Skipping meals and frequency of snack consumption are important eating behaviours related to obesity in hospital employees

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ABSTRACT

Obesity is an epidemic nutritional disease caused mainly by excessive dietary intake and/or insufficient exercise. The purpose of this study was to investigate associations between a number of demographic characteristics and eating habits with prevalence of overweight and obesity in hospital employees. The study was cross-sectional performed on employees of Namazi Hospital in Shiraz, Iran. Subjects were selected from different departments of the hospital. Demographic characteristics, eating habits, and exercise were questioned by interview. Overweight and obesity was defined as a body mass index $\geq$ 25 kg/m^2. The rate of overweight/obesity was 30.2%. Among demographic characteristics, only age (OR=5.6 for older ages, p=0.001) and sex (OR=0.4 for females, p=0.04) were significantly associated with overweight/obesity. Skipping breakfast was not associated with overweight/obesity, but skipping meals (OR=2.8, p=0.08) and consuming $\geq$ 3 snacks per day (OR=0.2, p=0.05) had associations with it, although non-significantly. Performing $\geq$ 60 min/day (but not $\geq$ 45 min/day) exercise was associated with a lower risk of overweight/obesity (OR=0.1, p=0.01). The association between exercise and overweight/obesity existed in both sexes, but the association between skipping meals and obesity was present only in females (OR=3.8, p=0.05). Females skipped meals especially breakfast more frequently than males (p=0.001) but snack consumption and exercise was not statistically different between the two sexes. Eating 3 meals and at least 3 snacks per day and performing 1 hour or more exercise may be introduced as helpful strategies in prevention of obesity.

Key words: skipping meal; snacks; eating habits; exercise; employees; obesity

INTRODUCTION

Obesity is the most rapidly increasing metabolic disorder worldwide [1]. According to the latest investigations, the prevalence of overweight and obesity has estimated 49.9% among Iranian adults [2] and 56.8% among adults in Shiraz [3]. Obesity has been recognized as a risk factor for chronic diseases, including cardiovascular diseases and type 2 diabetes [4]. In addition to physical-related health effects, obesity may be associated with mental and psychological distress [5] which can affect quality of life, social activities, and work productivity [6]. In the last decades, the shape of life has enormously changed. Nowadays, most jobs are sedentary. People spend long hours at work and so get less time to exercise or to take care of their diet [7, 8]. Depending on the type of work and also workload, the extent to which employees follow recommendations of healthy diet and physical activity may be different.

In hospitals, staffs are engaged in two main types of job: medical and non-medical occupations. Due to the content of their education, those in medical and paramedical jobs are supposed to have adequate information about the risk of obesity and preventive strategies against it. On the other hand, employees in non-medical occupations are educated in non-medical disciplines or have lower educational levels. These employees usually obtain health-related information through conversations with colleagues and are incited to follow healthful recommendations because of day to day confronting patients and illnesses. We hypothesized that the prevalence of overweight and obesity are lower in hospital employees than that in general population.

In the present study we evaluated the frequency of overweight and obesity among hospital employees and explored whether eating habits and exercise patterns can be important factors in the risk of obesity in this subject category.

METHODS

Subjects

The study was cross-sectional conducted on 109 employees of Namazi Hospital in Shiraz. The subjects were selected by stratified random sampling from different departments of the hospital. Subjects were employed either in medical and paramedical professions, such as nurses and doctors, or in non-medical occupations, such as secretors, laboratory technicians, and official and financial employees. Inclusion criteria were the consent to participate and the absence of diseases which largely affect diet, such as hypo- or hyper-thyroidism, liver or renal failure, severe anorexia, cancer, and gastroenteritis.

The protocol of the study was approved by the Ethics Committee of Shiraz University of Medical Sciences. Informed consent was obtained from the participants before their participation in the study. All information was kept confidential and used for research purposes only.

Data collection

Information was gathered by a trained interviewer. A questionnaire was filled to collect demographic characteristics, eating habits, and the rate of exercise. The eating habits which were questioned included: frequencies of consuming meals in general and breakfast in particular, frequency of snack consumption, and the type of snacks. The snack was defined as everything that was eaten between meals except for coffee and tea. Questions of eating habits were similar to "how many meals do you consume every day?", "how many times during the day and night do you consume foods and drinks (except for coffee and tea) between meals?", "how many breakfasts do you consume in a week?", and "what sort of snacks do you usually consume, including 1) sweets, cakes, biscuits, etc; 2) Nuts; 3) fresh or dried fruits; and 4) dairy such as milk and yoghurt?". For evaluation of exercise pattern, the participants were asked if they exercised < 30 min/day, 30 to < 45 min/day, 45 to < 60 min/day, or ≥ 60 min/day. The exercise was defined as performing at least 10 min ceaseless walking or other forms of exercises [9].

Weight was measured with minimal clothing to the nearest 0.1 kg (Seca, Germany) and height was assessed without shoes to the nearest 0.1 cm using a non-stretchable tape fixed on a wall. Body mass index (BMI) was calculated by dividing the weight in kilogram by the height squared in meters. BMI was classified according to the World Health Organization classification: underweight: < 18.5 kg/m^2; normal: 18.5-24.9 kg/m^2; overweight: 25-29.9 kg/m^2; Obese: ≥ 30 kg/m^2 [10].

Statistical analysis

Data were analyzed by the SPSS software, version 16. Data was presented as the Mean ± SD or as the frequency and percentage. Univariate and multivariate logistic regression analyses were used to calculate the effect of each parameter in the prediction of BMI. Chi-square test was used to compare eating habits between two sexes. Statistical significance was set at $p < 0.05$. The independent variables were entered dichotomously in the regression. Age was divided as "< 30" and "≥ 30" years, education as "< BSc" and "≥ BSc", occupation as "medical and paramedical" and "others", breakfast frequency as "< 5" and "≥ 5" days per week, meal skipping as "1 or 2" meals skipped per day and "No skipping", snack frequency as "< 3" and "≥ 3" snacks per day, and exercise once as "< 45" and as "≥ 45" min per day and the other time as"< 60" and "≥ 60" min per day. The dietary habits or exercise were dichotomously presented because this way compares correct versus incorrect dietary habits and sufficient versus insufficient exercise more appropriately.

The cutoff point for breakfast was set at "5" to ensure comparing consuming breakfast for most of the week days against consuming it for a lesser part of the week. For meal skipping, consuming 3 meals per day (no skipping) was compared with skipping 1 or 2 meals per day. The cutoff point for snack frequency was set at 3 because consuming 1-2 snacks per day is more common than consuming ≥ 3 snacks and so consuming ≥ 3 snacks per day was considered as frequent snacking.

The cutoff point of 45 min of moderate-intensity exercise was chosen according to the guidelines of the US Department of Health and Human Services, which suggest adults should do 150-300 min per week moderate-intensity aerobic physical activity (equal to 45 min/day) [9]. However, because a minimum of 60 min moderate-intensity physical activity per day is probably needed to avoid or limit weight regain in formerly overweight or obese individuals [11], we also expressed results using 60 min as the cutoff point.

RESULTS

The age range of participants was 22 to 55 years, with an average of 32.5 ± 6.9 years. Most of the subjects were females, married, and under forties. The distribution of participants in different BMI categories has been displayed in Table 1. The rate of underweight, overweight, and obesity was 3.7, 28.4, and 1.8 percent, respectively. Females generally possessed lower BMI than males ($p<0.001$) and more males were found in overweight and obese categories than females.

Table 2 demonstrates the contribution of demographic characteristics, eating habits, and exercise to BMI of the participants. Age and sex were important factors in the prediction of BMI (OR=5.6 and 0.2, respectively, p=0.001) and the effect of sex remained persistent after adjustment for age (OR=0.4, p=0.04).

Marital status and occupation were also non-significantly associated with BMI in unadjusted model, but not after adjustment for age. Among eating habits, the frequency of consuming breakfast was not associated with BMI, but for meal skipping the association was close to statistical significance after adjusting for age and sex (OR=2.8, p=0.08). The frequency of consuming snacks was significantly associated with BMI even after adjusting for age (OR=0.2, p=0.04) but after adding sex in the model, although the OR did not change, the p value of the association moved to over the arbitrary threshold for significance (OR=0.2, p=0.054). Also, snack consumption was important in the crude model, i.e. those who consumed dairy and nuts as snacks had significantly lower BMI compared to those who consumed fruits (OR=0.3, p=0.03).

However, after doing adjustments for age and sex this association was faded away. Exercise at the cutoff point of 45 min/day was not significantly associated with BMI (OR=0.4, p=0.1 after adjusting for age and sex), but at the level of ≥ 60 min/day had a negative association with BMI even after adjusting for age and sex (OR=0.1, p=0.01).

Because sex was an important factor in determination of the risk of overweight, the association between overweight and demographic characteristics or eating habits was assessed for each sex using the age as the covariate (Table 3). None of demographic characteristics had significant associations with overweight and obesity in either sex. Nonetheless, marital status and education had stronger associations with overweight and obesity in females and the type of occupation was more importantly relevant to obesity in males.

Meal skipping was associated with higher risk of obesity in females (p=0.05) but not males. The frequencies of consuming breakfast and snacks had similar associations with obesity in the two sexes and both were negatively associated with obesity. Activity, especially at ≥ 60 min/day, was significantly associated with lower rate of obesity in both sexes, particularly women.

Table 1. Distribution of the study subject in different BMI categories

BMI categories (kg/m^2)	**N (%)**		
	Male	Female	Total
< 18.5	0	4 (6.0) [1]	4 (3.7)
18.5-24.9	21 (50)	52 (76.1)	73 (66.1)
25-29.9	20 (47.6)	11 (16.4)	31 (28.4)
≥ 30	1 (2.4)	1 (1.5)	2 (1.8)

[1] Percentages were separately calculated for each sex.

Table 2. Descriptive analysis of BMI in different demographic and eating habit categories and logistic regression analysis of the demographic characteristics and eating habits in prediction of overweight and obesity

Parameters	N (%)	BMI[1]	OR (95% CI)[2]		
			Unadjusted model	Model 1	Model 2
Age					
< 30	43 (39.4)	22.0 ± 2.8	1.0		
≥ 30	66 (60.6)	24.1 ± 3.3	5.6 (2.0-16.0)		
p value			0.001		
Sex					
Male	42 (38.5)	25.0 ± 3.2	1.0	1.0	
Female	67 (61.5)	22.2 ± 2.8	0.2 (0.09, 0.5)	0.4 (0.1, 0.9)	
p value			0.001	0.04	
Marital status					
Single	19 (17.6)	21.6 ± 2.3	1.0	1.0	1.0
Married	89 (82.4)	23.7 ± 3.4	4.5 (1.0, 21.0)	1.9 (0.4, 10.0)	1.8 (0.3, 9.3)
p value			0.05	0.4	0.5
Education					
< BSc	40 (36.7)	24.1 ± 2.9	1.0	1.0	1.0
≥ BSc	69 (63.3)	22.8 ± 3.4	0.5 (0.2, 1.2)	0.7 (0.3, 1.8)	0.7 (0.3, 1.8)
p value			0.1	0.4	0.4
Occupation					
Paramedics	25 (22.9)	22.1 ± 2.7	1.0	1.0	1.0
Others	84 (77.1)	23.6 ± 3.4	2.8 (0.9, 9.0)	1.4 (0.4, 1.8)	1.2 (0.3, 4.3)
p value			0.08	0.6	0.8
Breakfast frequency (/week)					
< 5	26 (23.9)	23.1 ± 3.1	1.0	1.0	1.0
≥ 5	83 (76.1)	23.4 ± 3.3	1.2 (0.5, 3.3)	0.8 (0.3, 2.4)	0.5 (0.2, 1.7)
p value			0.7	0.7	0.3
Meal Skipping (/day)					
No skipping	77 (70.6)	23.1 ± 3.0	1.0	1.0	1.0
1 or 2	32 (29.4)	23.7 ± 3.8	1.3 (0.5 3.2)	1.6 (0.6 4.0)	2.8 (0.9 8.6)
p value			0.6	0.4	0.08
Snack frequency (/day)					
< 3	82 (75.2)	23.8 ± 3.4	1.0	1.0	1.0
≥ 3	27 (24.8)	21.9 ± 2.3	0.2 (0.06, 0.8)	0.2 (0.06, 0.96)	0.2 (0.06, 1.0)
p value			0.02	0.04	0.05
Snack type					
Fruits	63 (61.8)	23.7 ± 3.6	1.0	1.0	1.0
Dairy, nuts	36 (35.3)	22.3 ± 2.4	0.3 (0.1 0.9)	0.4 (0.1 1.2)	0.4 (0.1 1.2)
Sweets	3 (2.9)	24.1 ± 5.0	3.7 (0.3 43.4)	6.1 (0.5 81.8)	6.4 (0.5 87.2)
p value[1] p value[2]			0.03 0.3	0.09 0.2	0.1 0.2
Exercise (min/day)					
< 45	72 (66.1)	23.3 ± 3.8	1.0	1.0	1.0
≥ 45	37 (33.9)	23.3 ± 1.9	0.6 (0.3, 1.6)	0.6 (0.2, 1.5)	0.4 (0.2, 1.3)
p value			0.3	0.2	0.1
< 60	85 (78)	23.4 ± 3.6	1.0	1.0	1.0
≥ 60	24 (22)	22.8 ± 1.7	0.2 (0.04, 0.7)	0.1 (0.02, 0.8)	0.1 (0.02, 0.6)
p value			**0.02**	**0.02**	**0.01**

[1] BMI is presented as means ± SD.
[2] Model 1 was adjusted for age, and model 2 was adjusted for age and sex.

Table 3. Logistic regression analysis of the demographic characteristics and eating habits of each sex in the prediction of overweight and obesity[1]

Parameters	Males		Females	
	N/N (%)[2]	OR (95% CI)	N/N (%)	OR (95% CI)
Marital status				
Single	1/3 (33.3)	1.0	1/16 (6.3)	1.0
Married	20/39 (51.3)	0.7 (0.05, 1.7)	11/50 (22.0)	2.9 (0.3, 26.7)
p value		0.8		0.3
Education				
< BSc	10/19 (52.6)	1.0	6/21 (28.6)	1.0
≥ BSc	11/23 (47.8)	0.9 (0.3, 3.4)	6/46 (13.0)	0.5 (0.1, 1.8)
p value		0.9		0.3
Occupation				
Paramedics	1/4 (25.0)	1.0	3/21 (14.3)	1.0
Others	20/38 (52.6)	2.0 (0.2, 22.5)	9/46 (19.6)	1.0 (0.2, 4.6)
p value		0.6		1.0
Breakfast frequency (/week)				
< 5	2/3 (66.7)	1.0	5/23 (21.7)	1.0
≥ 5	19/39 (48.7)	0.3 (0.02, 5.0)	7/44 (15.9)	0.6 (0.2, 2.2)
p value		0.4		0.4
Meal skipping (/day)				
No skipping	18/37 (48.7)	1.0	4/40 (10.0)	1.0
1 or 2	3/5 (60.0)	1.2 (0.1 9.5)	8/27 (29.6)	3.8 (0.99 14.8)
p value		0.9		0.05
Snack frequency (/day)				
< 3	19/35 (54.3)	1.0	11/47 (23.4)	1.0
≥ 3	2/7 (28.6)	0.2 (0.03, 1.9)	1/20 (5.0)	0.2 (0.02, 1.8)
p value		0.2		0.2
Exercise (min/day)				
< 45	13/24 (54.2)	1.0	11/48 (22.9)	1.0
≥ 45	8/18 (44.4)	0.6 (0.2, 2.3)	1/19 (5.3)	0.2 (0.02, 1.8)
p value		0.5		0.2
< 60	19/32 (59.4)	1.0	12/53 (22.6)	1.0
≥ 60	2/10 (20.0)	0.1 (0.02, 1.0)	0/14 (0)	< 0.001
p value		0.05		NA

[1] Age was controlled in the analysis.
[2] Number of participants with overweight and obesity/total number of participants in the category e.g., single males. (%) indicates the percentage of overweight and obese participants in the category.

Table 4. Distribution of participants in different eating habit and exercise categories

Parameters	N (%)	
	Males	Females
Breakfast frequency (/week)		
< 5	3 (7.1)	23 (34.3)
≥ 5	39 (92.9)	44 (65.7)
p value[1]	0.001	
Meal skipping (/day)		
No skipping	37 (88.1)	40 (59.7)
1 or 2	5 (11.9)	27 (40.3)
p value[1]	0.001	
Snack frequency (/day)		
< 3	35 (83.3)	47 (70.1)
≥ 3	7 (16.7)	20 (29.9)
p value	0.1	
Activity (min/day)		
< 60	32 (76.2)	53 (79.1)
≥ 60	10 (23.8)	14 (20.9)
p value	0.7	

[1] p value for the difference between males and females as evaluated by chi-square test.

We also compared eating habits of males and females (Table 4). More males were used to eating 3 meals a day and eating breakfast (p=0.001 for the difference between sexes), whereas more females were used to snacking (eating ≥ 3 snacks/day) (p=0.1). There was no difference between two sexes regarding exercise.

DISCUSSION

In this study we explored the prevalence of overweight and obesity in employees of a hospital in Shiraz and investigated the association between overweight and obesity with a number of eating habits and exercise. The results showed that the rate of overweight and obesity was as high as 30%. Other investigations have shown higher rates of overweight and obesity in Iranian adult

population. For instance, in a previous study in Shiraz, the prevalence of overweight and obesity among 2282 adults aged 25-55 years was 56.8% [3]. Also, the prevalence of overweight and obesity among 89404 Iranian adults aged 15-65 years was 49.9 [2]. The reason of difference in these rates is probably the age of the participants. Age is very important factor in determining BMI (as shown in our results). In the current study 87.3% of participants aged less than 40 years while participants of the aforementioned investigations were in relatively older ages.

Due to the location of their job, hospital staffs especially those in paramedic professions or in higher academic educations are expected to have lower rates of overweight and obesity compared to other people. However, the high prevalence of overweight and obesity observed in the present study indicates that working in a hospital is not a strong factor to stimulate individuals to effectively control their weight and the type of job or the level of education are not prohibiting factors either. Similar findings from previous studies also indicate high prevalence of overweight and obesity in hospital workers [12], physicians [13], and academics [14].

Females generally possessed lower BMI than males and males were more frequently in overweight and obese categories compared to females. Although due to pregnancies females are at increased risk of obesity [15], males generally have a higher prevalence of overweight [16], even though the association between sex and overweight largely depends on the region [17]. The higher rate of overweight and obesity in male employees of this study are in line with previous investigations conducted on similar study subjects. For instance, in a group of hospital consultants, females exerted better weight management than males and males were involved in overweight and obesity more frequently than females [18]. Also, in a hospital in Italy men had higher rate of overweight compared to women [19].

The lower rate of overweight and obesity in women is probably the result of their concept and attitude towards weight and body image. Women are more concerned about food and eating with respect to weight and health issues [20]. Accordingly, BMI has a stronger influence on women's body image than men's [21]. Moreover, men are more satisfied with their body [21, 22], while women usually like to be slimmer than their actual body image [23]. Hence, women are more likely to use weight control strategies than men [24].

Males and females demonstrated differences in eating habits. Females skipped meals more than males (40.3% compared to 11.9%), with breakfast being probably the most skipped meal. Since women are more concerned about their weight and body image (as discussed above), they may conceive that skipping meals can help them to better control their weight. According to results presented here, skipping meals including breakfast is unlikely to be associated with a lower risk of overweight and obesity but contrarily with a higher risk especially among women (OR=0.4, p=0.08 for the whole population and OR=0.3, p=0.05 for women). Previous studies have also shown that skipping meals [25], especially breakfast [26, 27], is associated with the higher risk of overweight. More importantly, skipping meals may be associated with accumulation of adipose tissue in visceral areas and increased risk of metabolic diseases [28]. Skipping meals may also have nutritional consequences. For instance, diet quality was compromised in adolescents who skipped breakfast [29].

Females also consumed snacks more frequently than males although the difference between the two sexes was not statistically significant (p=0.1). Frequent snacking in females may be a consequence of skipping meals. Skipping meals usually compel individuals to snack repeatedly in order to repress their hunger [30]. Our results showed that frequent snacking was almost significantly associated with a lower risk of overweight and obesity (OR=0.2, p=0.054). There are studies concordant with ours, demonstrating a negative association between frequent snacking and overweight [31], especially among children and adolescents [32, 33]. However, there are also studies reporting a positive relationship between snacking and weight gain [34]. On the other hand, some reviews on this issue have declared that no association exists between snack frequency and either BMI or overweight [35] or between eating frequency and weight in either weight loss or weight maintenance interventions [36].

The cause of controversies is likely the lack of a universal definition for the snacking and the multifactorial nature of obesity which makes extracting a clear and factual conclusion on the issue difficult [37, 38]. Nevertheless, what makes the difference in the effect of snacking on weight is probably the amount of energy provided by snacks [39] and the compensation (if any) which is made in the energy intake by subsequent meals and snacks [40, 41].

As most of the participants (91.9%) consumed breakfast we could not assess the association between consuming breakfast and BMI, but did assess the association between breakfast frequency and overweight and did not observe a relationship. Other investigators found an inverse association between breakfast consumption and the risk of weight gain in middle-aged and older adults with normal BMI [42] and in children and adolescents [43]. In overweight and obese individuals the results may be different as Dhurandhar et al. [44] found no effect from either eating or skipping breakfast on their weight loss in a randomized controlled trial [44]. Similar to breakfast frequency, skipping meals did not show significant association with overweight; however, after adjusting for age and sex those who skipped 1 or 2 meals per day were more likely to have overweight compared to those who did not skipped meals and consumed 3 meals per day ($p=0.08$). Performing at least 1 hour exercise per day was associated with lower risk of overweight ($p<0.05$) and the relationship remained significant after performing adjustments for age and sex. According to the guidelines of the US Department of Health and Human Services, adults should perform at least 150-300 min a week of moderate-intensity aerobic physical activity [9]. At such a level of physical activity we did not find a significant association with overweight and obesity but at ≥ 60 min/day physical activity was significantly associated with the lower rate of overweight in the whole population and also in each sex. This higher than recommended level of physical activity may be required to prevent weight regain in formerly overweight or obese individuals [45, 46].

CONCLUSION

According to findings presented here, possessing academic education does not guarantee prevention of obesity. More effective educational strategies should be used in schools' and universities' curriculums. Also, periodic educational programs are needed to strengthen staffs' knowledge on nutritional and healthy lifestyle principles. In this study low sample size was a limitation. Also our study lacked estimation of energy intake of participants.

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REFERENCES

1. Bray GA, Bellanger T. Epidemiology, trends, and morbidities of obesity and the metabolic syndrome. Endocrine. 2006;29:109-17.

2. Janghorbani M, Amini M, Willett WC, Mehdi Gouya M, Delavari A, Alikhani S, Mahdavi A. First nationwide survey of prevalence of overweight, underweight, and abdominal obesity in Iranian adults. Obesity (Silver Spring). 2007;15(11):2797-808.

3. Ayatollahi SM, Ghoreshizadeh Z. Prevalence of obesity and overweight among adults in Iran. Obes Rev. 2010;11(5):335-7.

4. Marinou K, Tousoulis D, Antonopoulos AS, Stefanadi E, Stefanadis C. Obesity and cardiovascular disease: from pathophysiology to risk stratification. Int J Cardiol. 2010;138:3-8.

5. Jagielski AC, Brown A, Hosseini-Araghi M, Thomas GN, Taheri S. The association between adiposity, mental well-being, and quality of life in extreme obesity. PLoS One. 2014;9(3):e92859.

6. Cash SW, Beresford SA, Henderson JA, McTiernan A, Xiao L, Wang CY, Patrick DL. Dietary and physical activity behaviours related to obesity-specific quality of life and work productivity: baseline results from a worksite trial. Br J Nutr. 2012;108(6):1134-42.

7. Heikkilä K, Fransson EI, Nyberg ST, Zins M, Westerlund H, Westerholm P, et al. Job strain and health-related lifestyle: findings from an individual-participant meta-analysis of 118,000 working adults. Am J Public Health. 2013;103:2090-7.
8. Lee WL, Tsai SH, Tsai CW, Lee CY. A study on work stress, stress coping strategies and health promoting lifestyle among district hospital nurses in Taiwan. J Occup Health. 2011;53:377-83.
9. DHHS. Department of Health and Human Services.2008 Physical Activity Guidelines for Americans. Washington DC: Department of Health and Human Services USA; 2008.
10. WHO expert consultation. Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. Lancet. 2004;157-63.
11. Lakka TA, Bouchard C. Physical activity, obesity and cardiovascular diseases. Handb Exp Pharmacol. 2005;(170):137-63.
12. Garrido RA, Semeraro MB, Temesgen SM, Simi MR. Metabolic syndrome and obesity among workers at Kanye Seventh-Day Adventist Hospital, Botswana. S Afr Med J. 2009;99:331-4.
13. Maddah M. Obesity and dyslipidemia among young general physicians in Iran. Int J Cardiol. 2007;118:111-2.
14. Pirinçci E, Rahman S, Durmus B, Açik Y. Prevalence and risk factors of overweight and obesity in Turkish academic staff. Southeast Asian J Trop Med Public Health. 2009;40:1306-14.
15. Satpathy HK, Fleming A, Frey D, Barsoom M, Satpathy C, Khandalavala J. Maternal obesity and pregnancy. Postgrad Med. 2008;120:E01-9.
16. Doak CM, Wijnhoven TM, Schokker DF, Visscher TL, Seidell JC. Age standardization in mapping adult overweight and obesity trends in the WHO European Region. Obes Rev. 2012;13:174-91.
17. Ginter E, Simko V. Adult obesity at the beginning of the 21st century: epidemiology, pathophysiology and health risk. Bratisl Lek Listy. 2008;109:224-30.
18. O'Cathail M, O'Callaghan M. A profile of hospital consultants: the health practices of a cohort of medical professionals. Ir Med J. 2013;106:134-6.
19. Abbate C, Giorgianni C, Munaò F, Beninato G, D'Arrigo G, D'Arrigo P, Brecciaroli R. Evaluation of obesity in healthcare workers. Med Lav. 2006;97:13-9.
20. Rozin P, Bauer R, Catanese D. Food and life, pleasure and worry, among American college students: gender differences and regional similarities. J Pers Soc Psychol. 2003;85:132-41.
21. Algars M, Santtila P, Varjonen M, Witting K, Johansson A, Jern P, Sandnabba NK. The adult body: how age, gender, and body mass index are related to body image. J Aging Health. 2009;21:1112-32.
22. Olmsted MP, McFarlane T. Body weight and body image. BMC Women's Health. 2004;4 Suppl 1:S5.
23. Cheung YT, Lee AM, Ho SY, Li ET, Lam TH, Fan SY, Yip PS. Who wants a slimmer body? The relationship between body weight status, education level and body shape dissatisfaction among young adults in Hong Kong. BMC Public Health. 2011;11:835.
24. Aina Mardiah B, Hazizi A, Nasir MM, Zaitun Y, Jan JH. Gender differences in the attitude and strategy towards weight control among government employees in Penang, Malaysia. Iran J Public Health. 2012;41:28-36.
25. Stea TH, Vik FN, Bere E, Svendsen MV, Oellingrath IM. Meal pattern among Norwegian primary-school children and longitudinal associations between meal skipping and weight status. Public Health Nutr. 2014:1-6.
26. Dubois L, Girard M, Potvin Kent M, Farmer A, Tatone-Tokuda F. Breakfast skipping is associated with differences in meal patterns, macronutrient intakes and overweight among pre-school children. Public Health Nutr. 2009;12:19-28.
27. McCrory MA. Meal skipping and variables related to energy balance in adults: A brief review, with emphasis on the breakfast meal. Physiol Behav. 2014;134:51-4.
28. House BT, Cook LT, Gyllenhammer LE, Schraw JM, Goran MI, Spruijt-Metz D, et al. Meal skipping linked to increased visceral adipose tissue and triglycerides in overweight minority youth. Obesity (Silver Spring). 2014;22:E77-84.
29. Woodruff SJ, Hanning RM, Lambraki I, Storey KE, McCargar L. Healthy Eating

Index-C is compromised among adolescents with body weight concerns, weight loss dieting, and meal skipping. Body Image. 2008;5:404-8.
30. Leidy HJ, Ortinau LC, Douglas SM, Hoertel HA. Beneficial effects of a higher-protein breakfast on the appetitive, hormonal, and neural signals controlling energy intake regulation in overweight/obese, "breakfast-skipping," late-adolescent girls. Am J Clin Nutr. 2013;97:677-88.
31. Bachman JL, Phelan S, Wing RR, Raynor HA. Eating frequency is higher in weight loss maintainers and normal-weight individuals than in overweight individuals. J Am Diet Assoc. 2011;111:1730-4.
32. Keast DR, Nicklas TA, O'Neil CE. Snacking is associated with reduced risk of overweight and reduced abdominal obesity in adolescents: National Health and Nutrition Examination Survey (NHANES) 1999-2004. Am J Clin Nutr. 2010;92:428-35.
33. Larson N, Story M. A review of snacking patterns among children and adolescents: what are the implications of snacking for weight status? Child Obes. 2013;9:104-15.
34. Bes-Rastrollo M, Sanchez-Villegas A, Basterra-Gortari FJ, Nunez-Cordoba JM, Toledo E, Serrano-Martinez M. Prospective study of self-reported usual snacking and weight gain in a Mediterranean cohort: the SUN project. Clin Nutr. 2010;29:323-30.
35. Hartmann C, Siegrist M, van der Horst K. Snack frequency: associations with healthy and unhealthy food choices. Public Health Nutr. 2013;16:1487-96.
36. Palmer MA, Capra S, Baines SK. Association between eating frequency, weight, and health. Nutr Rev. 2009;67:379-90.
37. Johnson GH, Anderson GH. Snacking definitions: impact on interpretation of the literature and dietary recommendations. Crit Rev Food Sci Nutr. 2010;50:848-71.
38. Gregori D, Foltran F, Ghidina M, Berchialla P. Understanding the influence of the snack definition on the association between snacking and obesity: a review. Int J Food Sci Nutr. 2011;62:270-5.
39. Bo S, De Carli L, Venco E, Fanzola I, Maiandi M, De Michieli F, et al. Impact of Snacking Pattern on Overweight and Obesity Risk in A Cohort of 11-13-y Adolescents. J Pediatr Gastroenterol Nutr. 2014 Jun 2. [Epub ahead of print]
40. Whybrow S, Mayer C, Kirk TR, Mazlan N, Stubbs RJ. Effects of two weeks' mandatory snack consumption on energy intake and energy balance. Obesity (Silver Spring). 2007;15:673-85.
41. Viskaal-van Dongen M, Kok FJ, de Graaf C. Effects of snack consumption for 8 weeks on energy intake and body weight. Int J Obes (Lond). 2010;34:319-26.
42. van der Heijden AA, Hu FB, Rimm EB, van Dam RM. A prospective study of breakfast consumption and weight gain among U.S. men. Obesity (Silver Spring). 2007;15:2463-9.
43. Szajewska H, Ruszczynski M. Systematic review demonstrating that breakfast consumption influences body weight outcomes in children and adolescents in Europe. Crit Rev Food Sci Nutr. 2010;50:113-9.
44. Dhurandhar EJ, Dawson J, Alcorn A, Larsen LH, Thomas EA, Cardel M, et al. The effectiveness of breakfast recommendations on weight loss: a randomized controlled trial. Am J Clin Nutr. 2014 Jun 4. pii: ajcn.089573. [Epub ahead of print]
45. Lakka TA, Bouchard C. Physical activity, obesity and cardiovascular diseases. Handb Exp Pharmacol. 2005;(170):137-63.
46. Phelan S, Roberts M, Lang W, Wing RR. Empirical evaluation of physical activity recommendations for weight control in women. Med Sci Sports Exerc. 2007;39:1832-6.