, race and ethnicity, lifestyle and the socio-economic status which are the facts influencing the difference in the statistical data on the prevalence rate of obesity across the world. Totally, comparing the statistical data on obesity in America, European countries and Iran it is concluded that the rate of obesity in Iran is continuing to increase, obesity has a wide geographical dispersion across the country and that the preventive programs in Iran have succeeded in the relative control of obesity in Iran. Given the influence of some factors including individual, demographic, environmental, international and educational factors on the epidemiology of obesity, the industrial, economical, international and governmental health agencies, public health institutes, all segments of the society, families and finally the individuals should make effort to have active roles in the prevention and control of obesity. In fact, the provided data reflect the urgent need to obesity preventive strategies which should be based on the environmental factors as well as individual and public issues. A massive international program also must be designed to avoid obesity epidemic in the future generation.

This study showed a positive association between the prevalence rate of obesity and age which may also be associated with the increased incidence of heart diseases. The educational interventions, therefore, seems to be necessary to modify lifestyles.

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