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Lifestyle Factors Association with BMI in Greek Male Conscripts

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Abstract

We determined associations between various lifestyle factors and body mass index (BMI) in 4326 conscripts of the Greek Army, aged 18-27 years. Prevalence of overweight was 32.3% and of obesity 13.2%. Prevalence of underweight was 1.2% and correlated with the level of education (τ=-0.32, p=0.01). In multivariate analysis we found that lower BMI levels were associated with living in urban areas (OR: 0.93, CI: 0.87-0.98, p=0.019), with more time spend in sporting activities (OR: 0.65, CI: 0.61-0.70, p<0.001), and with more juice consumption (OR: 0.75, CI: 0.67-0.83, p<0.001). On the contrary, higher BMI levels were associated with beverage and alcohol consumption (OR: 1.26, CI: 1.14-1.39, p<0.001, and OR: 1.15, CI: 1.04-1.28, p=0.007, respectively). Education and cigarette smoking were not correlated with BMI.

In conclusion, prevalence of underweight was correlated with the level of education and obesity was associated with living in rural areas, physical inactivity, heavy alcohol drinking, consumption of sugar sweetened beverages, and low consumption of orange juice.

Keywords: Underweight; Overweight; Obesity; Lifestyle factors.

Introduction

The prevalence of overweight and obesity in adults in Greece has been increasing over several decades [1] but there are no studies on the prevalence of underweight in our population.

Underweight, like overweight, increases the risk of morbidity and mortality [2]. It has been established that social and cultural factors play an important role in obesity [3]. However, there are only a few studies assessing the risk factors of underweight. In the study reported herein we examined associations between various lifestyle factors and abnormal body mass index (BMI), namely underweight, overweight, and obesity, in a young population of male Greek conscripts.

Methods

Study population: The study included 4326 young men (conscripts enlisted in the Greek Army from February 2007 to November 2008), aged 18-27 years. All healthy young men in the country are obliged to serve in the army and before enlistment they pass a thorough medical assessment. All recruits who successfully passed this assessment were eligible for the study. Recruits come to recruitment centers from all over the country and so our sample was quite representative regarding the geographical origin of participants. All participants were informed about the research and gave their consent before participating. The study was approved by the Ethics Committee of Attikon University Hospital.

Anthropometry: Measurements of height and weight were performed by the same physician with a substantial measuring experience prior to the study. During measurements the soldiers were lightly dressed (underwear only) and without shoes. Conscripts were defined as underweight when BMI was <18.5 kg/m^2, overweight when BMI was 30>BMI≥25 kg/m^2 and obese when BMI was ≥30 kg/m^2. BMI was analyzed in relation to the socio-demographic characteristics, dietary habits, physical activity and lifestyle behaviors of the conscripts.

Demographics and dietary information: The conscripts' place of residence was classified as urban (>10000 people) or rural (<10000 people), based on data from the National Statistical Service of Greece. The degree of education, which is a stable and robust indicator of socioeconomic status, was distributed in three categories depending on the years of schooling, i.e. individuals with up to 9 years, 9 to 12 years, and more than 12 years of schooling. The data collection concerning alcohol, sugar sweetened beverages and 100% fresh orange juice consumption were based on validated questionnaires of Greek National Statistical Service for the estimation of health related issues in the Greek population. For alcohol consumption we took into account only distilled spirits, i.e., beverages of high alcohol content, such as brandy, gin, rum, vodka, whiskey; the subjects were categorized as never drinkers, moderate drinkers (1-7 drinks/week), and infrequent heavy drinkers (>7 drinks/weekday or weekend day). None of the conscripts was categorized as a frequent heavy drinker (≥ 4 drinks every day). For sugar sweetened beverages consumption the subjects were categorized as never drinkers, drinkers of 1-7 bottles of 330 ml/week and drinkers of >7 bottles of 330 ml/week. For 100% fresh orange juice (or another fresh juice) consumption, subjects were categorized as never drinkers, drinkers of 1-7 bottles of 250 ml/week and drinkers of >7 bottles 250 ml/week.

Smoking and physical activity: The WHO Monica Smoking Questionnaire was used to assess smoking. The participants were classified as those who had never smoked (never smokers), those who

were smoking 1-20 cigarettes per day and those who are smoking >20 cigarettes per day. There were no former smokers in our sample. Time spent in health related sporting activities was assessed by asking the conscripts if they participated in any sporting activity; if they did, they were asked what was their most practiced sport, its duration (categorized, from 30 minutes per week to 3.5 hrs per week and more than 3.5 hrs per week) and its frequency (ranging from once/year to more than once/day).

Statistical analysis: For the purposes of univariate analysis we used our data in the ordinal scales described above. Associations between variables were explored with chi-square and Kendall's Tau-b (τ). For multivariate analysis we used an ordinal logistic regression model where we examined the effect of each one of the lifestyle factors on BMI, after having adjusted for the potential confounding effect of the others. Age was included in the model as a covariate. BMI was considered an ordinal variable with four levels (<18.5 kg/m^2, 25>BMI ≥ 18.5 kg/m^2, 30>BMI ≥ 25 kg/m^2, and ≥ 30 kg/m^2, as described above). Explanatory variables were included in the model as ordered categorical variables. Results are described as odds ratios (OR) and 95% confidence intervals (CI).

Results

Mean age (sd) and mean BMI (sd) for the whole study population were 23.7 (3.1) years and 25.5 (4.4) kg/m^2, respectively. Prevalence of overweight was 32.3% and of obesity 13.2%. Prevalence of underweight was 1.2% and correlated negatively with the level of education (τ=-0.32, p=0.01), whereas no correlation was found with the place of residence (Table 1).

Underweight		Total	N (%)	P
Level of Education	≤9	131	3 (2,3)	
(years)	12-Oct	1087	20 (1,83)	0
	≥13	3108	30 (0,96)	
Type of residence	Urban	3241	41 (1.3)	
	Rural	1085	12 (1.1)	0.6
	7-Jan	2699	18 (0.7)	
	>7	1205	31 (2.6)	

Table 1: Prevalence of underweight (BMI<18.5 kg/m^2) in relation to level of education and type of residence.

The prevalence of underweight, overweight and obesity in relation with dietary habits, physical activity and lifestyle behaviors are presented in Table 2.

BMI		Total	Mean Age (± SD)	Normal	Overweight	Obese	OR	CI	p
				n (%)	n (%)	n (%)			
100% orange juice consumption (250ml bottles / week)	Never	422	23.4 (3.1)	194 (46)	145 (34.3)	83 (19.7)			
	7-Jan	2699	23.9 (3.1)	1413 (52.4)	907 (33.6)	379 (14)			
	> 7	1205	23.3 (3)	753 (62.5)	346 (28.7)	106 (8.8)	0.75	0.67-0.83	<0.001
Sugar sweetened beverages consumption (330ml bottles / week)	Never	932	24.2 (3.1)	528 (56.7)	335 (35.9)	69 (7.4)			
	7-Jan	2671	23.7 (3)	1480 (55.4)	846 (31.7)	345 (12.9)			
	> 7	723	23.3 (3.2)	352 (48.7)	217 (30)	154 (21.3)	1.26	1.14-1.39	<0.001
Alcohol consumption	Never	805	23.9 (3.1)	476 (59.2)	237 (29.4)	92 (11.4)			
	1 - 7 drinks / week	2922	23.6 (2.9)	1590 (54.4)	955 (32.7)	377 (12.9)			
	>7 drinks / weekday or weekend day	599	23.7 (3.6)	294 (49)	206 (34.4)	99 (16.6)	1.15	1.04-1.28	0.007
Smoking status, cigarettes / day	Never	2025	23.8 (3)	1112 (54.9)	691 (34.1)	222 (11)			
	Current	2301	23.6 (3.1)	1248 (54.2)	707 (30.7)	346 (15.1)			
	20-Jan	1776	23.5 (3)	988 (55.6)	536 (30.2)	252 (14.2)			
	>20	525	24 (3.5)	260 (49.5)	171 (32.6)	94 (17.9)	0.95	0.87-1.04	0.77
Health related sports, hours / week	Never	1349	23.5 (3.1)	570 (42.2)	473 (35.1)	306 (22.7)			
	0.5-3.5	977	24.3 (2.9)	506 (51.8)	354 (36.2)	117 (12)			
	>3.5	2000	23.5 (3.1)	1284 (64.2)	571 (28.6)	145 (7.2)	0.65	0.61-0.70	<0.001
Level of Education (years)	≤9	128	20.5 (2.3)	81 (61.8)	31 (23.6)	16 (12.2)			
	12-Oct	1067	20.4(2.3)	564 (51.9)	349 (32.1)	154 (14.1)	1.06	0.95-1.19	0.45

	≥13	3078	24.9 (2.3)	1662 (53.4)	1018 (32.7)	398 (12.8)			
Type of residence	Rural	1085	21.9 (2.4)	590 (54.3)	346 (31.9)	149 (13.7)			
	Urban	3241	22.9 (2.5)	1817 (56.0)	1000 (30.8)	424 (13.0)	0.93	0.87-0.98	0.019

Table 2: Dietary habits, physical activity and lifestyle behaviors. Odds ratios (OR), 95% confidence intervals (CI), and p-values were calculated from multivariate analysis with an ordinal logistic regression model.

In multivariate analysis we found that lower BMI levels were associated with living in urban areas (OR: 0.93, CI: 0.87-0.98, p=0.019), with more time spend in sporting activities (OR: 0.65, CI: 0.61-0.70, p<0.001), and with more juice consumption (OR: 0.75, CI: 0.67-0.83, p<0.001). On the contrary, higher BMI levels were associated with more beverage consumption (OR: 1.26, CI: 1.14-1.39, p<0.001), and more alcohol consumption (OR: 1.15, CI: 1.04-1.28, p=0.007). Education and cigarette smoking were not correlated with BMI.

Discussion

In the present study we determined the possible association of several socio-demographic and lifestyle factors with underweight, overweight, and obesity in a representative sample of Greek young men.

Obesity has reach epidemic proportion globally, and is now considered a disease of civilization [4]. In Europe the number of obese people has tripled over the past 20 years and more than 50% of European adults are obese or overweight [5]. As it was expected, the prevalence we found in our study for overweight and obesity was consistent with the above number, since Greece in the years before economic crisis was a wealthy country with living standards that did not differ from the rest of Europe. The prevalence is also comparable with a report from another study conducted in Greece in about the same time period [6].

In the present study we found a very low percentage of underweight individuals. Although there are only a few studies that address the issue of underweight, available reports from either developed [7,8] or developing [9,10] countries have shown a relatively higher prevalence of underweight than the one we report. While the reasons of underweight differ in each population, there is always an etiologic factor related with the underlying socio-economic conditions. In particular, in affluent countries the underweight problem is not related with lack of nutrients or food, but it is rather a complex issue of psychosocial and psychological characteristics attributable to individuals and their social backgrounds [11]. In this context, our finding of underweight being positively correlated with the level of education comes as no surprise, since highly educated individuals are more prone to higher demands which in turn are associated with greater emotional symptoms and conduct problems [12].

As far it concerns fruit juice, Dennison et al. [13] initially raised concerns about considering it a dietary factor associated with overweight, whereas others [14] found no association between its consumption and weight in children. Our data suggest that frequent orange juice consumption in young men is related to lower BMI. This may be due to a healthier lifestyle that these young men adopt and/or eating smaller quantities of the usual meals.

The majority of the cross-sectional studies and relevant prospective cohort studies have found an adverse association between sugar-sweetened soft drink consumption and body weight. In accordance with these results, our study showed that BMI was positively correlated with sugar sweetened beverages consumption [15].

The results of epidemiological studies on the association between alcohol intake and body weight are equivocal. Breslow and Smothers [16], examining the association between drinking patterns and BMI, reported a positive association. Another study has reported that moderate drinking appears not to be positively associated with overweight in both genders [17]. Our results suggest that alcohol drinking is associated with higher BMI and are in agreement with the Breslow's and Smothers's results.

Smoking is usually associated with lower BMI. According to John et al. [18], body weight appears to be the highest in ex-smokers, and the lowest in current and medium in never smokers. Our results do not corroborate these findings since we found no association between smoking and BMI.

Exercise training has been shown to decrease body weight. Based on evidence from epidemiological and intervention studies, it has been recommended that adults should engage in at least 30 min of moderate intensity physical activity on most, and preferably all, days of the week. Since we found that physical activity is negatively correlated with BMI in our population, an increase in time spent in athletic activities and in general, a less sedentary way of life will probably result in a reduction of BMI.

In conclusion, prevalence of underweight was correlated with the level of education and obesity was associated with living in rural areas, physical inactivity, heavy alcohol drinking, consumption of sugar sweetened beverages, and low consumption of orange juice.

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