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ORIGINAL ARTICLE

Prevalence of Overweight and Obesity Among Greek Army Recruits

George Michas, MD, MSc, PhD,[1]* Asterios Kampouras, MD,[2]*
Miltiadis Kokolios, MD,[3] Ioannis Alexandros Drosatos, MD,[4]
Maria Schoina, MD,[5] Andreas Asimakos, MD,[6] Renata Micha, RD, PhD[7]

[1]*Department of Internal Medicine, General Hospital of Kalamata, Kalamata, Greece*
[2]*Medical Service of the Hellenic Army, XXIV Armored Brigade, Litochoro, Greece*
[3]*Medical Service of the Hellenic Army, 523 Infantry Training Center, Mavrodendri Kozani, Greece*
[4]*Medical Service of the Hellenic Army, Artillery Training Center, Thiva, Greece*
[5]*Department of Internal Medicine, General Hospital of Katerini, Katerini, Greece*
[6]*Department of Intensive Care Medicine, Evagelismos Hospital, Athens, Greece*
[7]*Department of Epidemiology, Harvard School of Public Health, Boston, MA, USA*
**First Authors (equal contribution): George Michas, MD, MSc, PhD, Asterios Kampouras, MD*

KEY WORDS: *body mass index; obesity; overweight; male adults; Greek army recruits; educational level; residence*

Abbreviations
BMI = body mass index
WHO = World Health Organization

Correspondence to:
George Michas, MD, Department of Internal Medicine, General Hospital of Kalamata, Antikalamos, Kalamata 24100, Greece;
Tel.: +30 27210 46825; Fax: +30-27213-63104;
Email: gv.michas@gmail.com

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ABSTRACT

OBJECTIVE Obesity poses a major public health issue whose prevalence is reaching epidemic proportions, especially among younger ages. Our aim was to determine the prevalence of overweight and obesity among Greek men recruited in the army, and to evaluate potential associations with place of residence and educational level.

SUBJECTS AND METHODS Height and weight were measured in 3,684 men, aged 23.2±2.8 (mean ± standard deviation) years. Body mass index (BMI, kg/m^2) was used as measure of adiposity. Associations between BMI categories and level of education (≤9 school years, >9 years) and between BMI categories and place of residence (urban, rural) were evaluated using chi-square test.

RESULTS Average BMI was 25.2±4 kg/m^2. The prevalence of overweight (25<BMI<30) was 33.7% and associated positively with a higher educational level ($p<0.001$), whereas the prevalence of obesity (BMI>30) was 10% and was not associated with educational level. Obesity was associated with place of residence; individuals from rural areas were more obese than those from urban areas ($p=0.04$). Our results, when compared with those of similar studies conducted in 1969, 1990, and 2006 showed a significant increase in mean BMI.

CONCLUSION Overall, we documented a high and increasing prevalence of overweight and obesity (43.7%) among younger Greek men.

INTRODUCTION

Obesity rates are on the rise in both developed and developing nations.[1] This phenomenon is quite alarming considering that obesity raises the risk for major chronic diseases such as cardiovascular disease, hypertension, diabetes mellitus, and dyslipidemia.[2] Socioeconomic status and place of residence are important factors associated with adiposity.[3,4]

In Greece, over the last 50 years there has been a significant increase in the mean body mass index (BMI) of the population.[5-7] There were three Greek studies carried out in 1969,[8] 1990,[9] and 2006,[10] which explored and observed associations between obesity, educational level and place of residence in army recruits that showed a rather worri-

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some increase in mean BMI. We wanted to evaluate whether this increase continues. The aim of the present study was to determine the current prevalence of overweight and obesity among young Greek army recruits; to evaluate potential associations with place of residence and educational level; and to compare our findings with those of similar earlier studies.

SUBJECTS AND METHODS

Our sample consisted of 3,684 newly recruited men in the Greek army between November 2010 and February 2011, aged 18-43 years. The study was conducted in the regions of Thiva and Mavrodendri where the Artillery Training Center and the 523 Infantry Training Center are currently based, respectively. Enrollment in the Greek Armed Forces is obligatory for all males above the age of 18 and takes place four times a year. The number of recruits at every enrollment is about 12,000-14,000 and is divided into 10 training centers. The two Training Centers host about 1,900 recruits at every recruitment period, who come from all areas of Greece, and from all socio-economic and educational categories. According to the military regulation, only men with severe obesity associated with functional impairment were excluded prior to classification (e.g. genetic syndromes, such as Prader-Willi). Anthropometric measurements (height, weight) were performed by medical doctors using standard techniques. Soldiers were measured for height and weight without shoes and in underwear. Fasting state could not be assured since the recruiting takes place throughout the day. Weight was measured with the same scale to the nearest 500g (Seca 762, maximum capacity 150 kg, graduations 0.5 kg) and height was measured with a Seca Telescopic Height Rod (Model 220) to the nearest 0.1 cm. Data on place of residence and educational level were collected during the interview on recruitment using a standardized questionnaire. The study protocol was approved by the Medical Directorate of the Greek Army General Staff.

Body mass index (BMI) was calculated as weight (kg)/height (m^2).[11] Adiposity status was classified according to the World Health Organization (WHO) criteria:[12] underweight, BMI<18.5 kg/m^2; normal weight, 18.5<BMI<25 kg/m^2; overweight, 25≤BMI<30 kg/m^2; and obese, 18.5≤BMI<25 kg/m^2 BMI ≥30 kg/m^2.

Place of residence of the recruits was classified as urban (≥10,000 people) and rural (<10,000), based on data from the National Statistical Service of Greece (2001 Census). Residential areas were further divided into urban (cities with population≥100,000 people), semi-urban (cities or towns with 10,000≤population<100,000 people), and rural (smaller cities, towns and villages with population<10,000 people).

For the data to be comparable with the previous studies,[8-10] the educational level was classified as "higher" (individuals with >9 school years; >high school), and "lower" (individuals with ≤9 school years; i.e., ≤ high school).

Analyses were performed with Microsoft Excel 2007 and Stata 10.0. T-test, ANOVA, and chi-square test were used and differences were regarded statistically significant when $p<0.05$ (two-tailed).

RESULTS

Mean age [±standard deviation (SD)] of the recruits was 23.2±2.8 years (Table 1). Their mean BMI was 25.2±4.0 kg/m^2. The prevalence of overweight and obese recruits was 43.7% in total; 33.7% of them were overweight and 10.0% were obese (Fig. 1). The number of recruits from urban areas was 2,456 (66.7%) and from rural areas 1,228 (33.3%) (Table 2). A total of 1,594 (43.3%) recruits had a higher education, whereas 2,090 (56.7%) belonged to a lower education level (Table 3).

Recruits from urban areas were more educated than those from rural areas (49.8% vs. 30.2%, $p<0.001$), and there was no difference in mean BMI between individuals from urban and rural areas ($p=0.15$) (supplementary Table 1). Although being overweight was not associated with place of residence,

TABLE 1. Characteristics of 3,684 males recruited in the Greek Armed Forces.

	Values	20th – 80th Percentile
Age (y)	23.2 ± 2.8*	20.0 – 25.0
Height (cm)	178.5 ± 6.7	173.0 – 185.0
Weight (kg)	80.4 ± 14.4	70.0 – 90.0
BMI (kg/ m^2)		
<18.5	17.6 ± 1.0	17.0 – 18.3
18.5 – <25	22.7 ± 1.6	21.2 – 24.2
25 – <30	26.9 ± 1.4	25.6 – 28.3
≥30	33.8 ± 4.0	30.9 – 36.3
Residence†		
Urban (%)	66.7	–
Rural (%)	33.3	–
Education**		
Lower (%)	56.7	–
Higher (%)	43.3	–

BMI = body mass index
* Mean ± SD (all such values)
† Place of residence was classified as urban (≥10,000 people) and rural (<10,000 people), based on the data from the National Statistical Service of Greece.
** Educational level was classified as lower (≤9 school years, i.e., ≤ high school) and higher (>9 school years, i.e., >high school).

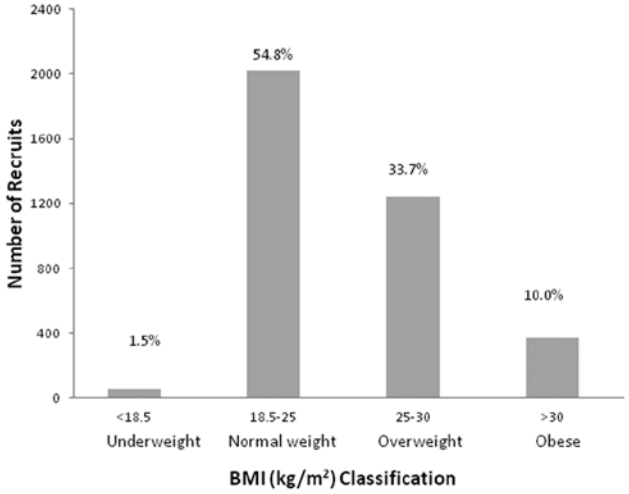

FIGURE 1. Prevalence of underweight, normal weight, overweight, and obesity in 3,684 Greek male recruits. The prevalence of total adiposity was 43.7%, including a 33.7% (n=1,240) of overweight and a 10.0% (n=370) of obese recruits. 54.8% (n=2,018) of the recruits had normal weight and 1.5% (n=56) were underweight. Classification of obesity status was performed according to the World Health Organization criteria[12] based on average body mass index (BMI) levels: underweight, <18.5 kg/m^2; normal weight, 18.5 – <25 kg/m^2; overweight, 25 – <30 kg/m^2; and obese: ≥30 kg/m^2.

being obese was associated with living in rural areas (p=0.04) (Table 2). This association, however, was no longer statistically significant when place of residence was classified as urban, semi-urban or rural (p=0.07) (supplementary Table 2). While mean BMI did not differ between recruits with higher and lower education, prevalence of overweight was significantly positively associated (39.6% vs. 29.1%, p<0.001) with higher education (Table 3). In contrast, obesity was not associated with educational level (p=0.1) (Table 3). Compared with previous similar studies, our findings showed an increase in mean BMI since the 1960s (Fig. 2).

DISCUSSION

We documented a 33.7% prevalence of overweight and a 10% prevalence of obesity among Greek male recruits. These figures are amongst the highest reported worldwide in similar populations. In another Mediterranean country, Portugal, the prevalence of overweight was 21.3% and of obesity 4.2% among army recruits.[13]

Previous Greek studies measured BMI among army recruits in 1969 (n=805, BMI= 23.8±1.4)[8], in 1990 (n=837, BMI= 23.8±2.9)[9] and in 2006 (n=2,568, BMI= 24.7±4.2).[10] Mean BMI did not differ between 1969 and 1990, while overweight and obesity status was not determined. However, over the last 21 years, from 1990 to 2011, a significant increase in mean BMI from 23.8 to 25.2 kg/m^2 has been noted (p<0.001). Even in the 5 years that elapsed between our study and the 2006 study, there has been a statistically significant increase in the mean BMI from 24.7 to 25.2 kg/m^2 (p<0.001). A similar conclusion can be drawn when comparing the mean BMI in Greek navy recruits between 1977[14] and 2009.[15] Similar trends have also been reported in Portuguese recruits, where the prevalence

TABLE 2. Prevalence of underweight, normal weight, overweight, and obesity in 3,684 Greek male recruits based on average BMI levels by place of residence.

	Place of residence*					
	Urban		Rural			
BMI (kg/ m^2)†	mean ± sd	n (%)	mean ± sd	n (%)	*P***	*P*††
<18.5	17.5 ± 1.0	29 (1.2%)	17.6 ± 1.0	27 (2.2%)	0.02	0.79
18.5 – <25	22.7 ± 1.6	1,371 (55.8%)	22.7 ± 1.6	647 (52.7%)	0.07	0.67
25 – <30	26.9 ± 1.4	827 (33.7%)	26.9 ± 1.3	413 (33.6%)	0.98	0.62
≥30	33.6 ± 3.6	229 (9.3%)	34.1 ± 4.6	141 (11.5%)	0.04	0.24
Total	25.1 ± 3.9	2,456 (100%)	25.3 ± 4.4	1,228 (100%)		

BMI = body mass index

* Place of residence was classified as urban (≥10,000 people) and rural (<10,000 people), based on the data from the National Statistical Service of Greece.

† Classification of obesity status according to the World Health Organization criteria[12] based on average body mass index (BMI) levels: Underweight: <18.5 kg/m^2; Normal weight: 18.5 – <25 kg/m^2; Overweight: 25 – <30 kg/m^2; Obese: ≥30 kg/m^2.

** χ^2 test comparing BMI prevalence between urban and rural areas.

†† t-test comparing mean differences in BMI between urban and rural areas.

TABLE 3. Prevalence of underweight, normal weight, overweight, and obesity in 3,684 Greek male recruits based on average BMI levels by educational level.

	Educational Level*					
	Lower		Higher			
BMI (kg/ m^2)†	**mean ± sd**	**n (%)**	**mean ± sd**	**n (%)**	***P*****	***P*††**
<18.5	17.5 ± 1	47 (2.2%)	17.9 ± 0.7	9 (0.6%)	<0.001	0.23
18.5 – <25	22.5 ± 1.7	1,209 (57.9%)	23.0 ± 1.4	809 (50.7%)	<0.001	<0.001
25 – <30	27.1 ± 1.4	609 (29.1%)	26.8 ± 1.3	631 (39.6%)	<0.001	<0.001
≥30	34.1 ± 4.5	225 (10.8%)	33.2 ± 3	145 (9.1%)	0.1	0.02
Total	25.0 ± 4.4	2,090 (100%)	25.4 ± 3.5	1,594 (100%)		

BMI = body mass index

* Educational level was classified as lower (≤9 school years) and higher (>9 school years).

† Classification of obesity status according to the World Health Organization criteria[12] based on average body mass index (BMI) levels: Underweight: <18.5 kg/m^2; Normal weight: 18.5 – <25 kg/m^2; Overweight: 25 – <30 kg/m^2; Obese: ≥30 kg/m^2.

** χ^2 test comparing BMI prevalence between lower and higher educational level.

†† t-test comparing mean differences in BMI between lower and higher educational level.

SUPPLEMENTARY TABLE 1. Average height, weight, and BMI in 3,684 Greek male recruits in all men, and by place of residence and education.

		Place of residence*				
		Urban	**Rural**	**Total**		
Educational Level†		**mean ± sd**	**mean ± sd**	**mean ± sd**	***P*****	***P*††**
Higher	Height (cm)	179.9 ± 6.6	179.4 ± 6.2	179.8 ± 6.5	0.13	<0.001
	Weight (kg)	81.8 ± 12.9	83.4 ± 13.7	82.2 ± 13.1	0.046	<0.001
	BMI (kg/m^2)	25.2 ± 3.4	25.9 ± 3.7	25.4 ± 3.5	<0.01	0.08
	n (%)	1,223 (49.8%)	371 (30.2%)	1,594 (43.3%)		
Lower	Height (cm)	177.7 ± 6.5	177.4 ± 6.9	177.6 ± 6.7	0.22	<0.001
	Weight (kg)	79.0 ± 14.9	78.9 ± 15.5	78.9 ± 15.2	0.90	<0.001
	BMI (kg/m^2)	25.0 ± 4.3	25.1 ± 4.6	25.0 ± 4.4	0.63	<0.001
	n (%)	1,233 (50.2%)	857 (69.8%)	2,090 (56.7%)		
Total	Height (cm)	178.8 ± 6.3	178.0 ± 6.8	178.5 ± 6.7	<0.01	<0.001
	Weight (kg)	80.4 ± 14.0	80.3 ± 15.1	80.4 ± 14.4	0.79	<0.001
	BMI (kg/m^2)	25.1 ± 3.9	25.3 ± 4.4	25.2 ± 4.0	0.15	<0.01
	n (%)	2,456 (100%)	1,228 (100%)	3,684 (100%)		

* Place of residence was classified as urban (≥10,000 people) and rural (<10,000 people), based on the data from the National Statistical Service of Greece.

† Educational level was classified as lower (≤9 school years) and higher (>9 school years).

** T-test comparing average height, weight and BMI between urban and rural areas in higher educational level (first 3 p-values), in lower educational level (mid 3 p-values), and overall (bottom 3 p-values).

†† T-test comparing average height, weight and BMI between higher and lower educational level in urban areas (first 3 p-values), in rural areas (mid 3 p-values), and overall (bottom 3 p-values).

SUPPLEMENTARY TABLE 2. Prevalence of underweight, normal weight, overweight, and obesity in 3,684 Greek male recruits based on average BMI levels by place of residence.

	Place of residence*							
	Urban		Semi-Urban		Rural			
BMI (kg/m²)†	mean ± sd	n (%)	mean ± sd	n (%)	mean ± sd	n (%)	*P***	*P*††
<18.5	17.6 ± 1	17 (1.2%)	17.4 ± 1	12 (1.2%)	17.6 ± 1	27 (2.2%)	0.06	0.88
18.5 – <25	22.8 ± 1.6	821 (57.1%)	22.7 ± 1.6	550 (54%)	22.7 ± 1.6	647 (52.7%)	0.06	0.55
25 – <30	26.9 ± 1.4	473 (32.9%)	27 ± 1.4	354 (34.7%)	26.9 ± 1.3	413 (33.6%)	0.64	0.81
≥30	33.7 ± 4	126 (8.8%)	33.4 ± 3	103 (10.1%)	34.1 ± 4.6	141 (11.5%)	0.07	0.40
Total	25 ± 3.9	1,437 (100%)	25.2 ± 3.9	1,019 (100%)	25.3 ± 4.4	1,228 (100%)		

*Place of residence was classified as urban (cities with population ≥100,000 people), semi-urban (cities or towns with 10,000 ≤population<100,000), and rural (smaller cities, towns and villages with population <10,000 people), based on the data from the National Statistical Service of Greece.
† Classification of obesity status according to the World Health Organization criteria (6) based on average body mass index (BMI) levels: Underweight: <18.5 kg/m²; Normal weight: 18.5 – <25 kg/m²; Overweight: 25 – <30 kg/m²; Obese: ≥30 kg/m².
** χ^2 test comparing BMI prevalence between urban, semi-urban and rural areas.
†† ANOVA comparing mean differences in BMI between urban, semi-urban and rural areas.

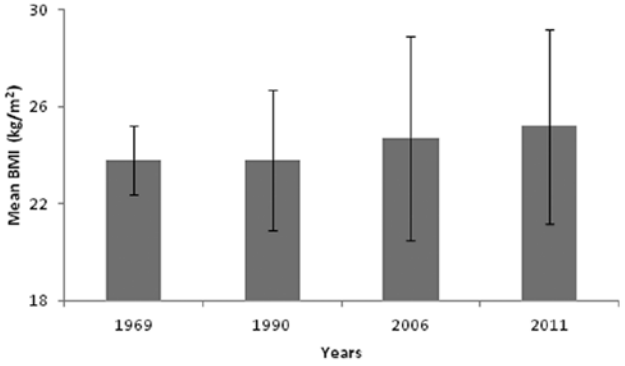

FIGURE 2. Mean BMI in 3,684 Greek male recruits in 2011, and its trends over the last 40 years. Mean BMI of Greek Army Recruits was 23.8±1.4 kg/m² in 1969, which was similar to that documented in 1990 (23.8±2.9 kg/m²). However, in 2006 mean BMI increased to 24.7±4.2 kg/m², and increased further in 2011 (25.2±4.0 kg/m²). BMI in 2011 was statistically significantly higher compared to mean BMI documented in all prior years, 1969 (p<0.001), 1990, (p<0.001), and 2006 (p<0.001).

of overweight increased from 10.5% in 1986 to 21.3% in 2000 and of obesity from 0.9% to 4.2%, respectively.[13] Likewise, in Belgium, median BMI in army men increased from 23.9 kg/m² in 1992 to 24.7 kg/m² in 2005.[16] In Poland, on the other hand, there has been a more gradual increase; the mean BMI in army recruits increased from 21.7 kg/m² in 1965 to 22.9 kg/m² in 2001.[17]

Place of residence was relatively unrelated to adiposity status. In 1969,[8] recruits from rural areas had higher mean BMI and were shorter than those from urban areas. This was suggested to be due to shortage of animal products in rural areas. Differences in BMI between recruits of different education levels were greater in those living in urban than rural areas, which was suggested to be due to the unevenness of the living conditions in the cities compared with the relative uniformity of the living conditions in rural areas of the country at the time.[8] Similarly, in 1990,[9] recruits from urban areas had higher mean BMI, which was more profound among individuals with a lower educational level. This difference was suggested to be due to the lack of physical activity, which was more prevalent in urban areas.[9] Lastly, in 2006[10] place of residence was unrelated to BMI.

Similar to 2006,[10] we found that recruits with a higher educational level were more overweight. Several factors could potentially contribute to the observed associations such as busier and sedentary lifestyles, as well as poorer dietary habits, which were nonetheless not measured in the present study. However, in contrast to the 2006 study, we did not observe a relationship between obesity and lower educational level. In 1969,[8] individuals with a higher educational level had a higher mean BMI, while in 1990[9] BMI was not associated with educational level. During the last 40 years, Greece underwent substantial but unbalanced socioeconomic changes that influenced and still continue to influence people's lifestyles and health. The alarming rise in obesity rates could be partially attributed to a nutritional transition towards a "western" diet and a sedentary lifestyle.[18-20] The ATTICA Study, which was carried out in Attica, Greece, concluded that obese and overweight participants were more frequently sedentary, consumed higher quantities of alcoholic beverages, and followed an unhealthier

diet compared with those of normal weight.[21]

LIMITATIONS

Potential study limitations should be considered. The cross-sectional design of the present study can only generate hypotheses about the associations between obesity and sociodemographic characteristics of our population. Data were not collected on smoking status, eating habits, and physical activity, which could potentially explain part of the trends observed. Our findings cannot be extrapolated to other populations (e.g., elderly, women), as our study included only healthy males between 18 and 43 years of age. However, the study population may be considered a representative sample of the general male population of that age in Greece, since enrollment in the Greek Armed Forces is obligatory for all males above the age of 18, and the tested population came from all parts of Greece and from all socio-economic and educational categories.[8-10,22,23] Previous studies conducted among Greek army recruits[8-10] included populations with similar sociodemographic characteristics to our studied subjects, as army recruitment has not changed in Greece in the last 50 years.

CONCLUSION

Overall, we documented a high prevalence of overweight and obesity (43.7%) among younger Greek men recruited in the army, with a trend towards higher BMI in the last 21 years. This becomes especially important in Greece as funds for promoting public health are reduced every year due to the financial crisis (0.9% of Growth Domestic Product decrease in the funding allocated to health services in 2011).[24] The medical community has to concentrate its efforts on the prevention of obesity, since it raises the risk for major chronic diseases such as cardiovascular disease, diabetes mellitus, and kidney disease[25] and it also poses an extreme financial burden on modern societies.[26]

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