Overweight and Obesity Prevalence in Israel: Findings of the First National Health and Nutrition Survey (MABAT)

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Abstract

Background: The prevalence of obesity has increased considerably in many countries in recent decades.

Objective: To describe the prevalence of overweight and obesity in the Israeli population, based on findings of the first national health and nutrition survey (MABAT).

Methods: This cross-sectional survey was carried out during 1999–2000. MABAT is based on a representative sample (n = 3,246) of the general Israeli population aged 25–64 years. The current study population comprised those with complete data on measured weight and height (n = 2,781). Participants were interviewed in person and had their weight and height measured by the interviewer.

Results: Over 50% of the study participants were women (n = 1,410); 76% were Jews and 24% Arabs. Most participants had an education of at least 12 years (72%). Body mass index ⩾30.0 was more prevalent in women compared to men ($P < 0.001$) in both population groups (Jews and Arabs). Obesity rates increased with age and reached 22.4% for men and 40.4% for women aged 55–64 years. Lower education was associated with higher obesity rates, with lowest rates observed for Jewish women with an academic education (13.6%) and highest rates observed for Arab women with a basic education (57.3%). Multiple logistic regression analyses showed age to be a significant risk factor in men. Age, education and origin (Arab, and the former Soviet Union for Jews) were significant risk factors for obesity in women.

Conclusions: Obesity rates in Israel are high and comparable to those in the United States. Of special concern is the subgroup of older Arab women (55–64 years), whose obesity rates reached 70%.

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The World Health Organization Consultation on Obesity meeting (Geneva, 3–5 June 1997) [1] agreed on an international standard for measuring overweight and obesity using the body mass index, which is defined as weight (kg) divided by height (m) squared, or kg/m^2. For assessing obesity in adult populations, the BMI categories are: (i) BMI 25–29.9 for overweight; (ii) BMI 30+ for obesity, and this category is further divided into (a) class I obesity (BMI 30–34.9), (b) class II obesity (BMI 35–39.9) and (c) class III obesity (BMI 40 and over) [1]. The prevalence of obesity (BMI ⩾ 30) has increased considerably in many countries, both developed and underdeveloped, in recent decades [2]. In the United States for instance, age-adjusted obesity rates among 20–74 year olds increased from 23% in the late 1980s to 31% in 2001–2002 [3]. Similar trends, with overall lower rates, were also observed in Canada, where obesity rates among adults increased from 9% and 8% in 1981 to 14% and 12% in 1996, in males and females, respectively [4], and in many other countries [5–8].

The association between BMI and higher morbidity and mortality is well established. Obesity is strongly associated with diabetes mellitus, cardiovascular diseases, hypertension, post-menopausal breast cancer, colon cancer, gallbladder disease, and arthritis [9–12]. Obesity is also associated with higher general mortality rates and shorter life expectancy [13,14]. Consequently, obesity is now considered a global epidemic [1].

The first Israeli national health and nutrition survey (the MABAT survey) was carried out between 1999 and 2000 by the Israel Ministry of Health's Food and Nutrition Services and the Israel Center for Disease Control. This survey is the first to collect national data on anthropometry, nutritional habits, health status and practices of the Israeli population, and their correlations with health outcomes. The purpose of the current study was to report the prevalence of obesity in the Israeli population based on the findings of this first national survey, and to serve as a reference for future publications on trends in Israel and globally.

Subjects and Methods

Study population

The study design was cross-sectional. The study population was based on a random sample from the population registry and the selected individuals' neighbors. Eligibility required that the participant was aged 25–64, had been in Israel for at least one year prior to the interview, and not living in long-term care or institutions. Both Jews and Arabs were included, with over-sampling of the Arab sector, but due to logistic problems the Bedouin population was excluded. In total, the MABAT survey comprised 3,246 participants. Of the 3,246 study participants, measured height and weight data were complete for 1,371 (88.7%) of the participating men and 1,410 (90.8%) of the participating women, yielding a total of 2,781 participants eligible for analyses in the current study.

Sampling design

A random sample of 5,929 persons was drawn from the national population registry, with an expected compliance of 60%. Telephone numbers were matched using a computerized matching program

BMI = body mass index

(Dvash-Telepathy) [15]. When a telephone number could not be found or was incorrect, a telephone number search based on the family name was conducted. The sampled individuals located had to consent to participate in the survey, and a letter explaining the survey and its importance was sent to those who agreed to participate. Persons who refused to take part in the survey or could not be located were classified as "refused" or "non-located", respectively. Of the random sample (n=5,929), 1,992 people aged 25–64 were approached by telephone, and of them, a total of 1,287 agreed to be interviewed (64.6%). In order to reduce the costs of the survey, it was decided to include neighbors of the sample persons in the study population. Finally, 1,277 sampled people (64.1%) and 1,969 neighbors completed the interview, comprising a study population of 3,246 participants in total. The MABAT survey was approved by the Institutional Review Board of the Sheba Medical Center and the Ministry of Health.

Data collection

Personal interview and questionnaire

A face-to-face interview with study participants was conducted in the person's home. The questionnaires were carried out in four languages (Hebrew, Arab, Russian, English) and contained general and dietary information.

Anthropometric measurements

Anthropometric measurements were taken by the interviewer at the end of the interview. All the measurements were done twice and both numbers were recorded. Height and weight were measured without shoes. Height was measured using a coil-spring tape measure, and a fixed angle (wood, plastic or aluminum) was used to determine intersection of the top of the subject's head with the wall. Stickers were used to mark and record the height measurement. If the two measurements differed by more than 0.4 cm, a third measurement was taken. Weight was measured using portable analog scales with dial (maximum measurement 130 kg, level of accuracy 0.5 kg) placed on a non-carpeted floor. If the two measurements differed by more than 1 kg, a third measurement was taken. Body mass index was computed as weight divided by height squared (kg/m^2), and categorized as low (BMI <20.0), normal (BMI 20.0–24.9), overweight (BMI 25.0–29.9), class I obesity (BMI 30.0–34.9), and class II + class III obesity (BMI $\geqslant$35.0).

Data entry and statistical analyses

Data entry was done through screens based on an SAS statistical program especially developed for the questionnaire. Crude data were usually categorized into subgroups. The total population was categorized into two population groups (Arabs and Jews) and education level into four categories: basic (0–8 years), mediate (9–11 years), high school (12 years and more, non-academic), and academic (more than 12 years, academic). Place of origin was categorized for Jews only, and was based on country of birth, or, in the case of individuals born in Israel, on the father's country of birth.

Findings of the current study are presented as absolute figures, rates or percentages (with 95% confidence intervals). Differences in percentages were tested by the chi-square test. In order to assess the independent associations of each variable on obesity prevalence we used univariate and later multiple logistic regression models for males and females, separately, with obesity (BMI $\geqslant$30) as the dependent variable. Independent variables included age (continuous), education (continuous) and origin as a categorical variable, with Arab origin as one category and Jewish origin subdivided into Asia, Africa, the former Soviet Union, and Europe/America/Australia. Israeli origin was used as the reference category. Interaction between age and education was examined as well. All analyses were done using the SAS statistical package.

Results

Basic characteristics of the study participants are presented in Table 1. Most of the study participants were married (82.5%) and had an education of at least 12 years (72%). Most of the Jewish participants had a father born in Israel (58.0%) [Table 1].

Mean BMI was lower for men than for women: 26.8 (standard deviation 3.9) for men and 27.1 (SD 5.5) for women. Overweight (BMI 25.0–29.9) was present in 45.8% of the men and 33.1% of the women (P < 0.001). Obesity rates were higher for women than for

SD = standard deviation

Table 1. Characteristics of the study population

	N	%
Total	2,781	100
Gender		
Male	1,371	49
Female	1,410	51
Population group		
Jews	2,113	76
Arabs	668	24
Age group (yrs)		
25–34	740	27
35–44	797	29
45–54	726	26
55–64	518	19
Marital status		
Single	287	10
Married	2295	82.5
Divorced/separated	125	4.5
Widowed	74	3
Education level (yrs)		
0–8	352	13
9–11	403	15
⩾12 (non-academic)	1367	49
>12 (academic)	648	23
Place of birth*		
Israel	1219	58
Asia	176	8
Africa	280	13
Former Soviet Union	211	10
Europe	166	8
America	61	3

* For Jews only

men (25.8% vs. 19.9%, respectively); class I obesity (BMI 30–34.9) was present in 17.1% of the men and 16.5% of the women ($P = 0.19$), and class II + III obesity (BMI ⩾35) was present in 2.8% of the men and 9.3% of the women ($P < 0.001$). For both genders, the youngest age group (25–34 years) had low rates of overweight or obesity (10.4% of the men and 13.7% of the women) while the oldest age group (55–64 years) was most frequently overweight or obese (75.6% of the men and 80.0% of the women).

In women, the prevalence of overweight, class I obesity and class II + III obesity increased monotonically with age. Men showed similar trends for overweight. There were no statistically significant differences between Jewish and Arab men regarding prevalence of overweight (47.0% and 45.4%, respectively) and obesity (21.4% and 19.4%, respectively). However, significant differences were noted between Jewish and Arab women, where prevalence of obesity (BMI ⩾30) was 23.6% among Jewish women as compared to 33.2% among Arab women ($P = 0.0006$). Table 2 presents the prevalence of overweight and obesity by gender, age group and population group. Overall, for both genders and both population groups, BMI means tended to increase with higher age [Table 2].

The distribution of obesity by educational level, gender and population group is presented in Figure 1. Mean BMI declined with higher education levels. This trend was observed for men and women in general. For population groups, it was evident more among Jews. Differences between BMI in Jews and Arabs by education were noted mostly for women. Among Jewish women, the prevalence of obesity was higher for those with basic education than for those with academic

Table 2. Prevalence (and 95% confidence intervals) of overweight (BMI 25.0–29.9) and obesity type I (BMI 30–34.9) and type II + III (BMI ⩾ 35) by age group, gender and population group

	Age group (yrs)	N	Mean BMI (SD)	BMI 25–29.9 % (95% CI)	BMI 30–34.9 % (95% CI)	BMI ⩾35 % (95% CI)
Men	**25–64**	**1,371**	**26.8 (3.9)**	**45.8 (43.2, 48.4)**	**17.1 (15.1, 19.1)**	**2.8 (2.0, 3.7)**
	25–34	365	25.4 (3.8)	35.1 (30.2, 40.0)	9.0 (6.1, 12.0)	1.4 (0.2, 2.6)
	35–44	383	26.8 (3.8)	48.0 (43.0, 53.0)	18.3 (14.4, 22.1)	2.6 (1.0, 4.2)
	45–54	360	27.8 (3.8)	48.9 (43.7, 54.0)	22.2 (17.9, 26.5)	4.4 (2.3, 6.6)
	55–64	263	27.4 (3.8)	53.2 (47.2, 59.3)	19.4 (14.6, 24.2)	3.0 (1.0, 5.1)
Women	**25–64**	**1,410**	**27.1 (5.5)**	**33.1 (30.6, 35.5)**	**16.5 (14.5, 18.4)**	**9.3 (7.8, 10.8)**
	25–34	375	24.6 (4.8)	24.8 (20.4, 29.2)	9.3 (6.4, 12.3)	4.3 (2.2, 6.3)
	35–44	414	26.6 (5.2)	31.9 (27.4, 36.4)	14.7 (11.3, 18.1)	7.3 (4.7, 9.7)
	45–54	366	28.2 (5.3)	38.3 (33.3, 43.2)	20.8 (16.6, 24.9)	11.5 (8.2, 14.7)
	55–64	255	29.7 (5.6)	39.6 (33.6, 45.6)	23.5 (18.3, 28.7)	16.9 (12.3, 21.5)
Jews only						
Men	**25–64**	**1,016**	**26.7 (4)**	**47.0 (41.8, 52.2)**	**18.6 (14.5, 22.6)**	**2.8 (1.1, 4.5)**
	25–34	236	24.8 (23.6)	34.3 (28.3, 40.4)	6.8 (3.6, 10.0)	0.9 (0.0, 2.0)
	35–44	261	26.8 (3.9)	47.1 (41.1, 53.2)	17.2 (12.7, 21.8)	3.1 (1.0, 5.2)
	45–54	310	27.8 (4)	47.1 (41.5, 52.6)	22.3 (17.6, 26.9)	4.8 (2.4, 7.2)
	55–64	209	27.2 (3.7)	53.1 (46.3, 59.9)	18.2 (12.9, 23.4)	1.9 (0.06, 3.8)
Women	**25–64**	**1,097**	**26.8 (5.3)**	**32.9 (30.1, 35.7)**	**15.4 (13.3, 17.5)**	**8.2 (6.6, 9.8)**
	25–34	236	24.1 (4.4)	21.6 (16.4, 26.9)	7.6 (4.2, 11.0)	3.4 (1.1, 5.7)
	35–44	310	25.8 (4.9)	29.4 (24.3, 34.4)	11.9 (8.5, 15.5)	5.5 (2.9, 8.0)
	45–54	326	27.9 (5.2)	39.0 (33.7, 44.2)	19.9 (15.6, 24.3)	9.8 (6.6, 13.0)
	55–64	225	29.3 (5..4)	40.9 (34.5, 47.3)	21.8 (16.4, 27.2)	14.7 (10.0, 19.3)
Arabs only						
Men	**25–64**	**355**	26.8 **(3.9)**	**45.4 (42.3, 48.4)**	**16.5 (14.2, 18.8)**	**2.9 (1.8, 3.9)**
	25–34	129	25.8 (4)	36.4 (28.1, 44.7)	13.2 (7.3, 19.0)	2.3 (0.0, 4.9)
	35–44	122	26.7 (3.4)	50.0 (41.1, 58.9)	20.5 (13.3, 27.6)	1.6 (0.0, 3.9)
	45–54	50	28.2 (2.9)	60.0 (46.4, 73.6)	22.0 (10.5, 33.5)	2.0 (0.0, 5.9)
	55–64	54	28.3 (4.2)	53.7 (40.4, 67.0)	24.1 (12.7, 35.5)	7.4 (0.4, 14.4)
Women	**25–64**	**313**	**28.0 (6.2)**	**33.6 (28.3, 38.8)**	**20.1 (15.7, 24.6)**	**13.1 (9.4, 16.8)**
	25–34	139	25.4 (5.5)	30.2 (22.6, 37.8)	12.2 (6.8, 17.7)	5.8 (1.9, 9.6)
	35–44	104	28.7 (5.7)	39.4 (30.0, 48.8)	23.1 (15.0, 31.2)	12.5 (6.1, 18.9)
	45–54	40	31.1 (5.8)	32.5 (18.0, 47.0)	27.5 (13.7, 41.3)	25.0 (11.6, 38.4)
	55–64	30	33.1 (5.6)	30.0 (13.6, 46.4)	36.7 (19.4, 53.9)	33.3 (16.5, 50.2)

CI = confidence interval

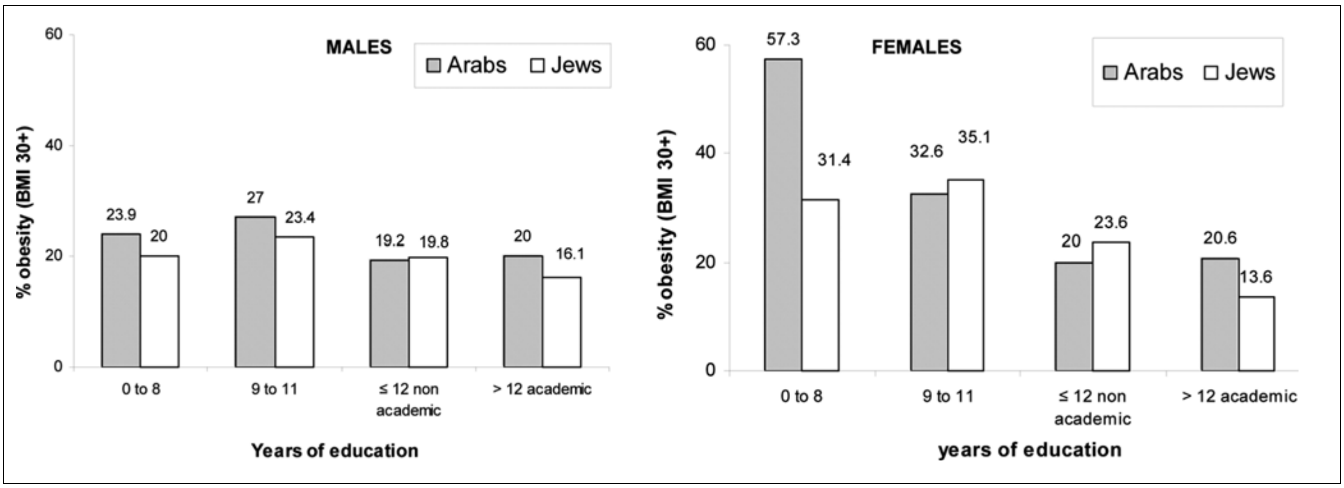

Figure 1. Obesity (BMI ⩾ 30) rates (%) by gender and level of education

education (31.4% vs. 13.6%, respectively). Among Arab women, prevalence of obesity was 57.3% for those with basic education and 20.6% for those with academic education. Among women with academic education, class II + III obesity was present only in 4.2% of the Jewish women as compared to 11.8% of the Arab women, while type I obesity prevalence was comparable (9.4% in Jews, 8.8% in Arabs) [Figure 1].

Jewish men in all origin categories were most frequently overweight (prevalence of 45.7%, 44.7%, 50.2%, 47.1% and 41.2% for men originating from Israel, Asia, Africa, former Soviet Union and Europe/USA/Australia, respectively). Women from Israel, Asia and Europe/America/Australia had normal BMI most frequently (71.8%, 45.9% and 43%, respectively), while women from Africa and those from the former Soviet Union distributed equally between the categories of normal BMI (38.7% and 33.1%, respectively) and overweight (36.8% and 32.1%, respectively). The prevalence of obesity type I was highest among men and women from the former Soviet Union (18.5% and 19.7%, respectively) while prevalence of obesity type II + III was highest among men from Europe/America/Australia (4.0%) and women from the former Soviet Union (13.1%). In total, men and women from Israel had the lowest prevalence of overweight and obesity (58.5% and 28.2%, respectively), while men and women from the former Soviet Union had the highest prevalence of overweight and obesity (66.4% and 64.9%, respectively) (data not shown).

By univariate logistic regression models, higher age and Europe/America/Australia origin (as compared to Israeli origin) were significant risk factors for obesity in men. In women, higher age, lower education, and origin (Arabs and all other origin groups as compared to Israeli origin) were significant risk factors (data not shown). In the multiple logistic regression analyses, which included age, education and origin as independent covariates, only age remained a significant predictor for men [Table 3], while for women, significant predictors were age, education, Arab origin and former Soviet Union origin as compared to Israeli origin [Table 3]. Interaction between age and education was not significant in men and only borderline significant in women and therefore was not included in the model.

Table 3. Odds ratios and 95% confidence intervals for obesity (BMI $\geqslant$30) by gender in a multivariate logistic regression model

	Males		Females	
Variable	**OR**	**95% CI**	**OR**	**95% CI**
Age	**1.03**	**1.02, 1.04**	**1.05**	**1.03, 1.06**
Education	0.93	0.80, 1.09	**0.71**	**0.61, 0.83**
Origin*				
Arab	1.76	0.90, 3.42	**3.50**	**1.51, 8.12**
Asia	1.31	0.65, 2.61	1.55	0.66, 3.64
Africa	1.29	0.64, 2.59	1.86	0.80, 4.31
Former Soviet Union	1.37	0.64, 2.96	**3.12**	**1.30, 7.49**
Europe/USA/Australia	1.58	0.80, 3.11	1.89	0.81, 4.41

* Origin was added as a categorical variable to the model with Arab origin as one category, and Jewish origin categorized into Asia, Africa, Former Soviet Union and Europe/America/Australia origin. Israeli origin was determined as the category of reference.

Discussion

The results of the first national health and nutrition survey (MABAT) indicate that rates of overweight and obesity for the 24–65 year old population in Israel are high, especially for the age group 55–64. The highest prevalence of type II + III obesity was noted for older, less educated Arab women, who may therefore be defined as a high risk group for obesity-related morbidity.

The main advantage of the current study is its national based sample. To the best of our knowledge this is the first national based study in this field in Israel. The fact that the values for height and weight were obtained through systematically controlled measurements assures the accuracy and validity of the data. Furthermore, strict quality control was maintained at all levels of the MABAT survey.

The inclusion of the subjects' neighbors into the sample was in order to reduce the costs of the survey. Potential differences between the random and the neighbors' samples were examined. In the neighbors' sample, the average age was 2.6 years higher. However, there was no difference in average number of years of schooling between the two samples, and after adjusting for gender, age and population group, no significant differences in weight, height or BMI were found between the interviewees in the two samples. Therefore, we have no reason to suspect a selection bias.

The results presented in this study are in accordance with previously published data for western countries in general [1–8] and for Israel in particular. Gofin et al. [16] assessed the prevalence of obesity and its changes over time (1970–1986) in men and women aged $\geqslant$50 years, residents of a defined neighborhood in Jerusalem. Their findings indicated rather high age- and gender-adjusted obesity rates that increased with time, from 21% in 1970 to 25% in 1986. Age- and gender-specific obesity rate (BMI $\geqslant$ 30) for 45–64 year old participants in the current study was 30%, which is higher. This discrepancy can probably be explained by the time differences between the studies (the late 1980s in the previous study and 1999–2000 in the current one), and perhaps also by the fact that the current study population is a representative sample of the general Israeli population while the previous study population was a selected group.

The Israeli CORDIS cohort study, which took place between 1985 and 1989 and screened 2,154 men and 1,395 women employed in Israeli industry for selected risk factors for cardiovascular diseases [17], presents somewhat intriguing results. For the age groups 25–34, 35–44, 45–54 and 55–64, the prevalence of BMI $\geqslant$ 30 was 7.3%, 12.6%, 14.5% and 14.9% for men and 7.1%, 19.2%, 32.9% and 36.4% for women, respectively (unpublished data). While the CORDIS values are considerably lower than those described in the current study for men, they are similar to the current findings for women, even though there is a gap of 12–15 years between the two studies. This observation could indicate that while men in industry may be healthier than the general population, women in industry are a selected group that may have higher obesity rates, perhaps due to lower education level, which is a significant predictor for BMI in women but not in men.

As compared to Israeli origin, Arab origin in men was associated with higher BMI (borderline significance), while for women it was

Arab origin as well as former Soviet Union origin (for Jews) that were significantly associated with higher BMI. According to these findings, Arab women, and in particular those aged ⩾45, constitute a high risk subgroup. These results are supported by other studies referring to obesity rates (BMI ⩾30) among Palestinian Arabs (37.5% and 40.9% among 30–65 year old rural and urban women, respectively) [18,19] and Saudi Arabians (24% among 15–95 year old women and 29.4% among a national based sample of women aged ⩾20) [20,21].

Age was a significant predictor for BMI in both men and women, while education level significantly predicted BMI only in women. Previous studies disclosed similar trends [16,22–24]. As basic metabolic rate slows down with age, the relationship between age and obesity is easy to interpret [22]. Educational level is closely related to socioeconomic status which, in turn, is inversely associated with obesity [23,24].

Conclusion

The current study indicates high obesity rates in the Israeli population. These high obesity rates call for systemic periodic surveillance and for the planning and implementing of specific population-based health promotion strategies. These strategies should include educational and intervention programs and strategies such as marketing regulations, price control, etc., as well as secondary intervention tools. The current results may serve as a reference for future trend studies concerning obesity rates as well as studies assessing specific intervention programs.

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