The Association between Skipping Breakfast and Biochemical Variables in Sedentary Obese Children and Adolescents

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Objective To investigate the relationship between skipping meals and biochemical variables in obese children and adolescents.

Study design The sample was composed of 174 obese children and adolescents, aged between 6 and 16 years (80 male and 94 female). Body composition was assessed by dual-energy x-ray absorptiometry, fasting blood glucose, and lipid profile were measured after 12 hours fasting. The frequency of skipping breakfast, lunch, or dinner was assessed through a face-to-face interview carried out with the parents.

Results The prevalence of eating breakfast daily was low in boys (47.5%) and girls (44.7%). A higher frequency of eating breakfast was negatively correlated with glucose ($r = -0.16$; $P = .026$), triglycerides ($r = -0.19$; $P = .011$), and very low density lipoprotein cholesterol ($r = -0.21$; $P = .005$). In the multivariate model, the weekly frequency of eating breakfast remained negatively associated with glucose ($\beta = -0.975$; $P = .017$), triglycerides ($\beta = -7.792$; $P = .017$), and very low density lipoprotein cholesterol ($\beta = -1.870$; $P = .009$) independent of age, sex, trunk fatness, and parents' education.

Conclusion Skipping meals, mainly breakfast, is associated with glucose and lipid levels in obese children and adolescents. *(J Pediatr 2012;161:871-4)*.

Behavioral variables, mainly physical inactivity and food intake, are strongly related to obesity development.[1] Skipping meals, mainly breakfast, is a behavioral factor related to the development of pediatric obesity.[2-4] It is not clear whether the habit of eating regular meals, in obese youth, could improve lipids and glucose metabolism in youth with obesity. This information is relevant for health professionals because skipping meals is a common type of behavior in children and adolescents in developed and developing countries.[3]

Thus, the purpose of this study was to investigate the relationship between skipping meals and biochemical variables in sedentary obese children and adolescents.

Methods

The subjects were invited, through television and newspaper advertising, to participate in an intervention program, which promoted the practice of physical exercise and improved nutrition for obese boys and girls. In the present study, only the initial data were used. After initial contact by phone, measurements were performed at the university laboratory. Subjects were invited to participate in the study if their initial body mass index measurement met the cut-off criteria for obesity proposed by Cole et al[5] and if they met the following criteria: (1) age (6-17 years); (2) sedentary behavior (based on no engagement in regular physical activity in the last 3 months); (3) no physical limitations that would prohibit participation in physical activity; and (4) a consent form, signed by parents/guardians, to participate in this study. The present research was approved by the Ethical Research Expert Committee of the University.

Sample size was estimated using an expected correlation of r = 0.25 between biochemical variables and skipping meals, α error of 5% (z = 1.96) and power of 80%. The minimum sample size required was 123 subjects. Initially, 196 children/adolescents contacted by researchers met all inclusion criteria. However, 22 were excluded from the sample because they did not answer the questionnaire (n = 20 [10.2%]) or did not show at the laboratory for blood samples (n = 2 [1%]). The final sample was composed of 174 obese children and adolescents (participation rate: 88.8%), ranging in age from 6 to 16 years old (80 male

FG	Fasting glucose
TFM	Trunk fat mass
TG	Triglycerides
VLDL-C	Very low density lipoprotein cholesterol

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and 94 female), and residents of the city of Presidente Prudente, São Paulo, Brazil.

Body weight was measured with an electronic scale (precision 0.1 kg) (Filizzola PL 150; Filizzola Ltda, São Paulo, Brazil) and height was measured with a wall-mounted stadiometer (precision 0.1 cm) (Sanny; American Medical do Brasil Ltda, São Bernardo do Campo, Brazil). Both measurements were taken with the subjects wearing light clothing and no shoes. Body mass index (kg/m^2) was calculated using the value of weight divided by height squared. All anthropometric measurements were performed by trained researchers, according to standardized techniques.

A dual-energy x-ray absorptiometry scanner (Lunar DPX-NT; General Electric Healthcare, Little Chalfont, Buckinghamshire, United Kingdom) with software v. 4.7 was used to assess whole and segmental body composition. In our study, because of the fact that obesity was an inclusion criterion, only trunk fat mass (TFM) was treated as a potential confounder. All measurements were taken by a trained researcher, in the University laboratory, in a room with a constantly controlled temperature.

Blood samples were collected, after a 12-hour fast, in vacuum tubes with ethylenediaminetetraacetic acid. The samples were centrifuged for 10 minutes at 3000 rpm, and triglycerides (TG), total cholesterol, high density lipoprotein cholesterol, low density lipoprotein cholesterol, very low density lipoprotein-cholesterol (VLDL-C), and fasting glucose (FG), were assayed by an enzymatic colorimetric kit processed in an Autohumalyzer A5 (Human Gesellschaft für Biochemica und Diagnostica mbH, Wiesbaden, Germany). All blood sample collections and biochemical analyses were done in a private laboratory, which meets the standardization criteria of quality control adopted by the Brazilian Health Ministry.

Home meal habits and parental education were assessed by a face-to-face interview carried out with parents by a trained researcher. Parents reported, on a Likert scale questionnaire, the weekly frequency (none; 1-2 days; 3-6 days; everyday) of meals (breakfast; lunch; dinner) at home, in the previous week. Parents were asked to report the data only if the previous week represented a normal eating pattern. For statistical analysis, each weekly frequency received a score (none [score 1]; 1-2 days [score 2]; 3-6 days [score 3]; everyday [score 4]) and any response instead of "everyday" denoted skipping a meal. Breakfast, lunch, and dinner were combined (breakfast/lunch/dinner), which denoted a score of the 3 meals (score ranging from 3-12 points).

Statistical Analyses

Median and IQR were used due to the nonparametric distribution of many variables. The Mann–Whitney test was used to compare groups and Spearman rank correlations were used to assess the relationship between continuous variables. Linear regression model produced β values adjusted by age, sex, TFM, and parents' formal education to evaluate the relationship between meals and biochemical variables. Statistical significance was set at 5% and statistical software SPSS v. 13.0 (SPSS Inc, Chicago, Illinois) was used for all analyses.

Table I. Subject characteristics (median and IQR) and daily meal consumption in percentages (n = 174)

	Male (n = 80)	Female (n = 94)	
	Median (IQR)	Median (IQR)	*P*
Variables			
Age (y)	10.5 (4.0)	10.0 (4.0)	.737
Height (cm)	149.8 (22.5)	148.2 (23.4)	.363
Weight (kg)	60.1 (26.2)	61.4 (27.0)	.409
BMI (kg/m^2)	27.6 (4.9)	27.1 (5.6)	.170
FG (mg/dL)	84.0 (8.0)	82.0 (9.0)	.041
TG (mg/dL)	92.0 (68.0)	97.0 (62.0)	.409
HDL-C (mg/dL)	43.0 (14.0)	43.5 (14.0)	.471
VLDL-C (mg/dL)	18.5 (14.0)	19.0 (13.0)	.299
LDL-C (mg/dL)	103.0 (38.0)	94.5 (42.0)	.217
TFM (kg)	14.2 (7.5)	13.4 (8.8)	.311
Daily consumption			
Breakfast (yes [%])	47.5	44.7	.826
Lunch (yes [%])	90.0	90.4	1.000
Dinner (yes [%])	78.8	77.7	1.000

BMI, body mass index; *HDL-C*, high density lipoprotein cholesterol; *LDL-C*, low density lipoprotein cholesterol.

Results

There were no significant differences between male and female participants with respect to age, weight, height, biochemical, and TFM variables (*P* values ranging from .217-.471). However, boys had higher median values of glucose than girls ($P = .041$). Eating breakfast daily was identified in less than 50% of the boys and girls. Lunch was the most common meal in the analyzed sample, followed by dinner. Daily meal consumption was similar in both sexes (Table I).

Eating breakfast was significantly associated with eating lunch ($r = 0.18$; $P = .013$), but not eating dinner ($r = 0.12$; $P = .101$), and eating lunch and dinner were significantly associated ($r = 0.22$; $P = .003$). A higher frequency of eating breakfast was negatively associated with FG ($r = -0.16$; $P = .026$), TG ($r = -0.19$; $P = .011$), and VLDL-C ($r = -0.21$; $P = .005$). On the other hand, higher consumption of breakfast/lunch/dinner was negatively related to TG

Table II. Spearman correlation (*r*) between meal skipping and biochemical variables in obese children and adolescents (Brazil, n = 174)

Independent variables (scores)	Dependent variables (fasting blood variables)					
	FG	TG	TC	HDL-C	VLDL-C	LDL-C
Breakfast	**−0.169**	**−0.192**	−0.075	0.058	**−0.213**	−0.050
P	**.026**	**.011**	.324	.446	**.005**	.516
Lunch	0.036	−0.081	−0.098	−0.043	−0.071	−0.082
P	.641	.288	.200	.571	.355	.284
Dinner	−0.042	0.010	−0.080	−0.111	−0.027	−0.010
P	.580	.895	.296	.146	.721	.899
Breakfast/ lunch/dinner*	−0.140	**−0.149**	−0.086	0.008	**−0.172**	−0.049
P	.066	**.049**	.260	.915	**.023**	.521

TC, total cholesterol.
Bold indicates significant results.
*Combined score of breakfast, lunch, and dinner.