

The Importance of the First Mealtime in Prevalence of Overweightness and Obesity Among Female Adolescents in Isfahan

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Received: October 12, 2014; Accepted: October 12, 2014

Background: Previous studies did not consider the importance of the first mealtime on metabolic health.

Objectives: Present study aimed to investigate the association between the first mealtime and obesity among a sample of female students in Isfahan.

Patients and Methods: This cross-sectional study was conducted on 265 female students, aged 11 to 13 years, in Isfahan, by using the systematic random sampling. Anthropometric variables were measured based on standard guidelines. Dietary intakes were evaluated by using validated food frequency questionnaire. Analyses were adjusted for potential confounders.

Results: There was no significant difference in the mean of age, height, physical activity, and blood pressure between those who consumed first meal before and after 9:30 A.M. The mean of BMI and waist circumference were significantly lower in participants who had earlier breakfast consumption than in those with later intake of the first meal ($P < 0.05$). After adjustment for energy, fat, saturated fat, dietary fiber, and physical activity, the prevalence of overweightness, obesity, and central adiposity was lower in those who consumed breakfast earlier ($P < 0.05$).

Conclusions: The prevalence of overweightness, obesity, and central adiposity was lower among earlier breakfast consumers. More investigations especially prospective studies should be conducted to clarify this association.

Keywords: Breakfast; Overweight; Obesity

1. Background

Overweightness and obesity are the major health problems worldwide that might result in several chronic diseases (1). The prevalence of overweight and obesity has been increased during the recent decades, even in developed countries (2). According to the previous reports, the same is true for Iranian adults and adolescents (3, 4). Following the recent investigations, 7.7% of girls in Tehran, who aged six to 12 years old, were obese (4). It may lead to obesity in adulthoods, which might elevate the risk of other chronic diseases (5, 6).

Several factors are related to overweightness and obesity among children and adolescents (7). Genetic and environmental factors are mentioned as important items (8). Among environmental factors, dietary intakes are associated with childhood obesity (9-11). Beside dietary intake, dietary habits are also important in this regard (12-14). Among dietary habits, skipping breakfast is correlated with obesity and overweight (15, 16). Nowadays, the prevalence of breakfast consumption is declined among adolescents and youngsters (17). In Iran, a recent report showed that 52% of young females had never consumed breakfast (18). Meal frequency and eating breakfast play an important role in preventing overweightness and obesity

among children and adolescents (15, 16, 19, 20).

Regular breakfast consumption is inversely associated with diabetes and risk of chronic diseases (21). Skipping breakfast in childhood and adulthood was related to higher values of waist circumference (WC), fasting blood glucose, and serum low density lipoprotein (LDL) and triglyceride (TG) (15, 22). In contrast, eating breakfast might enhance the level of TG despite the increase in quantity of diet (23). On the other hand, the breakfast time duration had an important role in the incidence of overweightness and obesity so that individuals with normal body weight spent more times to eat breakfast (24).

Several studies investigated the association between eating breakfast and body weight, prevalence of the obesity, and chronic diseases. The role of breakfast time and energy density of the first meal as well as quality of this meal has been investigated in several current studies (24, 25). Breakfast consumption is correlated with lower total daily energy intake (25). In addition, spending short time for eating breakfast is associated with lower qualities of breakfast consumption (24). However, the time of meal intake is not considered in the previous studies, which might be important in metabolic health (26).

2. Objectives

We hypothesized that the time of the first meal would play an important role in overweightness and obesity. Therefore, we aimed to evaluate the association between the time of the first meal and overweightness and obesity among a sample of adolescents, in Isfahan, Iran, who ate breakfast.

3. Patients and Methods

3.1. Participants

This cross-sectional study was conducted among 265 female students, who aged 11 to 13 years, in Isfahan, Iran. We randomly selected the students in some regions of city through systematic random sampling. Different regions with different socioeconomic status were included. We randomly chose some schools among the selected regions. We selected the students by the list of students in each school according to a computer based random sequencing program. None of the students adhered to a specific diet. All the students were in the prepubertal stage. No one had known kidney, liver, cardiovascular, respiratory, or thyroid diseases as well as diabetes, hypertension, or allergy. Written informed consent was obtained from all participants and one of her parents. Formula for calculating sample size was described completely in our previous study (27).

3.2. Anthropometric Measurements

Weight was measured without wearing shoes, with light clothes, and in the standing position by the standard scale and was rounded to the nearest 0.1 kg. Height was measured while standing with normal position of shoulder without wearing shoes by the tape measure and was rounded to the nearest 1 cm. body mass index (BMI) was calculated as weight (kg) divided by squared of height (m). WC was measured in narrowest girth after the exhalation and with relaxed abdominal muscles without any pressure by a rigid tape and was rounded to the nearest 0.1 cm. Hip circumference was measured at the maximum level of hip with no pressure to the body surface. We defined overweightness and obesity based on World Health Organization (WHO) guideline. The BMI between of 85 and 95 percentiles and BMI over 95 were considered as overweightness and obesity, respectively.

Systolic and diastolic blood pressure (SBP and DBP, respectively) were measured in duplicate after at least five minutes rest, in sitting position, and with appropriate cuff sizes according to the arm size. Trained technicians measured the SBP by defining it as hearing clear first sound (first Korotkoff phase) and DBP by defining it as disappearance of sound (fifth Korotkoff phase). The average of two BP measurements was recorded and included in the analysis.

3.3. Dietary Assessment

We asked usual dietary intake by using self-administered semi-quantitative food frequency questionnaire (FFQ) which includes 53 food items. To assess the validity of questionnaire, we compared the results of FFQ with intakes estimation from the average of three 24-hour dietary records, which was collected during one weekend and two days in a week. Evaluation of the validity and reliability of FFQ was previously explained (27). We questioned about status of breakfast consumption and the time of the first meal intake. Questions about the breakfast consumption and the content of the breakfast were answered as "yes" or "no". The participants also reported the usual time of first meal intake. Questions about the consumption of breakfast, usual habits in this regard, and the numbers of meals and snacks were asked in pretested questionnaire on meals information.

3.4. Assessment of Other Variables

Data on physical activity (PA) were obtained by writing their activities in three days in the weeks (two working days and one resting day). Finally, we calculated the mean of PA through the following equation:

$$PA_{\text{mean}} = \sum \left(\text{Timeactivity} \times \frac{\text{MET}}{72} \right)$$

Time activity is total time (hour) of each activity within three days (72 hours) and MET is the metabolic equivalent extracted from reference (28).

Additional covariate information regarding the age, sex, history of diseases, and different medication use were asked by questionnaire.

3.5. Statistical Analysis

We categorized demographic characteristics of female students according to the time of breakfast consumption: before 9:30 A.M. and after 9:30 A.M. Independent-samples t-test was performed to examine the differences in the mean of demographic features (e.g. age, BMI, WC, MET, SBP, DBP, and height) between two groups. We reported the results of Chi square test for significant differences of qualitative characteristics. Mean of daily intakes were reported by using independent-samples t-test. We used multivariable logistic regression to determine the association of overweightness, obesity, and central adiposity with the first mealtime. In multivariable logistic regression, we used crude model without adjustment and one additionally adjusted models for several potential confounders (e.g. energy, fat, saturated fat, dietary fiber, and PA). Statistical analysis was performed by using the SPSS 16 for Windows (SPSS Inc., Chicago, IL), and P value < 0.05 was considered as statistically significant.

4. Results

General characteristics of female students according to time of breakfast consumption are shown in Table 1. The mean of BMI of those who consumed breakfast before and after 9:30 A.M. were respectively 17.9 ± 2.33 and 20.51 ± 3.4 kg/m² ($P = 0.0001$) and their WC were respectively 64.96 ± 6.8 and 70.30 ± 9.24 cm ($P = 0.001$). The frequency of overweightness (85th < BMI < 95th percentile) and obesity (BMI > 95th percentile) was significantly lower in participants who consumed first meal before the 9:30 A.M. than in those with later consumption of the first meal (32.5% vs. 67.5%, respectively; $P = 0.0001$). The frequency of central adiposity (WC > 75th) significantly lower in participants who consumed breakfast before 9:30 A.M. (32.5%; $P = 0.01$). There was no significant difference between groups in mean of SBP ($P = 0.06$) and DBP ($P = 0.12$).

Daily energy and nutrients intake according to the first mealtime are shown in Table 2. The mean of energy intake of participants in two groups was 2214.3 ± 919.06 and 2502.5 ± 1005.08 kcal, respectively, which was lower in early breakfast consumption group in a marginally significant level ($P = 0.08$). We reported energy adjusted BMI because of significant different in BMI between two groups. The mean of energy adjusted BMI between two groups was significantly different (0.04). Individuals with early breakfast consumption had lower fat intake, which was marginally significant ($P = 0.05$). The mean of protein, thiamin, vitamin D, and folate intakes was significantly higher in those who consumed first meal before the 9:30 A.M. (P value of 0.04, 0.01, 0.02, and 0.02, respectively). We did not observe any significant differences between the first mealtime and the amount of carbohydrate, fiber, calcium, iron, magnesium, zinc, vitamin A, and vitamin C intake ($P > 0.05$).

Odds ratios (OR) for being overweight and obese according to the time of breakfast consumption are shown in Table 3. Model 1 is a crude model. In model 2, we adjusted for the effects of potential dietary confounders including energy, fiber, saturated fat, and total fat. Other assessed covariate including age, sex, history of diseases, and different medication use were not significantly different between two groups. We collected both overweight and obese subjects in one category. Participants who consumed breakfast later than other group had significantly higher prevalence of overweightness and obesity in both crude model (OR = 2.16; 95% CI, 1.09-3.18; and $P = 0.0001$) and adjusted model (OR = 2.23; 95% CI, 1.11-3.19; and $P = 0.0001$). In addition, we found the significant association between earlier breakfast consumption and lower prevalence of central adiposity after adjustment for potential confounders. Subjects who eat breakfast later than other group had significantly higher WC in both crude model (OR = 2.27; 95% CI, 1.21-3.33; and $P = 0.0001$) and adjusted model (OR = 2.39; 95% CI, 1.28-3.40; $P = 0.0001$).

Table 1. Demographic Characteristics of Female Students According to the Time of Breakfast Consumption^{a, b}

Variables	Group 1 (n = 86) ^c	Group 2 (n = 179) ^d	P Value ^e
Age, y	11.96 ± 1.02	12.24 ± 0.89	0.66
Height, cm	149 ± 7.8	152.2 ± 7.7	0.81
Physical activity, MET h/d	14.04 ± 5.39	13.41 ± 4.93	0.90
85th < BMI < 95th or BMI > 95th, %	32.5	67.5	0.0001
BMI	17.9 ± 2.33	20.51 ± 3.4	0.0001
WC	64.96 ± 6.8	70.30 ± 9.24	0.001
Systolic blood pressure, mmHg	116.01 ± 11.57	115.51 ± 17.61	0.06
Diastolic blood pressure, mmHg	72.36 ± 9.22	72.30 ± 12.73	0.12

^a abbreviations: MET, metabolic equivalent extracted; BMI, body mass index; and WC, waist circumference.

^b Data are presented as Mean ± SD.

^c The participants who eat breakfast before the 9:30 A.M.

^d The participants who eat breakfast after 9:30 A.M.

^e P values are resulted from independent-samples t-test.

Table 2. Daily Energy and Nutrients Resulted by Breakfast Consumption According to the Time of Breakfast Consumption^a

Variables	Group 1 (n = 86) ^b	Group 2 (n = 179) ^c	P Value ^d
Energy, kcal	2214.3 ± 919.06	2505.5 ± 1005.08	0.08
Energy adjusted BMI	2138 ± 838	2396 ± 1043	0.04
Carbohydrate, g	331.00 ± 133.19	363.45 ± 145.97	0.45
Fat, g	71.31 ± 43.00	86.71 ± 45.52	0.05
Protein, g	70.6 ± 31.33	77.68 ± 35.73	0.04
Fiber, g	12.67 ± 4.86	13.00 ± 5.05	0.46
Calcium, mg	1434.1 ± 791.85	1549.8 ± 868.08	0.24
Iron, mg	8.83 ± 3.49	9.52 ± 4.12	0.09
Magnesium, mg	257.67 ± 114.49	286.78 ± 122.92	0.12
Zink, mg	8.66 ± 4.09	9.59 ± 4.47	0.21
Vitamin A, mg	608.74 ± 504.58	628.47 ± 446.91	0.83
Thiamin, mg	1.29 ± 0.49	1.42 ± 0.58	0.01
Cholesterol, mg	176.14 ± 117.48	173.49 ± 100.59	0.39
Vitamin D, mg	2.25 ± 2.33	2.83 ± 2.66	0.02
Folate, mg	213.01 ± 91.94	237.56 ± 101.81	0.02
Vitamin C, mg	49.69 ± 57.40	55.24 ± 51.66	0.64

^a Data are presented as Mean ± SD.

^b The participants who eat breakfast before the 9:30 A.M.

^c The participants who eat breakfast after 9:30 A.M.

^d P values are resulted from independent-samples t-test.

Table 3. Odds Ratios for Overweightness and Obesity According to the Time of Breakfast Consumption ^a

Variables	Group 1 (n = 86) ^b	Group 2 (n = 179) ^c	P Value ^d
Overweightness and obesity^e			
Model I ^f	1	2.16 (1.09-3.18)	0.0001
Model II ^g	1	2.23 (1.11-3.19)	0.0001
Central adiposity			
Model I	1	2.27 (1.21-3.33)	0.0001
Model II	1	2.39 (1.28-3.40)	0.0001

^a Data are presented as odds ratio (95% CI).

^b The participants who eat breakfast before the 9:30 AM.

^c The participants who eat breakfast after 9:30 AM.

^d P values are resulted from logistic regression.

^e Overweightness and obesity are defined as the 85th < BMI < 95th or BMI > 95th percentile and central adiposity is defined as WC > 75th percentile.

^f Model I is crude model (without adjusted).

^g Model II is adjusted for energy, fat, saturated fat, dietary fiber, and physical activity.

5. Discussion

Our study suggested that first mealtime had a key role in the prevalence of overweightness, obesity, and central adiposity among adolescents. Indeed, not only the consumption of breakfast plays an important role on health, but also the time of breakfast consumption is an important issue in this regard. To our knowledge, this was the first investigation in which breakfast time was considered.

We found that individuals with earlier consumption of breakfast had significantly lower prevalence of overweightness and obesity. This association was also found after considering the potential confounders including energy, fat, saturated fat, dietary fiber, and PA. Furthermore, those with earlier breakfast consumption had significantly lower WC after adjustment for potential confounders.

Different results regarding the association between regular breakfast consumption and body weight have been reported (29, 30). Several investigations have shown the association between intake of breakfast with lower daily energy intake and normal body weight (29). In one study, children who ate breakfast regularly had lower risks of overweightness and obesity (30). In addition, a previous cross-sectional study among a sample of children at the age of 10 to 12 years had reported significantly twice less risks for overweightness and obesity in daily breakfast eaters with more than three meals per day (20).

Based on previous studies, breakfast eaters were more satiated and had lower daily energy intake and better diet quality (16, 23, 31) because these participants had more snacks and meals during the day (20), which might have beneficial effects on appetite (25). Participants who omit the breakfast meal usually have fewer snacks (16)

and it might disrupt the distribution of daily energy intake (32). Furthermore, those without breakfast meal had a lower adherence to the healthy recommendations and had lower levels of PA (33). Based on evidence, skipping breakfast is substantially associated with weight gain, increased risks of central adiposity, and higher levels of lipid profile (16, 22). Skipping breakfast was positively correlated with higher feeling of hunger and eating desire in comparison to habitual breakfast eater males (32). In contrast, no significant correlations were found between consumption of breakfast with daily energy intake and BMI in some studies (33, 34). Breakfast eaters with high breakfast energy intake had more daily energy intake and body weight according to one study (29). Since the mechanisms and the role of breakfast on body weight have not been clearly elucidated, these controversial results might be due to other unknown effective factors.

It seems that beside regular breakfast consumption, other factors including breakfast quality and the time of breakfast consumption play important roles on body weight. Some investigations showed that eating high amounts of fiber, whole grains, and nutritious foods in the breakfast meal controlled appetite and might play the key roles in preventing chronic disease and obesity (35). It seems that besides the breakfast consumption and quality of the breakfast meal, as the first meal, breakfast time might have an effective role on body weight.

Earlier breakfast consumption was associated with lower daily energy intake in our study. Eating in the morning might have more satiating effects (16). Thus, earlier breakfast eating might beneficially affect appetite and daily energy intakes as well as health status. Furthermore, in our study, participants who consumed first meal before 9:30 A.M. had lower intake of energy protein and fat. Nevertheless, we observed the link between the first mealtime and anthropometric parameters, even after adjustment for daily energy and nutrient intakes. According to previous investigations, mealtime was an effective factor in overweightness and obesity. In our study, the first mealtime was associated with overweightness, obesity, and central adiposity. We recently showed that breakfast consumption was significantly correlated with higher scores of healthy eating index and dietary diversity score. Regular breakfast consumption was associated with lower BMI and WC (36).

Breakfast skippers had higher amounts of total intakes and even night eating syndrome, which might also affect circadian rhythm (26). Circadian timing system affects dietary intake behaviors, functions of the gastrointestinal system, and glucose and lipid metabolism. The circadian control of digestion and metabolism might play an important role in implications of several aspects of individuals' dietary intake (37). Skipping breakfast leads to metabolic and hormonal diversions in the responses to foods consumed later in the morning. It also plays a key role on subjective appetite and elevation of energy intake (32).

The major strength of this study was that we were able to adjust the effects of individuals' intake as well as PA status on the association of the first mealtime with obesity. Regarding the association between the first mealtime and risks of obesity and central adiposity, our results were independent of dietary intakes. However, we were unable to adjust for several lifestyle habits such as sleep duration. Residual confounding due to incomplete adjustment for unknown confounders might have led to disrupt the actual associations in the present study. Another limitation to our study was its cross-sectional design. The risk of misclassification was also a major limitation. Thus, more prospective studies should be conducted in this population. Another limitation of this study was the small sample size. Nevertheless, our samples were selected by effective random sampling and significant associations were observed. Future studies should be conducted to verify the association between the first mealtime and obesity. It needs to assess the association between several hormones related to individuals' intake and the first mealtime. In addition, more studies are needed to propose probable mechanisms in this regard.

There are significant association between the first mealtime and overweightness, obesity, and central adiposity among adolescents. Girls with earlier breakfast consumption had lower prevalence of overweightness and obesity and higher WC. This association remained significant even after adjusting for the possible confounders.

Funding/Support

Isfahan University of Medical Sciences, Isfahan, Iran supported this study.

References

- Halpern A, Mancini MC, Magalhaes ME, Fisberg M, Radominski R, Bertolami MC, et al. Metabolic syndrome, dyslipidemia, hypertension and type 2 diabetes in youth: from diagnosis to treatment. *Diabetol Metab Syndr*. 2010;**2**:55.
- Kelly T, Yang W, Chen CS, Reynolds K, He J. Global burden of obesity in 2005 and projections to 2030. *Int J Obes (Lond)*. 2008;**32**(9):1431-7.
- Hosseini F, Barzin M, Eskandary PS, Mirmiran P, Azizi F. Trends of obesity and abdominal obesity in Tehranian adults: a cohort study. *BMC Public Health*. 2009;**9**:426.
- Gaeini A, Kashef M, Samadi A, Fallahi A. Prevalence of underweight, overweight and obesity in preschool children of Tehran, Iran. *J Res Med Sci*. 2011;**16**(6):821-7.
- Izadi V, Farabad E, Azadbakht L. Serum adiponectin level and different kinds of cancer: a review of recent evidence. *ISRN Oncol*. 2012;**2012**:982769.
- Izadi V, Kelishadi R, Qorbani M, Esmaeilmotlagh M, Taslimi M, Heshmat R, et al. Duration of breast-feeding and cardiovascular risk factors among Iranian children and adolescents: the CASPIAN III study. *Nutrition*. 2013;**29**(5):744-51.
- Economos CD, Bakun PJ, Herzog JB, Dolan PR, Lynskey VM, Markow D, et al. Children's perceptions of weight, obesity, nutrition, physical activity and related health and socio-behavioural factors. *Public Health Nutr*. 2014;**17**(1):170-8.
- Izadi V, Farabad E, Azadbakht L. Epidemiologic evidence on serum adiponectin level and lipid profile. *Int J Prev Med*. 2013;**4**(2):133-40.
- Ip EH, Zhang Q, Schwartz R, Toozee J, Leng X, Han H, et al. Multi-

- profile hidden Markov model for mood, dietary intake, and physical activity in an intervention study of childhood obesity. *Stat Med*. 2013;**32**(19):3314-31.
- Grimes CA, Riddell LJ, Campbell KJ, Nowson CA. Dietary salt intake, sugar-sweetened beverage consumption, and obesity risk. *Pediatrics*. 2013;**131**(1):14-21.
- Arora M, Nazar GP, Gupta VK, Perry CL, Reddy KS, Stigler MH. Association of breakfast intake with obesity, dietary and physical activity behavior among urban school-aged adolescents in Delhi, India: results of a cross-sectional study. *BMC Public Health*. 2012;**12**:881.
- Hasnain SR, Singer MR, Bradlee ML, Moore LL. Beverage intake in early childhood and change in body fat from preschool to adolescence. *Child Obes*. 2014;**10**(1):42-9.
- Sjoberg A, Hallberg L, Hoglund D, Hulthen L. Meal pattern, food choice, nutrient intake and lifestyle factors in The Goteborg Adolescence Study. *Eur J Clin Nutr*. 2003;**57**(12):1569-78.
- Novaes JF, Franceschini Sdo C, Priore SE. Mother's overweight, parents' constant limitation on the foods and frequent snack as risk factors for obesity among children in Brazil. *Arch Latinoam Nutr*. 2008;**58**(3):256-64.
- Thompson-McCormick JJ, Thomas JJ, Bainivaliku A, Khan AN, Becker AE. Breakfast skipping as a risk correlate of overweight and obesity in school-going ethnic Fijian adolescent girls. *Asia Pac J Clin Nutr*. 2010;**19**(3):372-82.
- Smith KJ, Gall SL, McNaughton SA, Blizzard L, Dwyer T, Venn AJ. Skipping breakfast: longitudinal associations with cardiometabolic risk factors in the Childhood Determinants of Adult Health Study. *Am J Clin Nutr*. 2010;**92**(6):1316-25.
- Alexy U, Wicher M, Kersting M. Breakfast trends in children and adolescents: frequency and quality. *Public Health Nutr*. 2010;**13**(11):1795-802.
- Azadbakht L, Esmailzadeh A. Macro and Micro-Nutrients Intake, Food Groups Consumption and Dietary Habits among Female Students in Isfahan University of Medical Sciences. *Iran Red Crescent Med J*. 2012;**14**(4):204-9.
- Jaaskelainen A, Schwab U, Kolehmainen M, Pirkola J, Jarvelin MR, Laitinen J. Associations of meal frequency and breakfast with obesity and metabolic syndrome traits in adolescents of Northern Finland Birth Cohort 1986. *Nutr Metab Cardiovasc Dis*. 2013;**23**(10):1002-9.
- Antonogeorgos G, Panagiotakos DB, Papadimitriou A, Priftis KN, Anthracopoulos M, Nicolaidou P. Breakfast consumption and meal frequency interaction with childhood obesity. *Pediatr Obes*. 2012;**7**(1):65-72.
- Pereira MA, Erickson E, McKee P, Schrankler K, Raatz SK, Lytle LA, et al. Breakfast frequency and quality may affect glycemia and appetite in adults and children. *J Nutr*. 2011;**141**(1):163-8.
- Freitas Junior IF, Christofaro DG, Codogno JS, Monteiro PA, Silveira LS, Fernandes RA. The association between skipping breakfast and biochemical variables in sedentary obese children and adolescents. *J Pediatr*. 2012;**161**(5):871-4.
- Min C, Noh H, Kang YS, Sim HJ, Baik HW, Song WO, et al. Skipping breakfast is associated with diet quality and metabolic syndrome risk factors of adults. *Nutr Res Pract*. 2011;**5**(5):455-63.
- Ortega RM, Redondo MR, Lopez-Sobaler AM, Quintas ME, Zamora MJ, Andres P, et al. Associations between obesity, breakfast-time food habits and intake of energy and nutrients in a group of elderly Madrid residents. *J Am Coll Nutr*. 1996;**15**(1):65-72.
- Schusdziarra V, Hausmann M, Wittke C, Mittermeier J, Kellner M, Naumann A, et al. Impact of breakfast on daily energy intake - an analysis of absolute versus relative breakfast calories. *Nutr J*. 2011;**10**:5.
- Fuse Y, Hirao A, Kuroda H, Otsuka M, Tahara Y, Shibata S. Differential roles of breakfast only (one meal per day) and a bigger breakfast with a small dinner (two meals per day) in mice fed a high-fat diet with regard to induced obesity and lipid metabolism. *J Circadian Rhythms*. 2012;**10**(1):4.
- Rouhani MH, Mirseifinezhad M, Omrani N, Esmailzadeh A, Azadbakht L. Fast Food Consumption, Quality of Diet, and Obesity among Isfahanian Adolescent Girls. *J Obes*. 2012;**2012**:597924.
- Ainsworth BE, Haskell WL, Whitt MC, Irwin ML, Swartz AM, Strath

- SJ, et al. Compendium of physical activities: an update of activity codes and MET intensities. *Med Sci Sports Exerc.* 2000;**32**(9 Suppl):S498-504.
29. Ma Y, Bertone ER, Stanek E3, Reed GW, Hebert JR, Cohen NL, et al. Association between eating patterns and obesity in a free-living US adult population. *Am J Epidemiol.* 2003;**158**(1):85-92.
30. Hoyland A, Dye L, Lawton CL. A systematic review of the effect of breakfast on the cognitive performance of children and adolescents. *Nutr Res Rev.* 2009;**22**(2):220-43.
31. de Castro JM. The time of day of food intake influences overall intake in humans. *J Nutr.* 2004;**134**(1):104-11.
32. Astbury NM, Taylor MA, Macdonald IA. Breakfast consumption affects appetite, energy intake, and the metabolic and endocrine responses to foods consumed later in the day in male habitual breakfast eaters. *J Nutr.* 2011;**141**(7):1381-9.
33. Song WO, Chun OK, Obayashi S, Cho S, Chung CE. Is consumption of breakfast associated with body mass index in US adults? *J Am Diet Assoc.* 2005;**105**(9):1373-82.
34. Kral TV, Whiteford LM, Heo M, Faith MS. Effects of eating breakfast compared with skipping breakfast on ratings of appetite and intake at subsequent meals in 8- to 10-y-old children. *Am J Clin Nutr.* 2011;**93**(2):284-91.
35. McCrory MA, Campbell WW. Effects of eating frequency, snacking, and breakfast skipping on energy regulation: symposium overview. *J Nutr.* 2011;**141**(1):144-7.
36. Azadbakht L, Haghighatdoost F, Feizi A, Esmailzadeh A. Breakfast eating pattern and its association with dietary quality indices and anthropometric measurements in young women in Isfahan. *Nutrition.* 2013;**29**(2):420-5.
37. Stenvers DJ, Jonkers CF, Fliers E, Bisschop PH, Kalsbeek A. Nutrition and the circadian timing system. *Prog Brain Res.* 2012;**199**:359-76.