Jesu li hrvatski davatelji krvi pretili?

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Original Scientific Paper

ARE CROATIAN BLOOD DONORS OBESE?

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SUMMARY – The rising prevalence of overweight and obesity is characterized as a pandemic of the modern era. The purpose of this study was to analyze the prevalence of overweight and obesity in healthy blood donors in Primorje-Gorski Kotar County, Croatia, and the relationship between socio-demographic factors, lifestyle and eating habits, and body mass index (BMI), including the association of these factors with overweight and obesity. This cross-sectional study included 1255 healthy individuals aged between 18 and 70 years who donated blood between January 2015 and October 2016 at the Clinical Institute of Transfusion Medicine. Each participant completed a questionnaire regarding weight, height, blood type, socio-demographic factors, health parameters, physical activity, alcohol consumption, and smoking habits. Overweight was defined as BMI of 25-29.9 kg/m^2, and obesity as BMI ≥30 kg/m^2. A logistic regression model was used on data assessment. BMI was normal in 33.6% of participants, whereas 44.1% were overweight and 21.8% were obese. Higher BMI was correlated with male sex (odds ratio [OR]=0.21), lower education level (OR=0.77) and unhealthy diet (OR=0.57), whereas lower BMI was correlated with lower age (OR=2.05) and unemployment (OR=1.85). To our knowledge, this is the first study to investigate the prevalence of BMI in a healthy Croatian population; our results confirmed the findings of studies conducted in other European countries. Our results highlighted the importance of improving education levels and raising awareness of healthy dietary habits in high-risk groups, i.e. men and older individuals with lower education levels.

Key words: *Blood donors; Body mass index; Obesity; Overweight; Prevalence*

Introduction

The rising prevalence of overweight and obesity is characterized as a pandemic of the modern era. According to the World Health Organization (WHO) report, overweight and obesity have become a global epidemiological problem[1], with associated comorbidities becoming the leading cause of death. Worldwide, around 3 million deaths *per* year are associated with overweight, which is an important risk factor for the development of several diseases such as cardiovascular disease, cancer, musculoskeletal disorders, and diabetes[2].

Obesity can be defined as a disease involving accumulation of excess body fat to an extent that may cause impairment of health. The most commonly used measure for obesity is the body mass index (BMI). BMI is a measure of weight adjusted for height, and is calculated as weight in kilograms divided by the square of height in meters (kg/m^2). BMI is generally used to classify individuals as overweight or obese. According to the WHO definition, individuals are classified into three categories based on BMI: normal (BMI 18.5-24.9 kg/m^2), overweight (BMI 25-29.9 kg/m^2), and obese (BMI ≥30 kg/m^2). A BMI of 30 or more is now widely accepted as denoting obesity[3]. A number of factors have been associated with overweight and obesity, such as eating habits, socio-demographic factors, and physical activity. One of the factors that influence obesity is the level of education, so that educated people have lower rates of obesity. Increasing levels of physical activity and smoking habits were found to decrease obesity rates. Several studies have examined the rela-

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tionship between demographic factors and obesity[4,5]. Eating habits reflect the individual's ecologic, social, and lifestyle conditions[6].

In the past, these conditions were relatively stable. However, eating habits are currently changing very quickly; food production has become simpler, and the media, marketing and social trends strongly influence contemporary eating habits. Eating habits vary in different parts of Croatia, but bear common features of modern food consumption trends such as increased consumption of unhealthy fast food[6]. In addition, Croatian society is faced with challenges such as management of the worsening socio-economic situation, production of sufficient quantities of food, effective prevention of diseases causally related to food and nutrition, and reduction of health care costs. Several commonly occurring diseases, including obesity, are closely related to lifestyle habits such as physical activity, smoking, alcohol intake, sedentary occupation, and diet. A recent epidemiological study indicated close association between sedentary behaviors measured as the amount of time spent sitting down, and impaired health[7,8]. Several epidemiological studies have shown that the quality of a person's diet is affected not only by their age, sex, occupation and education, but also by their socio-economic status[5,9,10].

Thus, because of the rapidly rising incidence of overweight and obesity, it is important to monitor the national trend of BMI, estimate its impact on the health of the population, identify factors that influence BMI, and formulate a strategy to reduce the increasing incidence of obesity and overweight[1,5,11]. Therefore, the first objective of this study was to assess the prevalence of overweight and obesity in healthy blood donors from Primorje-Gorski Kotar County in Croatia. The relationship between socio-demographic factors, lifestyle, and eating habits, and BMI was also assessed, including the association of these factors with overweight and obesity.

Subjects and Methods

Ethics statement

This study was approved by the Ethics Committee of the Rijeka University Hospital Centre, University of Rijeka. All subjects voluntarily participated in the study and provided oral and written informed consent without incentives. Data were collected anonymously.

Participants

This cross-sectional study included healthy individuals having donated blood between January 2015 and October 2016 at the Clinical Institute of Transfusion Medicine. The age range of the participants was defined by Croatian legislation, which allows only healthy individuals aged between 18 and 70 years to donate blood. Participants were categorized in four categories based on age: 18-30 years, 31-45 years, 46-60 years, and 61-70 years. Furthermore, the required criteria for blood donation were Croatian nationality and hemoglobin level ≥135 g/L for men and ≥125 g/L for women. After fulfilling the criteria for blood donation, the blood donors were offered a questionnaire by a health professional. Instructions for filling out the questionnaire were provided after having consented to participate in the study. Completing the questionnaire took about 5 minutes. Out of 1335 blood donors, 1255 consented to participate in this study, yielding a 94% response rate.

The questionnaire was anonymous and consisted of 40 questions; 35 questions were multiple choices (respondent had to choose one answer from the list of answer choices) and five were open-ended questions (year of birth and age, weight, height, education level, and occupation). Demographic data collected included the place of residence, age, sex, level of education, and marital status. Information was also collected on the participant blood type, physical activity, smoking, alcohol use, and eating habits. The occupation of blood donors was categorized as currently employed or unemployed. Self-reported weight (kg) and height (cm) data were also collected. Upon completion of testing, we calculated BMI using the formula: BMI = weight (kg)/height (cm^2)[12]. In the questionnaire, the participants provided information on their education level, which was categorized as follows: elementary school, high school, undergraduate, or university graduate. Marital status categories were married, unmarried, and other, which included divorced or widowed participants. According to smoking status, we categorized participants as current smokers or non-smokers, which included never-smokers and participants having quit smoking for at least 6 months. Regarding physical activity, participants indicated whether they exercised, and if the answer was yes, then they had to provide their weekly activity frequency: no activity, activity 1

Table 1. Socio-demographic characteristic of blood donors according to gender

Characteristic	Women		Men		Statistics	All	
	n	%	n	%	p	N	%
Body mass index:							
Normal	151	60.2	271	27.2	<0.001*	422	33.6
Overweight	62	24.7	492	49.3	<0.001*	554	44.1
Obese	38	15.1	235	23.5	0.345	273	21.8
Age category (years):							
18-30	78	31.1	291	29.2	0.852	369	29.5
31-45	107	42.6	419	42	0.998	526	42.1
46-60	55	21.9	218	21.8	0.868	273	22.0
61-70	11	4.4	70	7.0	0.742	81	6.5
All	251	20.1	998	79.9		1249	100

*Significant difference between groups according to gender

time *per* week, activity 2 times *per* week, or activity 3 or more times *per* week.

The questionnaire contained 13 questions on nutritional habits for the following food items: whitefish, white meat, red meat, bread/pasta, oily fish, vegetables, and fruits; e.g., How often do you eat oily fish? The participants were required to indicate the frequency of food consumption: 0 = never, 1 = once a week, 2-6 = several times a week, or 3 = every day. The final question asked the participants to self-evaluate their nutritional habits as healthy or unhealthy.

Statistical analysis

Statistical analysis was performed using the MedCalc® version 12.13. (©1993-2017 MedCalc Software, Ostend, Belgium, www.medcalc.be) software. Data were expressed in categories with absolute and relative frequencies. Differences among BMI groups were tested using the χ^2-test, and *post hoc* comparisons of proportions were used to determine statistical significance. Correlations of BMI categories with all included factors were calculated with the Spearman rank correlation coefficient to obtain logistic regression conditions. Logistic regression was calculated to identify factors that determine BMI. BMI was further categorized into an underweight-normal category (0) and overweight-obese category (1). Logistic regression data were expressed as odds ratios (ORs) with their 95% confidence intervals (CI). Data were considered statistically significant at $p<0.05$.

Results

Of the 1255 participants, there were 256 (20%) women and 999 (80%) men. The measured BMI was normal in 33.6% of the participants. Most of the participants were overweight (44.1%) and 21.8% were obese. Because only six participants were underweight (0.5%), their data were excluded from group analyses. The female group had a higher proportion of participants with normal BMI ($p<0.001$) and lower proportion of overweight participants ($p<0.001$) as compared with the male group. There were no significant sex differences in the proportion of obese participants ($p=0.345$). There were no significant sex differences in the participant distribution in different age categories either (Table 1).

The majority of participants with normal BMI were aged 18-30 years, and the number of participants in this age group was significantly higher than those in the other three age groups ($p=0.002$, $p<0.001$, and $p<0.001$ *vs.* 31-45, 46-60, and 61-70 age groups, respectively). Most of the overweight and obese participants were aged between 31 and 45 years, and the number of participants in this age group was significantly higher than those in the other three age groups ($p<0.001$ all). The level of education was significantly different among BMI categories. Participants with normal BMI had a higher level of education (university graduate) than overweight and obese participants did ($p=0.014$). Among participants with secondary school education, the number of obese participants

Table 2. Socio-demographic and baseline characteristic of blood donors according to body mass index category

Characteristic	Normal	Overweight	Obese	Statistics	All	
	n (%)	n (%)	n (%)			
N=1249	422 (33.6)	554 (44.1)	273 (21.8)	p	N	%
Age category (years):						
18-30	196 (46.5)	140 (25.3)	33 (12.1)	<0.001*	369	29.5
31-45	163 (38.6)	238 (43.0)	125 (45.8)		526	42.1
46-60	53 (12.6)	134 (24.2)	86 (31.5)		273	22.0
61-70	10 (2.4)	42 (7.6)	29 (10.6)		81	6.5
Gender:						
Men	271 (64.2)	492 (88.8)	235 (86.1)	<0.001*	998	79.9
Women	151 (35.8)	62 (11.2)	38 (13.9)		251	20.1
Blood type:						
0	164 (38.9)	195 (35.2)	113 (41.4)	0.631	472	37.8
A	167 (39.6)	243 (43.9)	109 (39.9)		519	41.5
B	68 (16.1)	84 (15.2)	36 (13.2)		188	15.0
AB	23 (5.5)	32 (5.8)	15 (5.5)		70	5.6
Level of education:						
Elementary school	13 (3.1)	17 (3.1)	13 (4.8)	<0.001*	43	3.4
Secondary school	227 (53.8)	371 (67.0)	197 (72.2)		795	63.7
Undergraduate	52 (12.3)	50 (9.0)	12 (4.4)		114	9.1
Graduate University	130 (30.1)	116 (21.0)	51 (18.7)		297	23.8
Employment status:						
Unemployed	137 (32.5)	108 (19.5)	54 (19.8)	<0.001*	299	23.9
Employed	285 (67.5)	446 (80.5)	219 (80.2)		950	76.1
Marital status:						
Single	218 (51.7)	194 (35.0)	59 (21.6)	<0.001*	471	37.7
Married	173 (41.0)	320 (57.8)	193 (70.7)		686	54.9
Other	31 (7.4)	40 (7.22)	21 (7.7)		92	7.4
Place of residence:						
Urban >100,000	266 (63.0)	342 (61.7)	153 (56.0)	0.159	761	61.0
Rural <100,000	156 (37.0)	212 (38.3)	120 (44.0)		488	39.0
Self-reported illness:						
Yes	387 (91.7)	500 (90.2)	238 (87.2)	0.503	1125	90.1
No	35 (8.3)	54 (9.8)	35 (12.8)		124	9.9
Smoking:						
Yes	146 (34.6)	143 (25.8)	75 (27.5)	0.009*	364	29.1
No	276 (65.4)	411 (74.2)	198 (72.5)		885	70.9
Alcohol drinking:						
Yes	257 (60.9)	329 (59.4)	159 (58.2)	0.773	745	59.6
No	165 (39.1)	225 (40.6)	114 (41.8)		503	40.4
Self-reported physical activity:						
No	137 (32.5)	174 (31.4)	119 (43.6)	<0.001*	430	34.4
Yes, 1 time/week	72 (17.1)	129 (23.3)	54 (19.8)		255	20.4
Yes, 2 times/week	95 (22.5)	133 (24.0)	39 (14.3)		267	21.4
Yes, 3 or more times/week	118 (28.0)	118 (21.3)	61 (22.3)		297	23.8
Self-reported healthy eating:						
No	100 (23.7)	171 (30.9)	110 (40.3)	<0.001*	381	30.5
Yes	322 (76.3)	383 (69.1)	163 (59.7)		868	69.5

*Significant difference between groups according to body mass index category

Table 3. Spearman rank correlation between factors and body mass index

	Body mass index
Blood type	-0.01
Age	0.29*
Gender	-0.23*
Education	-0.14*
Employment	0.12*
Sedentary occupation	0.09*
Marital status	0.17
Place of residence	0.06
Illness	0.04
Smoking/drinking	-0.05
Physical activity	0.16
Self-reported healthy eating	-0.13*

*Factors significant at p<0.050

Table 4. Logistic regression model for normal body mass index in blood donors

Factor (referee)	OR	95% CI	p
Age (18-30 years)	2.5	1.74-2.42	<0.001*
Gender (men)	0.21	0.16-0.30	<0.001*
Education (low)	0.77	0.67-0.89	<0.001*
Employment (unemployed)	1.85	1.37-2.50	<0.001*
Healthy eating (no)	0.56	0.42-0.76	<0.001*

OR = odds ratio; 95% CI = 95% confidence interval; *factors significant at p<0.050

was significantly higher than the number of those with normal BMI (p<0.001). There was no difference in BMI between participants with undergraduate and primary school education (p>0.050). Among unemployed participants, the number of participants with normal BMI was significantly higher than that of overweight and obese participants (p<0.050). In contrast, among employed participants, the number of overweight and obese participants was significantly higher than that of participants with normal BMI (p<0.001). Among single participants, the number of participants with normal BMI was significantly higher than that of overweight or obese participants (p>0.001), whereas among married participants, the number of obese participants was significantly higher than that of overweight participants or those with normal BMI (p<0.001 both). Among non-smokers, the number of overweight participants was significantly higher than that of participants with normal BMI (p<0.004), whereas among smokers, the number of participants with normal BMI was significantly higher than that of overweight participants (p=0.004). Among participants reporting no physical activity, the number of obese participants (43.6%) was significantly higher than that of participants with normal BMI (p=0.004). In addition, among participants who were physically active twice a week, the proportion of participants with normal BMI was greater than that of obese participants (p=0.010). Participants with normal BMI evaluated their nutritional habits as healthy more often than overweight and obese participants did (p<0.010 all). Overweight participants also evaluated their nutritional habits as healthy more often than obese participants did (p=0.009). No significant differences in BMI were found according to different blood types (p=0.631), place of residence (p=0.159), illness (p=0.503), or alcohol consumption (p=0.773) (Table 2). In addition, no significant difference in nutritional habit frequencies was found between participants with different BMI (p>0.05 all).

Spearman rank correlations of other factors to BMI were significant, but low (r<0.20) to moderate (r=0.20-0.40) (Table 3). The results of logistic regression analysis revealed that younger and unemployed participants had a higher frequency of normal (OR 2.05) or underweight BMI (OR 1.85), whereas male sex (OR=0.21), lower education level (OR=0.77), and self-reported lack of healthy eating (OR=0.57) were correlated with overweight and obese BMI (Table 4).

Discussion

To our knowledge, this is the first study to analyze data on the socio-demographic status, baseline characteristics, and eating habits of blood donors in Primorje-Gorski Kotar County, Croatia, and the association of these factors with BMI. The overall prevalence rate of underweight was 0.5%, normal BMI 33.6%, overweight 44.1%, and obesity 21.8%. In a study of overweight and obesity in the 16 European countries including Croatia, Gallus *et al*. report on the 21.5% prevalence of obesity in Croatia, which was similar to the results of the present study[11]. The study conducted by Murphy *et al*. in healthy blood donors showed that the

prevalence rates of overweight were 41% and 31%, and of obesity 29% and 26% in men and women, respectively, which was similar to our findings[13]. In addition, men had a higher average BMI than women did, and the distribution of BMI in both sexes was age-dependent, as confirmed in our study. In the present study, we found lower prevalence rates of overweight and obesity compared to those reported in a large study by Ng *et al*.[1]. That study, which was conducted on the global, regional and national levels from 1980 to 2013, found a higher incidence of overweight and obesity in comparison to our study. The discrepancies in these findings may be attributed to the fact that Croatia is currently going through economic and social changes, with consequential changes in eating habits. Moreover, the influence of the Mediterranean diet could be a reason for the lower prevalence of overweight and obesity found in the present study. Our study participants were residents of Primorje-Gorski Kotar County, which is in the Mediterranean region of Croatia, and no other Croatian counties were included.

Between-group analyses showed differences in age, sex, level of education, employment status, marital status, smoking, physical activity, and healthy eating among different BMI categories.

Younger participants (18-30 years) had a significantly lower BMI than older participants did. These results are consistent with those reported by Gallus *et al*. and Aminde *et al*.[11,14]. Gallus *et al*. also found the prevalence of obesity to increase significantly with age and decrease with education level[11], which is consistent with our results. In the present study, the level of education was inversely proportional to BMI. According to Kenkel, education allows people to choose a healthy lifestyle by improving their knowledge of health behavior[15].

The present study revealed that married participants had a significantly higher prevalence of obesity than single participants did. Consistent with this finding, some previous studies found that older age, being married, low levels of education, and physical inactivity were potential determinants of overweight and obesity[13-17].

The proportion of female blood donors in our study was slightly higher than that recorded in the 2011 WHO Report, which indicated that 17.2% of blood donors in Croatia were women. (World Health Organization: Gender distribution of blood donors, by country)[18-21]. In addition, our findings regarding the prevalence of blood groups were consistent with the findings of previous studies in the Croatian population, as follows: A (41.5% *vs*. 41%), 0 (37.8% *vs*. 39%), B (15.0% *vs*. 15%), and AB (5.6% *vs*. 5%)[22,23].

Data on the effects of smoking on body weight consistently indicate that smokers have a lower body weight than non-smokers do[24]. In our study, the prevalence of obesity among non-smokers was significantly higher than among smokers. In addition, among non-smokers, the number of overweight participants was significantly higher than that of participants with normal BMI; among smokers, the number of participants with normal BMI was significantly higher than that of overweight participants. However, smoking cannot be used for controlling body weight because of its myriad negative effects on health[24,25.]

The results of the present study revealed that obese participants were not physically active as overweight participants and those with normal BMI were[26]. Furthermore, the frequency of self-reported unhealthy eating in obese subjects was significantly greater than that among participants with normal BMI or those who were overweight. Conversely, participants with normal BMI reported healthier nutritional habits than overweight and obese participants did[26, 27]. Romo-Perez *et al*. found that regular walking in adults was associated with better positive self-rated health and better BMI profile[28]. Thus, it is essential to improve the health and lifestyle habits of the general population, increase physical activity levels, and make education available across all age boundaries. BMI is largely dependent on the presence or absence of physical activity, but the frequency of physical activity is also an important factor affecting BMI[27-31].

Logistic regression analysis revealed that factors associated with the prevalence of different BMIs were age, sex, education level, employment status, and healthy eating. Higher BMI was associated with older age, male sex, lower education level, unemployment, and lack of healthy eating. However, because younger participants are more likely to be unemployed, employment status could be a covariate for BMI. Future studies should investigate this correlation further.

This study had some limitations. Several measures used in this study were self-reported, such as body weight, height, waist circumference, nutritional habits, illness, physical activity, and healthy eating; thus, these

data were subject to recall bias, and validity and reliability issues. Moreover, the questionnaire included year of birth and age instead of the exact date of birth. Despite these limitations, the primary strength of this study was that it included data from a very large sample of blood donors. This made it possible to analyze differences and correlations between subgroups, and to achieve statistically reliable data. Future studies should investigate individuals from all Croatian counties, and include eating and dietary habits, as well as socioeconomic status indicators such as income. The results of this study reveal high-risk target groups that need to be additionally educated in order to prevent overweight and obesity, to raise awareness of healthy eating, and to emphasize the relationship between higher BMI and diseases, especially cardiovascular and endocrine diseases.

Conclusion

To our knowledge, this is the first study to investigate the prevalence of BMI in a healthy Croatian population; our results confirm the findings of studies conducted in other European countries. The higher prevalence of overweight or obesity in men than in women is consistent with earlier findings in Europe, indicating the need of change and development of strategies to reduce obesity and promote healthier eating habits and regular physical activity. Our results evidence the importance of education and increased awareness of healthy nutrition habits in high-risk target groups, i.e. men and older adults with lower education levels.

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Sažetak

JESU LI HRVATSKI DAVATELJI KRVI PRETILI?

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Sve veća učestalost pretilosti predstavlja pandemiju modernog doba. Svrha ovoga istraživanja bila je analiza učestalosti prekomjerne tjelesne težine i pretilosti u zdravih darivatelja krvi kao dijela zdrave populacije u Primorsko-goranskoj županiji, Hrvatska. Analiziran je utjecaj i povezanost socio-demografskih čimbenika, načina života, prehrambenih navika s indeksom tjelesne mase (ITM), prekomjernom težinom i pretilošću. Presječnim istraživanjem ispitano je 1255 zdravih osoba u dobi od 18 do 70 godina koje su darivale krv u razdoblju od siječnja 2015. do listopada 2016. u Kliničkom zavodu za transfuzijsku medicinu. Svaki sudionik ispunio je upitnik s podatcima o vlastitoj težini, visini, krvnoj grupi, socio-demografskim podatcima, pokazateljima zdravstvenog stanja, fizičkoj aktivnosti, konzumaciji alkohola i navikama pušenja. ITM od 25-29,9 kg/m^2 definiran je kao prekomjerna težina, a ITM ≥30 kg/m^2 kao pretilost. Za procjenu podataka korišten je logistički regresijski model. Normalan ITM imalo je 33,6% sudionika, 44,1% ispitanika je imalo prekomjernu težinu, a 21,8% je bilo pretilo. Visoki ITM bio je povezan s muškim spolom (omjer vjerojatnosti [OR]=0,21), nižom razinom obrazovanja (OR=0,77) i nezdravom prehranom (OR=0,57), dok je niži ITM bio povezan s nižom dobi (OR=2,05) i nezaposlenošću (OR=1,85). Prema našim saznanjima, ovo je prva studija koja istražuje učestalost ITM u zdravoj hrvatskoj populaciji; naši rezultati potvrđuju rezultate istraživanja provedenih u drugim europskim zemljama. Rezultati ovoga istraživanja naglašavaju važnost obrazovanja i podizanja svijesti o zdravim prehrambenim navikama, naročito u skupinama visokog rizika, tj. kod muškaraca i starijih osoba s nižim stupnjem obrazovanja.

Ključne riječi: *Dobrovoljni davatelji krvi; Indeks tjelesne mase; Pretilost; Prekomjerna tjelesna težina; Učestalost*