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ORIGINAL ARTICLE

Association of fruit and vegetable intake with meal skipping in children and adolescents: the CASPIAN-V study

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Abstract

Background There are few studies on the association of main meal consumption with fruit and vegetable intake. This study aims to assess the relation between skipping main meals and fruit and vegetable intake in children and adolescents.

Methods This multi-centric cross-sectional study was conducted in 30 provinces of Iran. This study was conducted in the framework of the fifth survey of a national surveillance program entitled Childhood and Adolescence Surveillance and Prevention of Adult Non-communicable Disease study (CASPIAN- V). 14,440 school students aged 7–18 years were assessed. Logistic regression analyses were used to evaluate the association between frequency of fruit and vegetable intake with skipping main meals.

Results Overall, 14,274 students completed the study (99% participation rate). Their mean (SD) age was 12.3 (3.2) (53% were aged 6–12), 50.6% of them were boys, and 71.3% lived in urban area. In multivariate logistic regression model, statistically significant associations were found between skipping main meals and low fruits and vegetables intake. Skipping breakfast was associated with vegetables intake [OR = 1.19(95% CI 1.02–1.38)] and fruits intake [OR = 5.33(95% CI 4.46–6.37)]. Skipping lunch was associated with vegetables intake [OR = 1.61(95% CI 1.29–1.96)] and fruit intake [OR = 9.11(95% CI 6.55–12.67)]. Skipping dinner was associated with vegetables intake [OR = 1.52 (95% CI 1.15–2.01)] and fruits intake [OR = 2.21(95% CI 1.64–2.97)].

Conclusions In this study, low frequency of fruit and vegetable intake was associated with skipping main meals. The results highlight the importance of promoting regular meal consumption with increase in the intake of fruit and vegetables among children and adolescents.

Level of evidence Level V.

Keywords Fruits · Vegetables · Meal pattern · Children and adolescents

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Introduction

Some findings have shown that decrease in the risk of chronic diseases including cardiovascular disease, obesity and some cancers are correlated with fruit and vegetable intake [1, 2]. Dietary behaviors and habitual diet are established in childhood and continues in adulthood [3]. Fruits and vegetables intake have more beneficial impact on prevention of chronic diseases when consumed from childhood. Thus, children should be encouraged for fruits and vegetables consumption [4].

Meal pattern determine the amount of fruit and vegetable intake in children [5]. There are few studies that assess the effect of main meal consumption on fruit and vegetable intake. However, it seems that regular meal consumption and healthy dietary habit associated with more fruits and vegetables consumption in children [6].

According to findings, higher frequency of meal consumption associated with higher fruits and vegetables intake in children [7]. Skip at least one main meal in children leads to less fruit and vegetable intake when compared with children that do not skip any main meal [8, 9].

Some findings showed that inadequate fruits and vegetables intake associated with low meal frequency and breakfast skipping in children and adolescents [10, 11]. However, any significant associations were not shown between meal frequency and fruit and vegetable intake in American adolescents [12] and among 8–10-year-old African-American girls [13].

Meal skipping has been reported in adolescents with lack of frequent consumption of regular meals [14]. Result of a meta-analysis on 24 studies in Iranian population showed that the prevalence of breakfast skipping was 21% [15]. Another study showed that the prevalence of breakfast, lunch and dinner skipping were 32.1%, 8.9% and 10.9%, respectively in Iranian adolescents [16].

There are few studies that investigate the association between meal frequencies and fruit and vegetable intake among children and adolescents. In addition, there is a lack of consistent findings in studies. The aim of the present study is to investigate whether there is any association between fruit and vegetable intake with skipping main meals in children and adolescents.

Materials and methods

The present study was conducted on the data of "the fifth survey of the school-based surveillance system entitled Childhood and Adolescence Surveillance and Prevention of Adult Non-communicable Disease (CASPIAN-V) study" (2014–2015), conducted in 30 provinces of Iran. Details on the study protocol have been discussed previously [17], and here we briefly point to the essential details related to the current study topic.

Study population and sampling

Using multistage stratified cluster sampling method, the study participants were selected from students aged 7–18 years in primary and secondary schools in urban and rural of 30 provinces.

For proportional to size sampling along with the student's residence area (urban or rural) and educational levels (primary and secondary) considered with equal sex ratio [18].

Achieving the desired number of samples was obtained using cluster sampling in each province with equal cluster sizes. Clusters were determined at school levels. The size of each cluster was 10 students; meaning that a total of 10 statistical units (including 10 students and their parents) would be considered in each cluster. The sample size of main survey included 480 students in each province (48 clusters of 10 students), i.e., a total of 14,400 students at national level.

Procedure and measurements of data gathering

Questionnaires

Data for students gathered through Persian-translated version of questionnaire that was developed based on the World Health Organization-Global School Student Health Survey (WHO-GSHS) [19]. The validity and reliability of questionnaires has been assessed through previous assessments [20]. Moreover, demographic information including age, sex, family history of diseases, complementary data on family characteristics, namely household size, order of students and socioeconomic variables were questioned through parents' questionnaires.

Physical measurements

A team of trained health care experts performed the physical examination under standard protocols and by calibrated instruments. Weight measured in light clothing to the nearest 0.1 kg on a SECA digital weighing scale (SECA, Germany). Height was assessed without shoes to the nearest 0.1 cm while the students were standing and the shoulders were in normal position [21].

Body mass index (BMI) was calculated by dividing weight (kg) to height squared (m^2). We used the WHO growth charts to define obesity (BMI > 95th ge—sex-specific percentile) [19].

Definition of meal, fruit and vegetable consumption

Dependent variables

We measured the intake of fruit and vegetables separately by a food frequency questionnaire (FFQ) on several food/drink items. The specific item was: "How many times a week do you usually eat/drink." followed by a list of different food and drink items. One of the items was "Fruit" and another "Vegetables". Response categories were: "Never", "Less than once a week", "Once a week", "2–4 days a week", "5–6 days a week", "Once a day every day" and "Several times every day". We dichotomised each variable where low intake of fruit and vegetables, respectively, was defined by eating fruit/vegetables 5–6 days a week or less frequently. In Denmark, adolescents are recommended to eat 600 g of fruits and vegetables daily. The data available for analyses did not provide information on the amount of the adolescents' daily intake. From a nutritional viewpoint, eating fruit and vegetables daily is preferable to eating fruit and vegetables less frequently. Further, we conducted sensitivity analyses by repeating the analyses with different cut points of both the dependent and independent variables. The direction of the associations was the same when changing cut points. The dichotomisation was based upon both a nutritional perspective and statistical power considerations.

Independent variables

The independent variables were regular intake of breakfast, lunch and evening meal. The schoolchildren responded to the following three questions: "On weekdays: How often do you usually have breakfast (more than a glass of milk or juice)/lunch (a proper meal in the middle of the day)/evening meal (a proper meal in the evening)". Response categories were: "I never have breakfast on weekdays", "1 day", "2 days", "3 days", "4 days", "5 days". We dichotomised each independent variable into irregular and regular meal consumption. Irregular breakfast and lunch consumption was defined as consuming the specific meal on 3 weekdays or less frequently. No clear guidelines exist regarding regular meal consumption, but according to the current Nordic Nutrition Recommendations (2004), a regular meal consumption during the day is recommended to avoid frequently eating snacks [22]. From this perspective, a regular meal intake is defined as eating the specific meal every day. However, in the present study, we chose the approach that a meal can occasionally be skipped and meal consumption can still be regular. For the evening meal, the cut point chosen was eating the meal on 4 weekdays or less frequently. This different cut point was applied due to the distribution of the variable.

Definitions of covariates

Demographic information: Through an interview with parents or child, demographic information was asked for all students in the sampled classes of the selected schools. Family based characteristics including: family history of chronic diseases (hypertension, dyslipidemia, diabetes, and obesity), parental level of education (the highest total years of schooling), type of family (live with single parent or living with both parents), possessing a family private car and type of home (rented/owned), body image, Physical activity (PA), and sedentary lifestyle.

PA: Through a validated questionnaire, information of weekly frequency of leisure time PA in outside the school was collected, for past week [20]. In this regard; at least 30 min' duration of exercises per day, that caused heavy sweating or large increases in breathing or heart rate, was defined as PA. The response options were categorized as; none, 1–2 days, 3–6 days, and every day. For statistical analysis, each weekly frequency categorized into two groups; 0–3 days per week (Low); 4–7 days (High) [23].

Screen time (ST): The ST behavior of the children was assessed through the questionnaire that asked them to report the average number of hours//day they spent on watching TV/VCDs, personal computer (PC), or electronic games (EG) in time of week days and weekends.

Socioeconomic status (SES): Aim to assessment the SES of students, using principle component analysis (PCA) method related questions including parental education, parents' job, possessing private car, school type (public/private), and having personal computer were combined as a unique index [15].

Any intention to change body weight and following weight-modifying plans (intended weight loss) was measured with a four-scale question including ""No, my weight is normal", "No, but I ought to lose weight", "No, because I have to gain weight" and "Yes, I am trying to lose weight"). The positive response to lose weight was considered as "intended weight loss". Body image was measured by asking the respondents "what do you think regarding your body image?" "Much too thin", "A bit too thin", "About the right size", "A bit too fat" and "Much too fat". For statistical analysis, respondents who respond "a bit too fat and much too fat" were considered as those who saw themselves as "fat".

Ethical concerns

Study protocols were reviewed and approved by ethical committees and other relevant national regulatory organizations.

The Research and Ethics council of Isfahan University of Medical Sciences approved the study (Project number: 194049). After complete explanation of the study objectives and protocols, written informed consent and verbal consent were obtained from the parents and students, respectively.

Statistical analysis

Continues and categorical variables were presented as mean [standard deviation (SD)] and frequency (%) respectively. Association between categorical variables were assessed using χ^2 test. We used univariate and multivariate logistic regression analyses to examine the association between low fruit and vegetable intake with skipping meals. In the multivariate model, the association was adjusted for potential confounders including sex, age, living area, socioeconomic status, family type, tended weight loss, obesity, physical activity and screen time. The results of logistic regression are presented as odds ratio (OR) and 95% confidence interval (CI). In all statistical analysis, the method of sampling was considered in statistical analysis using "survey analysis method". All statistical analysis was performed using STATA software (version 12).

Results

Data of 14,274 children and adolescents were available for the present study, (participation rate: 99%). Participants had a mean (SD) age of 12.3 (3.2) (53% were aged 6–12), 50.6% of them were boys, and 71.3% were urban resident. The socio-demographic characteristics, fruit and vegetable intake and meal consumption according to gender and age are presented in Table 1. Girls reported statistically higher daily vegetables intake (33.9% vs. 31.1%), skipping breakfast (7.9% vs. 6.6%) and skipping dinner (2.9% vs. 2%) (p value < 0.01). Prevalence of obesity in boys and girls was 12.5% and 10.1%, respectively, which was statistically different between them (p value < 0.001).

Frequency of daily fruit and vegetable intake by frequency of breakfast, lunch and dinner meal according to gender is shown in Table 2. Overall, students with low intake of vegetable were more breakfast, dinner and lunch skipper ($p < 0.05$). Also, frequency of daily fresh fruit with skipping all meals in both sexes were statistically significant ($p < 0.001$).

Table 3 shows significant associations between low fruit and vegetable intake and skipping breakfast, lunch and dinner meal (skipping breakfast: vegetables OR = 1.19(95% CI 1.02–1.38), fruit OR = 5.33 (95% CI 4.46–6.37); lunch: vegetables OR = 1.61 (95% CI 1.29–1.96), fruit OR = 9.11(95% CI 6.55–12.67); dinner: vegetables OR = 1.52 (95% CI 1.15–2.01), fruit OR = 2.21 (95% CI 1.64–2.97)).

Discussion

The present study confirmed the relationship between low fruit and vegetable consumption and skipping main meals in children and adolescents.

Previous study showed that the relationship between fruit and vegetable intake among children and adolescents and meal frequencies that are consistent with our study [24, 25]. However, there are various measurement methods related to meal and fruit and vegetable consumption. The reasons for the inconsistent findings are the difference in the design of studies, characteristics of participant, various ethnicities, outcome measures, various food components in the diet and different geographic, environmental, cultural, and social conditions [26].

The positive associations between irregular meals frequently and the amount of fruits and vegetables intake were found in middle and high school students from Minneapolis. Less frequency of main meal consumption associated with low amount of fruit and vegetable intake and vice versa [7]. Skip at least one main meal was correlated with low frequency of fruits and vegetables intake in children of three elementary schools in urban Hamilton [8].

We found significant relationship between low fruit and vegetable consumption and missing breakfast in children and adolescents. Study on Tuscan students (11, 13 and 15 year old) showed skipping breakfast associated with lower consumption of fruit and vegetable, especially among 15-year-old girls [27].

According to findings, there is correlation between poor nutrition and missing breakfast [28, 29]. Consumers of breakfast have lower fat and energy intake and higher fiber, vitamins and minerals intake than breakfast skippers [30]. More studies showed a positive association between missing breakfast as unhealthy life style and obesity. Thus, encourage breakfast eating may be beneficial in all populations [31, 32].

Significant relationship between low fruit and vegetable consumption and skipping lunch and dinner meal were found in the present study. Skipping meals is considered as unhealthy eating habits in children and adolescent. Study on Norwegian, 13–15 year olds subjects showed that higher frequency of breakfast, lunch and evening meal intake correlated with higher fruit and vegetables consumption [25]. An association between irregular intake of breakfast, lunch and evening meal and low frequency of fruit and vegetable consumption was found for 11, 13 and 15 years old adolescents in Denmark. Thus, promoting regular meal intake may be useful for increasing the fruit and vegetables consumption among adolescents [33].

Table 1 Sociodemographic characteristics, fruit and vegetable intake and meal skipping according to gender and age group: the CASPIAN-V study

	7–12 year			13–18 year			Total		
	Boy	Girl	*P* value	Boy	Girl	*P* value	Boy	Girl	*P* value
Daily fruit intake									
No	1289 (39.7)	1346 (40.7)	0.39	1261 (40.4)	1072 (39.1)	0.3	2550 (40.1)	2418 (40)	0.94
Yes	1959 (60.3)	1960 (59.3)		1857 (59.6)	1668 (60.9)		3816 (59.9)	3628 (60)	
Daily vegetables intake									
No	2577 (70.4)	2488 (65.8)	< 0.001	2337 (67.4)	2105 (66.5)	0.4	4914 (68.9)	4593 (66.1)	< 0.001
Yes	1085 (29.6)	1295 (34.2)		1061 (33.5)	1128 (32.6)		2213 (31.1)	2356 (33.9)	
Breakfast consumption									
Non-skipper	3453 (93.5)	3539 (92.9)	0.27	3232 (93.2)	2884 (91.2)	0.002	6685 (93.4)	6423 (92.1)	0.004
Skipper	239 (6.5)	271 (7.1)		235 (6.8)	279 (8.8)		474 (6.6)	550 (7.9)	
Lunch consumption									
Non-skipper	3588 (97.2)	3696 (97.1)	0.84	3333 (96.2)	3031 (95.6)	0.21	6921 (96.7)	6727 (96.4)	0.35
Skipper	104 (2.8)	110 (2.9)		133 (3.8)	141 (4.4)		237 (3.3)	251 (3.6)	
Dinner consumption									
Non-skipper	3628 (98.4)	3728 (97.9)	0.1	3401 (97.6)	3086 (96.7)	0.02	7029 (98)	6814 (97.4)	0.008
Skipper	58 (1.6)	79 (2.1)		82 (2.4)	104 (3.3)		140 (2)	183 (2.6)	
Obesity									
Yes	484 (13.1)	396 (10.4)	< 0.001	323 (10.2)	412 (11.9)	0.02	896 (12.5)	719 (10.3)	< 0.001
No	3211 (86.9)	3395 (89.6)		2855 (89.8)	3062 (88.1)		6273 (87.5)	6250 (89.7)	
Intended weight loss									
No	3142 (84.9)	3217 (84.4)	0.59	2914 (83.8)	2620 (82.1)	0.06	6056 (84.4)	5837 (83.4)	0.11
Yes	560 (15.1)	593 (15.6)		563 (16.2)	571 (17.9)		1123 (15.6)	1164 (16.6)	
See oneself as fat									
No	2700 (72.5)	2743 (71.5)	0.31	2458 (70.2)	2113 (65.9)	< 0.001	5158 (71.4)	4856 (69)	0.001
Yes	1022 (27.5)	1093 (28.5)		1045 (29.8)	1093 (34.1)		2186 (31)	2067 (28.6)	
Family type									
Single parent	189 (5.1)	189 (5)	0.77	234 (6.7)	224 (7)	0.64	423 (5.9)	413 (5.9)	0.98
Both parents	3511 (94.9)	3618 (95)		3243 (93.3)	2968 (93)		6754 (94.1)	6586 (94.1)	
Family SES									
High	1187 (33.1)	1240 (34.1)	0.51	1068 (32)	1057 (34.5)	0.09	2297 (34.3)	2255 (32.6)	0.07
Medium	1170 (32.2)	1196 (33.4)		1147 (34.3)	1002 (32.7)		2343 (33.8)	2172 (32.4)	
Low	1200 (33.5)	1227 (33.7)		1125 (33.7)	1007 (32.8)		2325 (33.6)	2234 (33.3)	
Living area									
Urban	2418 (65)	2491 (64.9)	0.95	2729 (77.9)	2550 (79.6)	0.08	5147 (71.2)	5041 (71.6)	0.63
Rural	1303 (35)	1346 (35.1)		775 (22.1)	654 (20.4)		2078 (28.8)	2000 (28.4)	
ST									
Low	3061 (84.6)	3195 (85.7)	0.16	2802 (82.2)	2586 (82.6)	0.73	5863 (83.4)	5781 (84.3)	0.18
High	559 (15.4)	533 (14.3)		605 (17.8)	546 (17.4)		1164 (16.6)	1079 (15.7)	
PA									
Low	2037 (55.2)	2272 (59.8)	< 0.001	1983 (57.1)	1943 (61.1)	0.001	4020 (56.2)	4215 (60.4)	< 0.001
High	1650 (44.8)	1529 (40.2)		1488 (42.9)	1239 (38.9)		3138 (43.8)	2768 (39.6)	

Data are presented as number (%)

ST screen time, *PA* physical activity, *SES* socioeconomic status

Skipping breakfast and lunch at least once a week was associated with unhealthy and poorest food and nutrient intake in Swedish adolescent girls (15–16 year old). Lower fruit and vegetables and higher white bread, soft drinks and sweets were consumed by adolescent girls that skipped main meals. No significant association was found in boys [24].

Table 2 Frequency of daily fruit and vegetable intake by frequency of main meal skipping according to gender: the CASPIAN-V study

Sex	Variable	Category	Fresh fruit			Vegetable		
			Daily	Nondaily	*P* value	Daily	Nondaily	*P* value
Boy	Dinner consumption	Non-skipper	3769 (98.9)	2434 (97.2)	< 0.001	2167 (98.4)	4763 (97.9)	0.19
		Skipper	40 (1.1)	71 (2.8)		36 (1.6)	102 (2.1)	
Girl		Non-skipper	3587 (99)	2306 (97)	< 0.001	2300 (97.9)	4424 (97.2)	0.1
		Skipper	37 (1)	71 (3)		50 (2.1)	126 (2.8)	
Total		Non-skipper	7356 (99)	4740 (97.1)	< 0.001	4467 (98.1)	9187 (97.6)	0.04
		Skipper	77 (1)	142 (2.9)		86 (1.9)	228 (2.4)	
Boy	Lunch consumption	Non-skipper	3757 (99.3)	2414 (95.3)	< 0.001	4741 (97.1)	2084 (95.8)	0.006
		Skipper	28 (0.7)	119 (4.7)		144 (2.9)	92 (4.2)	
Girl		Non-skipper	3575(99.2)	2288 (95.1)	< 0.001	4419 (96.8)	2220 (95.6)	0.01
		Skipper	29 (0.8)	118 (4.9)		145 (3.2)	101 (4.4)	
Total		Non-skipper	7332 (99.2)	4702 (95.2)	< 0.001	9160 (96.9)	4304 (95.7)	< 0.001
		Skipper	57 (0.8)	237 (4.8)		289 (3.1)	193 (4.3)	
Boy	Breakfast consumption	Non-skipper	3704 (97.4)	2248 (89.1)	< 0.001	2058 (94)	4530 (93)	0.13
		Skipper	97 (2.6)	274 (10.9)		132 (6)	341 (7)	
Girl		Non-skipper	3501 (96.8)	2123 (88.3)	< 0.001	2165 (92.8)	4168 (91.7)	0.12
		Skipper	115 (3.2)	281 (11.7)		169 (7.2)	377 (8.3)	
Total		Non-skipper	7205 (97.1)	4371 (88.7)	< 0.001	4223 (93.3)	8698 (92.4)	0.03
		Skipper	212 (2.9)	555 (11.3)		301 (6.7)	718 (7.6)	

Table 3 Association between low fruit and vegetable intake and skipping main meals in logistic regression: the CASPIAN-V study

Meal skipping	Model	Vegetables (non daily/daily)		Fresh fruits (non daily/daily)	
		OR (CI)	*P* value	OR (CI)	*P* value
Dinner	Model 1	1.28 (1.003–1.65)	0.04	2.86 (2.16–3.78)	< 0.001
	Model 2	1.52 (1.15–2.01)	0.003	2.21 (1.64–2.97)	< 0.001
Lunch	Model 1	1.42 (1.19–1.72)	< 0.001	6.48 (4.84–8.67)	< 0.001
	Model 2	1.61 (1.29–1.96)	< 0.001	9.11 (6.55–12.67)	< 0.001
Breakfast	Model 1	1.15 (1.007–1.33)	0.03	4.31 (3.66–5.07)	< 0.001
	Model 2	1.19 (1.02–1.38)	0.02	5.33 (4.46–6.37)	< 0.001

Model 1: Crude model

Model 2: Adjusted for gender, age, living area, socioeconomic status, family type, tended weight loss, obesity, physical activity and screen time

Skipping meals was related to large amount of soft drinks, white bread and sweets intake and less amount of fruits and vegetables intake in 16 years old girls and boys in a population-based study [11].

Study on 14,400 students aged 7–18 years showed that meal skipping and irregular breakfast, lunch and dinner eating were correlated with some somatic and psychological health complaints including headache, stomachache, backache and difficulty in getting to sleep. Therefore, regular meal consumption, at least three times a day, is highly recommended in children and adolescents [34].

Study on among 1109 students from classes 2–5 in 36 schools in Sindh, Pakistan reported that the regular intake of meals and nutrient-rich snacks should be educated by school-based nutrition education programs. Consumption of dried seeds, fruits, vegetables, milk and its derivatives can compensate nutrient deficiencies. This study showed that eggs, nuts and seeds were frequently skipped in the diet of school children. Consumption of fruits is more infrequent in comparison with other food groups [35]. Junk food consumption plays an important role in childhood overweight and is correlated with high blood pressure in pediatric age group [36].

Findings demonstrated that irregular meal patterns, poor guidance from family and peers, expensive and unappealing healthy food, lack of access to healthy food and poverty lead to skipping meal and having unhealthy dietary pattern. The reasons of failure for having healthy eating are complicated and mutually reinforcing. It correlated with economic strain [37].

To the best of our knowledge, this study is the first that reports the associations of low fruit and vegetable intake with skipping meal in Iranian children and adolescents.

According to findings, promoting regular meal intake, healthy eating habits and fruits and vegetables consumption should be considered for increasing the quality of eating pattern in children and adolescents. Low fruit and vegetable consumption in children and adolescents can lead to nutritional deficiency in one of the most important periods of life [38, 39].

The main limitations of the present study are the cross-sectional nature of the findings and using questionnaire-based data. However, all questionnaires were valid instruments. The strengths of the present study are the large sample size and the analyses were adjusted for several well-known confounding factors.

Conclusion

The findings of the present study showed that irregular meal consumption and skipping main meals were correlated with low fruit and vegetable consumption among Iranian children and adolescents. Making the useful changes in the school and family environments and encouraging for healthy eating habits can increase the motivation of children and adolescents for improving the quality of life.

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Compliance with ethical standards

Conflicts of interest There are no conflicts of interest.

Ethics approval The study was approved by the Research and Ethics Council of Isfahan University of Medical Sciences (Project number: 194049).

Informed consent After explaining the objectives and protocols of the study, written informed consent and verbal consent were obtained from all the children and adolescents, respectively.

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