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REVIEW ARTICLE

The Prevalence of Overweight and Obesity in Iranian Men: a Systematic Review and Meta-Analysis Study

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Abstract: **Introduction:** Overweight and obesity is one of the most common diseases worldwide that is less considered in men. In this regard scattered studies have been conducted in Iran, and our aim was to systematically study the prevalence of overweight and obesity in Iranian men. **Methods:** Major international databases including: Scopus and PubMed, and Web of Science and national databases including Magiran and SID were searched for articles in Persian and English which were published from August 10, 2010 to August 10, 2020. Qualitative evaluation of the studies was performed using the Newcastle-Ottawa Scale checklist (NOS). Random effects model was used to estimate the pooled prevalence by STATA software version 14.2 with significance level of 0.05. **Results:** Overall, 52 studies with a total sample size of 120,440 men with age range of 20-77 years were included in this systematic review. Most studies were conducted in 2017 and almost all of them were in Tehran province. The pooled prevalence of overweight was 46% (95% CI: 46, 46) in men. The lowest prevalence of overweight was 11.1% in Fars and the highest was 57% in Tabriz. The pooled prevalence of obesity in men was 18% (95% CI: 18, 19) with the highest prevalence in Birjand (46.5%) and the lowest in Tehran (0.8%). **Conclusion:** Our results showed a variety of tools for measuring overweight and obesity in Iran. Based on the BMI index, we found that the prevalence of overweight and obesity was substantial among Iranian men. There seems to be an urgent need for health policy makers to develop and implement proper preventive strategies in order to control this public health problem and its serious health consequences among men, especially in the workplace.

Keywords: Iran; Overweight; Obesity; Prevalence; Systematic Review

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1. Introduction

The number of overweight and obese people is increasing worldwide (1, 2). Obesity is one of the determinants of health and remains the most frequent form of malnutrition in the world, which increases the prevalence of complications related to obesity and the global burden of the disease (3-5). Obesity is globally regarded as a chronic recurrent disease (6). Studies have shown individuals' genes, and their environment plays a role in the development of obesity(7). Energy imbalance may cause obesity through hypothalamic regulation, while eating habits are closely related to energy balance(8). The prevalence of obesity is rapidly increasing in many developed countries, especially the United States as well as the developing countries. Systematic review studies in 191 countries show that there are 1.64 billion overweight people and 504 million obese people in the world (9). In Iran, the prevalence of overweight and obesity in men and women in 2005 was 42.8% and 57%, which in 2015 reached 54% and 74%,respectively (2). Results of another systematic review between 1990 and 2011showed that obesity reached an alarming level in all age groups of the EMRO (Eastern Mediterranean Region) member states, so that the prevalence of overweight and obesity among adults ranged from 25% to 81.9% (10). The overall prevalence of obesity is reported as 21.4% in Iranian adults (11) while it is estimated from 17.2% to 17.7% in men in 2010 (12). Studies have predicted an increase in the prevalence of overweight and obesity in Iran (13). Previous studies have generally considered obesity without gender discrimination while a proportion of them addressed obesity only in women. With the growing trend of gender-oriented health policies around the world, epidemiologic information on the burden of overweight/obesity is required for evidence-based policy making.

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This piece of information would also help to draw a more accurate picture of the men's health status in Iran with regard to non-communicable health conditions. In this study, we have reviewed all the conducted studies in Iran in the last ten years on the prevalence of overweight and obesity in men.

2. Methods

2.1. Search strategy

This study was a systematic review and meta-analysis, which was conducted to investigate the prevalence of overweight and obesity in Iranian men during a ten-year period from August 10, 2010, to August 10, 2020. A systematic search was conducted to retrieve published studies related to overweight/obesity in Iranian men. The research question in terms of Population, Intervention (Exposure), Comparison, and Outcome (PICO) was defined as prevalence of overweight or obesity in Iranian men. Major international scientific databases including Scopus, PubMed and Web of Science as well as the national databases including Magiran and SID were searched from August 10, 2010 to August 10, 2020. In the PubMed search, we utilized the following combination of terms: (Abdominal obesity, Overweight, Obesity Management, Body Mass Index, Metabolic syndrome, hip-to-waist ratio, waist circumference) AND (Iran, Iranian) AND (Men, male) AND prevalence. In Scopus, Magiran and SID, we have used a combination of keywords: Iran, Iranian, Men, male and Obesity abdominal, Overweight, Obesity Management, Body Mass Index, Metabolic syndrome, hip-to-waist ratio, waist circumference. Hence, 484 articles on the University Jihad Scientific Information Center (SID) database and 3434 articles on the Magiran scientific database were found based on the keywords: body mass index, waist diameter, forearm, waist-to-pelvic diameter ratio, anthropometric indices, anthropometric indices, which 35 of them were related ones.
Furthermore, 165 articles were found in PubMed which all of them were removed from the study after reading their summaries and full text as a result of irrelevance to the topic and lack of inclusion criteria. On the Scopus database, out of 7022 articles which were found 31 of them were studied. (Figure1).

2.2. Inclusion/Exclusion Criteria

All the epidemiologic studies with the following criteria were included: Cross-sectional studies which reporting the prevalence of overweight or obesity in Iranian adult men during 2010-2020. There was no language restriction on published articles as Farsi and English articles were included. The definition of overweight and obesity was based on the calculated BMI (Body Mass Index) values as follow: overweight was defined as BMI of 25 to 29.9 kg/m2 and obesity was defined as BMI of 30 or higher (14). The studies which did not contain separated data on the prevalence of obesity in men, those with no access to their gender-stratified estimates and those conducted on subjects below the age of 18 were excluded.

2.3. Data collection

To prevent bias, the search was conducted independently by two researchers. The Persian keywords and their English equivalents which were used included obesity, overweight, abdominal obesity, obesity mass, obesity volume, body mass index, waist diameter, waist circumference, waist-to-pelvis ratio, Anthropometric indicators index, anthropometric indices, overweight management, obesity treatment, slimming diet, metabolic syndrome, Iran, Iranians, men, male, and a combination of these.
Quality assessment of studies was performed using the Newcastle-Ottawa Scale (NOS) checklist(15). Thus, we used selection and outcome domains with the following items: representativeness of the sample, determining the sample size, assessing the outcome, and statistical tests. The evaluation was done independently by two researchers. To be clarified, any disagreement between the researchers was resolved through negotiation.

2.4. Heterogeneity assessment and statistical analysis

The heterogeneity of the studies was determined by the forest plot diagram and statistical tests. The statistical tests included Chi-square, X2, I2, and Tau2 (16, 17). The random-effects model was used to report the pooled prevalence with a 95% confidence interval (CIs). We used Stata 14 software to analyze the data considering 5% as the significance level.

3. Results

3.1. Search and Selection

The result of the initial search obtained 11,105 articles, which according to the PRISMA selection guide(18), the number of retrieved articles was reduced to 64 with a total of 120,440 sample size of Iranian men in the age range of 20-77 years (Table 1).
The quality of articles was assessed by NOS standard questionnaire before entering the meta-analysis. Findings of dissemination bias are reported in Figure1. These studies included cross-sectional and baseline data from cohort studies. From the 64 studies included in the meta-analysis, 11 studies (17.46%) were conducted in 2017 while 7 (10.9%) were respectively conducted in 2018, 2015, and 2013. Also, Tehran had the highest number of studies among other cities of the country, of which 7 studies were conducted only in the city of Tehran (11.11%).

3.2. Heterogeneity test (Overweight)

According to the results of the chi-square test, heterogeneity of studies was significantly high, yielding an I2 of 99.7% ($p < 0.001$). Although we could not combine these studies, we reported an estimate of the prevalence of overweight/obesity in men in Iran., we divided the studies into subgroups of subject's age to achieve greater homogeneity.

3.3. An estimate of the prevalence of Overweight

The estimated pooled prevalence of overweight in men was 46% (95% CI: 46,46) (Figure 2). The lowest and highest values for the prevalence of overweight in men was from the study of Mohammadi et al. in Fars province in 2010 (11.1%) and the study of Gholabi in Tabriz city in 2019 (57%) (Figure 2).

3.4. Heterogeneity test (Obesity)

According to the results of the chi-square test for the prevalence of obesity in men, the heterogeneity of the studies was significantly higher than the prevalence of overweight, so that I2 was 99.7 ($p <0.001$).

3.5. An estimate of the prevalence of Obesity

Overall, the estimated pooled prevalence of obesity in men was 18% (95% CI: 18,19) (Figure 3). The highest reported prevalence of obesity is related to the study of Khodabakhshi in Birjand city in 2019 (46.5% as the prevalence of abdominal obesity). The lowest reported prevalence of obesity is related to the study of Hassanipour-Azgomi in Tehran city in 2016 (0.8%) (Figure 3).

3.6. Subgroup analysis

When considering age as a dichotomous variable (cut point of 38 years based on the mean age of the total sample size), the subgroup analysis showed that prevalence of obesity and overweight increases with age. Accordingly, the pooled prevalence of overweight was estimated as 47% (95%CI:40-49%) and 34% (95%CI:33-36) among subjects aged above 38 years and equal or below 38 years, respectively. On the other hand, the pooled prevalence of obesity was estimated as 22% (95%CI:15-29) and 14% (95%CI: 9-25) among subjects aged above 38 years and equal or below 38 years, respectively.

4. Discussion

Numerous studies have been conducted on the prevalence of overweight and obesity, some of which have been performed on men. However, these studies have reported the prevalence of overweight and obesity very differently, so that in our country the prevalence of overweight in different cities varies from 11 to 57% and the prevalence of obesity varies from 0.8 to 83% in men.

This study was a systematic review of studies which reported the prevalence of overweight and obesity in Iranian men. The results of the present study showed that the overall prevalence of overweight and obesity in men was approximately 46% and 18%, respectively.

Previous studies have shown that the average body mass index and subsequently the prevalence of overweight and obesity is increasing. In 2005, the total number of overweight adults was 937 million worldwide and the number of obese people was 396 million. This number has been doubled compared to the last 20 years and subsequently is predicted to reach 3.1 billion in overweight issue as well as 573 million obesity by 2030 (19).

The growing prevalence of overweight and obesity is putting a heavy financial burden on countries' economies, and the need for health care in obese people is constantly expanding, according to a systematic review study by Dee et al. The direct and indirect costs of overweight and obesity were shown to be between 54% and 59% of total medical costs. Indeed, there is a relationship between increased BMI and direct and indirect healthcare costs (as a result of reduced productivity and premature mortality)(20).

Furthermore, overweight and obesity among the country's military personnel are also a health problem in men that may affect their military performance. A systematic review study conducted by Salimi et al. from December 2017 to 2019 on 10 studies with no time limit, showed that the prevalence of overweight and obesity was respectively 41% and 13%. In the subgroup analysis, a lower prevalence of overweight was reported in the Army (12%) and a higher prevalence of overweight in the Navy (69%)(21).

Although age was the main source of inter-study variation, some studies reported the mean age of the subjects and the age range of the participants was undetectable.

Moreover, the age distribution of individuals in one study was quite different. Also, we could not use a significant portion of the study simply because the authors did not fully cite the characteristics of the subjects. Hence, most studies calculated BMI for both sexes and all age groups to determine the prevalence of obesity. On the other hand, they did not choose a specific strategy, and we had to exclude these studies and some studies which have reported the prevalence of obesity and overweight in men together, so the prevalence of obesity and overweight has been unseparated.

5. Conclusion

The results of this systematic review showed that prevalence of overweight and obesity in men in Iran is not negligible. Moreover, the prevalence of this disease in different areas can vary depending on people's lifestyle.

Overall, this evidence may be useful for health policymakers in designing appropriate preventive and therapeutic in-

terventions.

6. Appendix

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6.2. Funding Support

None.

6.3. Conflict of Interest

The authors declare that they have no competing interests.

6.4. Author's contribution

All the authors have the same contribution.

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Table 1: Characteristics of the included studies in systematic review of for the prevalence of overweight/Obesity in men.(Continuous)

Authors	year of publication	Study Location	Sampling method	Prev. Obesity (%)	Prev. Overweight (%)	Source Population	Age	Sample Size. Male	Total sample
Naghashpour M.(22)	2011	Khozestan	random sampling	17.9	16.7	Healthcare centers	31-49	68	51
Gholipour M.(23)	2012	Tehran	random sampling	2	32	General Population	20-32	150	223
Khodabakhshi H.(24)	2019	Birjand	random sampling	82.9	NA*	General Population	≥60	200	400
Veghari G.(25)	2012	Golestan	random sampling	14.1	32.4	General Population	15-65	3245	6489
Gholabi F.(26)	2019	Tabriz	cluster sampling	27.8	56.6	General Population	20-64	208	400
Alavai S.(27)	2018	Jahrom	cluster sampling	3.4	16.5	General Population	20-24	107	360
Najafipour H.(28)	2017	Kerman	cluster sampling	9.7	30.5	General Population	15-75	3100	6200
Abdollahi A.(29)	2010	Golestan	cluster sampling	42.3	20.3	Healthcare centers	≥17	2500	5000
Fallah-Moshkani R.(30)	2016	Isfahan	cluster sampling	9.7	56.5	Healthcare centers	≥18	NA	7958
Karimi N.(31)	2017	Babolsar	cluster sampling	18	27	General Population	25-65	70	150
Shishehbor F.(32)	2016	Ahvaz	cluster sampling	16.6	28.7	General Population	18-64	223	515
Mirzaeian S.(33)	2014	Isfahan	cluster sampling	7.5	36.6	General Population	≥30	384	1000
Mohammadi M.(34)	2010	Fars	cluster sampling	NA	11.1	General Population	20-70	3622	8647
Nouri R.(35)	2012	Shiraz	cluster sampling	13.5	39.5	General Population	≥19	354	727
Barghamadi M.(36)	2019	Mashhad	Convenience Sampling	14.2	42.9	General Population	20-60	2559	3737
Salem Z.(37)	2014	Rafsanjan	NA NA NA	General Population	≥18	28	59		
Mohammadi M.(38)	2015	Yazd Seven major cities:Ardabil	NA	21	28	General Population	≥18	87	181
Agha-Alinejad H.(39)	2013	Isfahan, Ahvaz,Tehran, Rasht,Kerman and Mashhad	Convenience Sampling	10.2	49	General Population	15-64	991	2179
Fallahzadeh H.(40)	2017	Yazd	cluster sampling	27.7	25.2	General Population	20-69	4646	9422
Mohammadi M.(41)	2016	Tehran	cluster sampling	24	28	General Population	≥60	165	375
Jahanlou A.(42)	2014	Bandar Abbas	cluster sampling	43.2	25.3	Healthcare centers	18-85	5893	20163
Modjtahedzadeh H.(43)	2017	Abadan	cluster sampling	30.2	48.6	General Population	20-64	701	721
Mirzaei M.(44)	2017	Yazd	cluster sampling	19.3	39.9	General Population	20-70	4921	9911
Hashemzadeh M. (45)	2018	Tehran	Non-probability Sampling	14.5	47	Healthcare centers	29-41	200	200

Table 1: Characteristics of the included studies in systematic review of for the prevalence of overweight/Obesity in men.(Continuous)

Authors	year of publication	Study Location	Sampling method	Prev. Obesity (%)	Prev. Overweight (%)	Source Population	Age	Sample Size. Male	Total sample
Attarzadeh Hosseini R.(46)	2017	Mashhad	random sampling	5.2	23.3	General Population	18-22	500	500
Serahati S.(47)	2013	Tehran	multistage cluster random	18.9	NA	General Population	≥20	2476	8875
Hassanipour Azgomi S.(48)	2016	Tehran	cluster sampling	0.8	26.5	General Population	18-33	132	342
Oji F.(49)	2017	Ardabil	Convenience Sampling	34	NA	Healthcare centers	50	88	172
Moghaddas F.(50)	2018	Sahlan Area in Tabriz	NA	42	31	Healthcare centers	≥60	119	245
Sarraf P.(51)	2017	Qom	cluster sampling	NA	NA	General Population	21	114	301
Cheraghpoor K.(52)	2015	Ahvaz	Stratified random Sampling	20.7	43.1	General Population	21.4	116	272
Kolahi, A. A.(53)	2018	31 provinces of Iran	multistage cluster random	13.9	36.2	General Population	≥20	4049	9878
Abbasalizad Farhangi, M.(54)	2015	Tabriz	simple random	25.2	32	General Population	34.36 (8.9)	99	300
Alavi,S.S.(55)	2015	Qom	random sampling	NA	37.2	General Population	≥18	1500	1488
Amani, S.(56)	2015	Kurdistan	random sampling	NA	NA	General Population	≥20	NA	13710
Ayatollahi, S.M.T.(57)	2010	Shiraz	multistage cluster random	10.5	39.2	General Population	25-55	1141	2282
Heydari,T.(58)	2011	Shiraz	Convenience sampling	2.6	15.7	General Population	18–27	153	288
Baygi F.(59)	2017	male seafarers of NITC	random sampling	4.1	46.7	General Population	≥18	500	500
Dalvand S.(60)	2015	Nationwide	cluster sampling design	13.6	NA	General Population	20–65	9130	18,990
Djalalinia, S.(61)	2020	urban and rural areas of Iran	PPS cluster sampling	15.3	53.6	General Population	≥18	14,080	30,042
Emamian, M. H.(62)	2017	urban and rural areas of Iran	random sampling	20.2	NA	General Population	15–64	NA	89,400
Gandomkar A.(63)	2005	Valashahr district in South of Iran	random sampling	9.1	33.6	General Population	40–75	4276	9264
Ghaderian,B.(64)	2020	Ahvaz	random cluster sampling	18.8	41.9	Healthcare centers	≥ 20	1187	2575

Table 1: Characteristics of the included studies in systematic review of for the prevalence of overweight/Obesity in men.

Authors	year of publication	Study Location	Sampling method	Prev. Obesity (%)	Prev. Overweight (%)	Source Population	Age	Sample Size. Male	Total sample
Gharakhanlou R.(65)	2012	from 7 major cities of Iran	telephone survey	10.2	39.4	General Population	15 - 74	991	2179
Ghorbani A.(66)	2013	Qazvin	multistage cluster random	26.1	49.2	General Population	20-77	527	1103
Ghorbani, R.(67)	2012	Semnan	multistage cluster random	NA	NA	General Population	30-70	1695	3799
Kheradmand M.(68) 10	2019	sari	random sampling	33.5	42.4	Healthcare centers	35–70	6000	255
Hosseinpanah, F.(69)	2016	Tehran	Population-based	NA	51.6	General Population	≥20	3536	7257
Mohebbi I.(70)	2012	West Azerbaijan	random sampling	21.3	41.4	General Population	20*70	12138	12138
Katibeh M.(71)	2020	Yazd	cluster sampling method	26	41	General Population	40–80	994	2320
Khabazkhoob M.(72)	2017	Shahroud	Random sampling	19.5	46	General Population	40-64	2213	5190
Veghari G.(73)	2013	Golestan (ethnic minorities of Fars-native, Turkman, and Sistani)	Cluster sampling	13.1	33	General Population	15-65	1499	2994
Kolahi A.(14)	2018	Nationwide	cluster sampling	NA	NA	General Population	≥20	4049	9878
Heydari,T.(58)	2011	Jahrom	cluster sampling	9.9	41.3	General Population	≥30	405	892
Shahbazian H.(74)	2013	Ahvaz	cluster sampling	15	NA	Healthcare centers	20-70	434	912
Haghighian A.(75)	2016	Tehran	Cluster Multi-stage Sampling	1.4	35	General Population	30–64	268	722
Mouodi S.(76)	2018	Amirkola, Northern Iran	Convenience	NA	NA	General Population	40–60	147	300
Rashidi A.(77)	2018	Mashhad	stratified-cluster method	17.2	45.4	Healthcare centers	≥20	3933	9847
Sarrafzadegan N.(78)	2013	Isfahan, Najaf-Abad,	surveys	37.9	45.8	General Population	≥ 20	3118	6175
Ghaderian B.(64)	2019	Ahvaz	cluster sampling	18.8	41.9	General Population	≥ 20	1187	2575
Sarrafzadegan N.(79)	2014	Isfahan	NA	13.2	42.6	General Population	≥35	1604	3284
Saberi H.(80)	2011	Kashan	random	23	41	Healthcare centers	21-73	429	429
Pourabdian S.(81)	2020	Nationwide	cluster sampling	10.8	39.1	Healthcare centers	≥20	37 625	36 625
Damirchi, A.(82)	2013	Rasht	multistage cluster random	14.5	54	General Population	18-69	200	400

*Not Available

Figure 1: PRISMA flow diagram of the included studies.

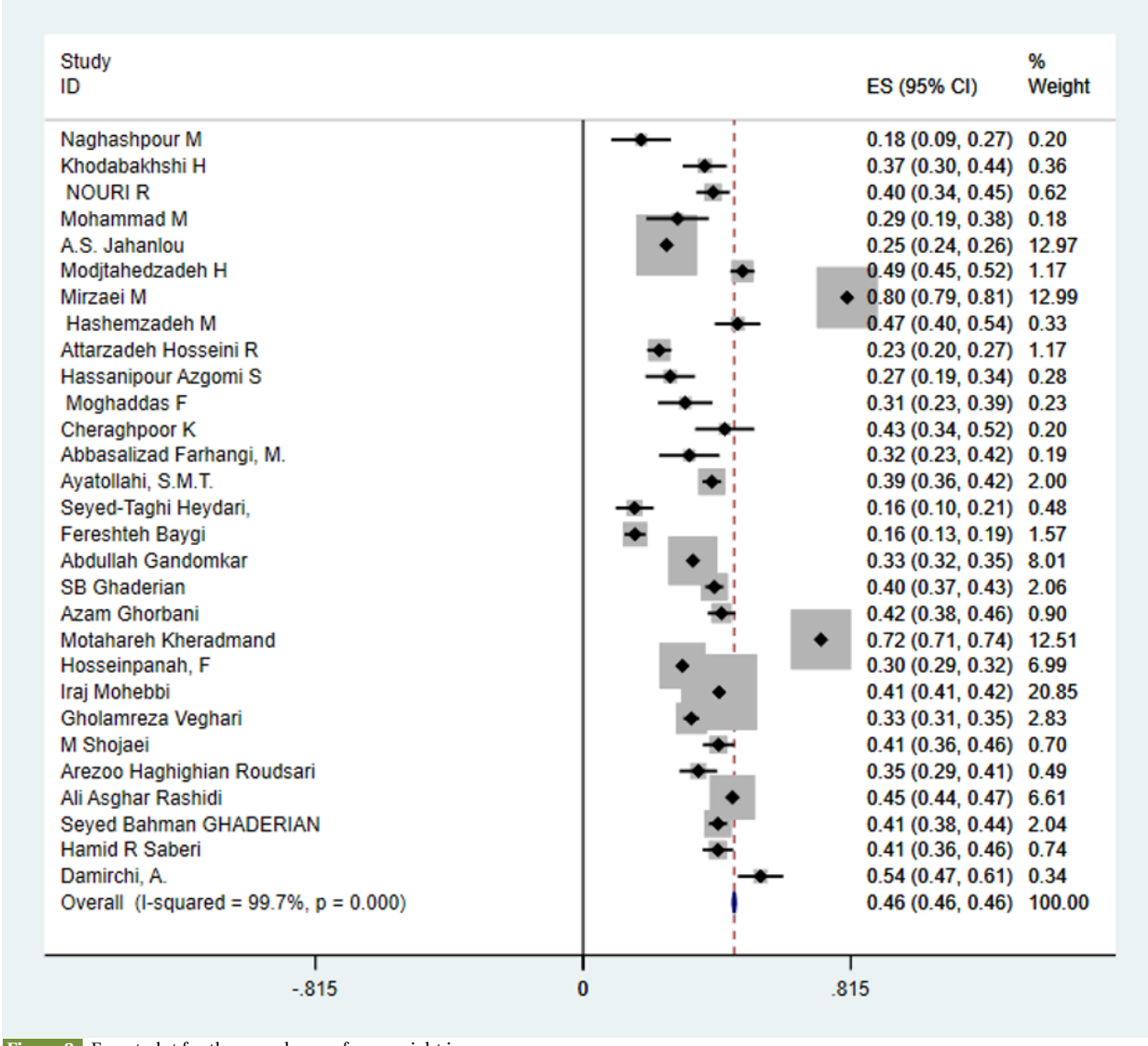

Figure 2: Forest plot for the prevalence of overweight in men.

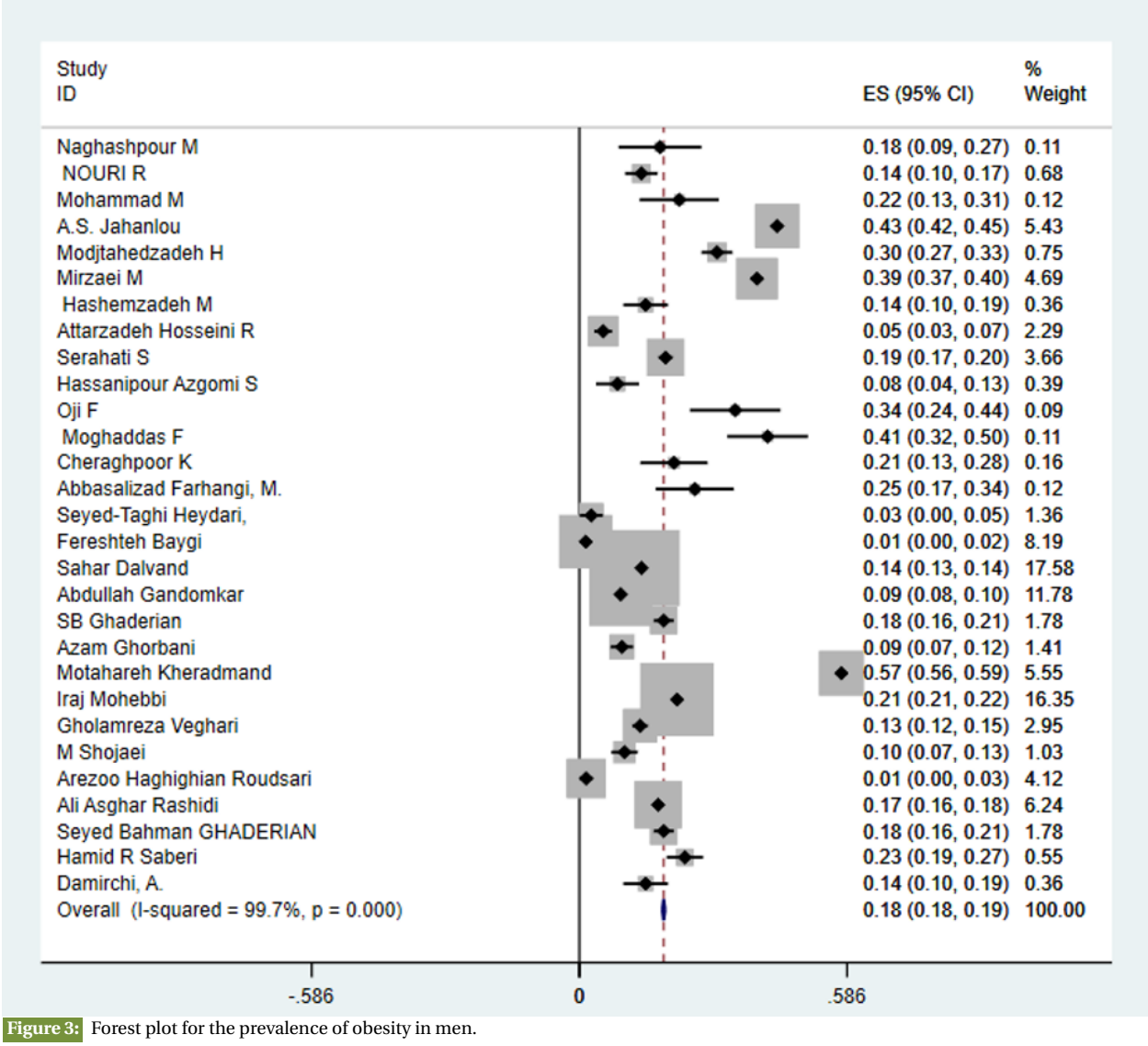

Figure 3: Forest plot for the prevalence of obesity in men.

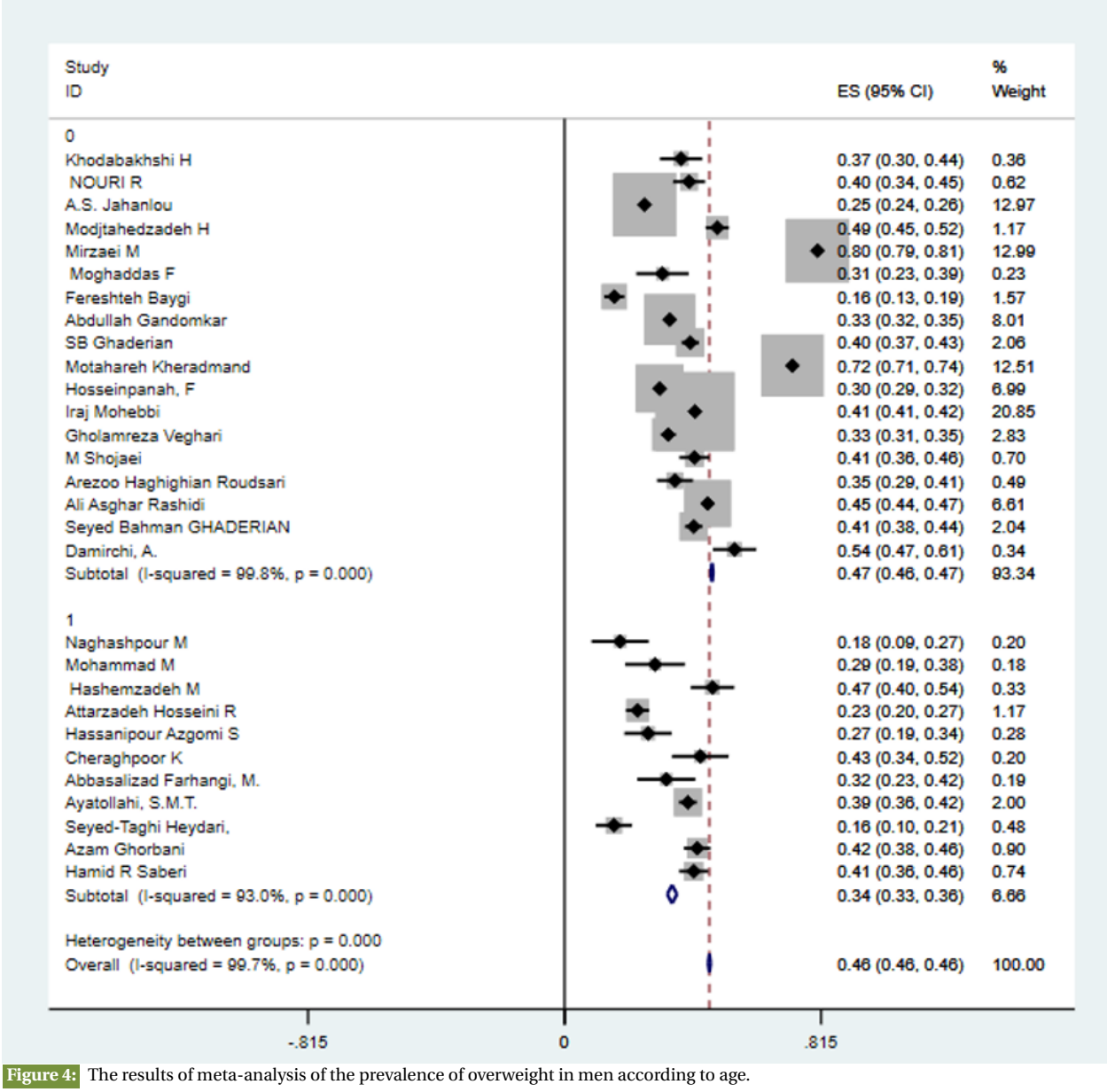

Figure 4: The results of meta-analysis of the prevalence of overweight in men according to age.

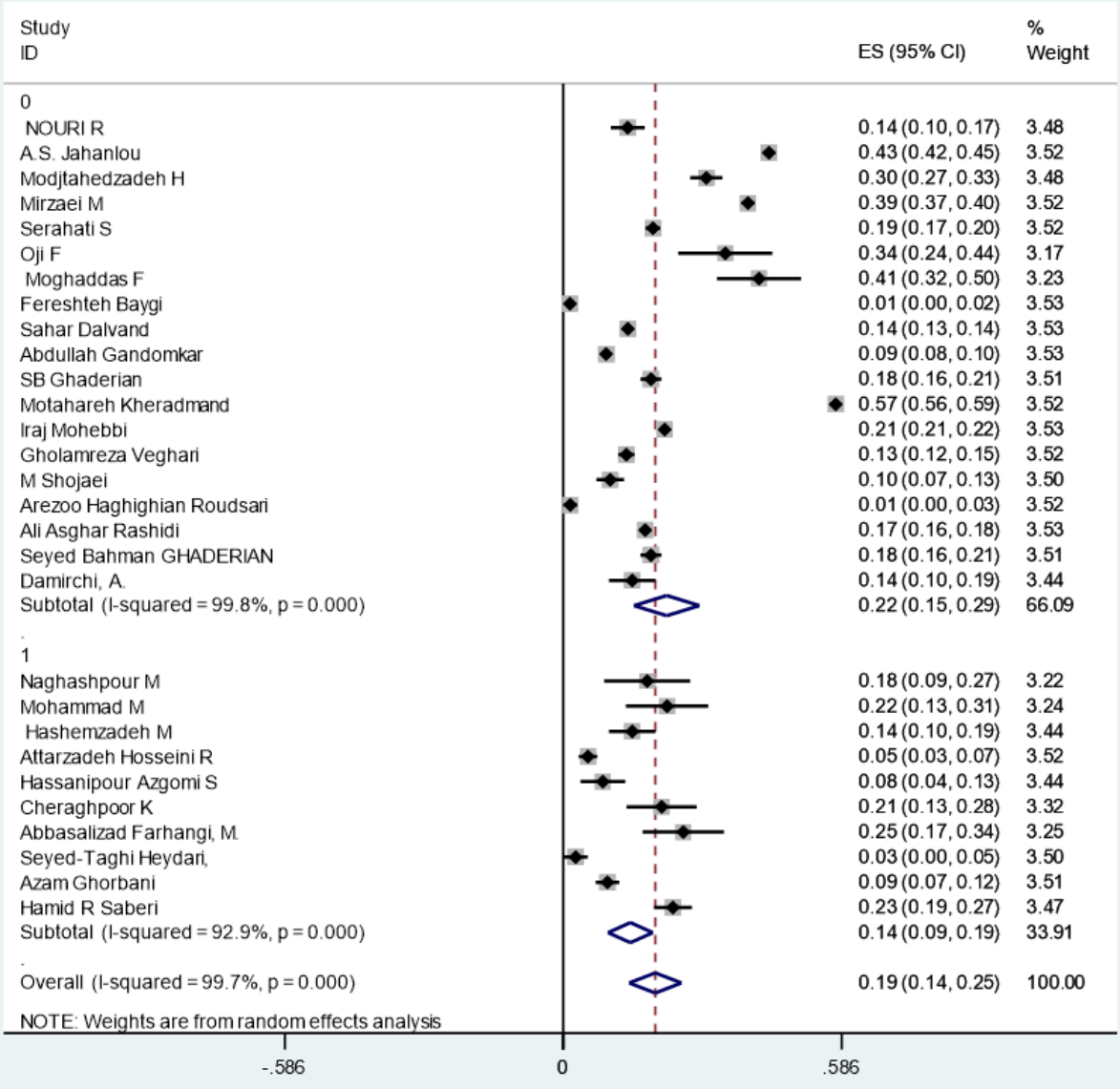

Figure 5: The results of meta-analysis of the prevalence of obesity in men according to age.