Higher Fruits and Vegetables and Less Red Meat Intake Lower Precocious Puberty Risk

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Research

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Abstract

Background & aims: The role of dietary intake on precocious puberty remains unclear. This study aimed to investigate the association between the amount and frequency of dietary intake and the risk of precocious puberty in Chinese girls.

Methods: In this case-control study, we enrolled 185 precocious puberty girls and 185 age-matched controls.

Their dietary intake was assessed through a semi-quantitative food frequency questionnaire. Their sociodemographic and lifestyle data were collected. The associations between dietary intake and risk of precocious puberty were assessed by conditional logistic regression models.

Results: Despite a higher weight and height of girls in the case group than in the control group, there was no statistical difference in BMI between the two groups (P=0.077). After multivariate adjustment, consuming higher amount of red meat was associated with higher precocious puberty risk [≥50g/day vs. <25g/day: OR (95% CI) = 2.74 (1.25, 6.02), P = 0.0121]. Compared with fruit intake frequency <7 times/week, consuming higher frequency of fruit was associated with lower precocious puberty risk [7-10 times/week: OR (95%CI) = 0.36 (0.14, 0.91); ≥10 times/week: OR (95%CI)= 0.21 (0.05, 0.94); P for trend = 0.024]. Furthermore, compared with vegetables intake <112.5 g/day, higher amount of vegetables intake was associated with lower risk of precocious puberty [112.5-240g/day: OR (95%CI) = 0.31 (0.12, 0.77); ≥240.0g/day: OR (95%CI) = 0.25 (0.11, 0.59); P for trend = 0.002].

Conclusion: Consuming more fruits and vegetables and less red meat could potentially reduce the risk of precocious puberty in Chinese girls.

1. Introduction

Precocious puberty refers to a phenomenon in which boys show secondary sexual characteristics before the age of 9 and girls before the age of 8 (1). Based on pathogenesis, it can be divided into Central Precocious Puberty (CPP) and Peripheral Precocious Puberty (PPP) (2). Reports indicate that the global incidence of precocious puberty in children is about 1 in 5000 to10000 with a male to female ratio of approximately 1:3 to 1:23 (3). Moreover, the proportion of children suffering from idiopathic CPP has increased greatly in many countries in recent years (4). For example, the incidence ranges from around 0.38–0.74% depending on the survey area in China (5). Notably, the incidence of the condition in girls is higher than in boys (5). In South Korea, the incidence of CPP rose from 89.4 to 415.3 per 100000 in girls under 9 years from 2008 to 2014 (6). Precocious puberty in children can lead to short stature in adulthood (7). Moreover, many studies have shown that girls with precocious puberty are at a high risk of cardiovascular diseases, diabetes, and breast cancer once they become adults (8, 9). In addition, girls with precocious puberty are more likely to have psychological and behavioral problems during adolescence (10, 11).

Dietary intake may play a significant role in pubertal timing (12). However, due to different study populations and dietary assessment methods, the evidence to date were not consistent regarding the association between dietary intake and the onset of puberty. For instance, Jansen *et al.* found that consuming higher frequency of red meat was associated with a significantly earlier age at menarche in girls (≥ 2 times/day vs. <4 times per week: Hazard Ratio (HR) 1.64, 95% CI: 1.11, 2.41) (13). On the contrary, Carwile *et al.* reported no association between peri-pubertal meat intake and age at menarche in 5583 girls from the United States, after adjusting for potential confounders including sociodemographic and nutritional factors (14). Additionally, in a study of 1,008 American girls, it was shown that the frequency of milk intake in girls between 5–12 years was negatively correlated with their age at menarche. Compared to girls with high milk intake, those who consumed the milk less frequently were at a lower risk of early menarche (HR: 0.6, 95% CI: 0.4-1.0) (15). Nevertheless, a prospective cohort study found that the frequency of milk intake could not predict age at onset of menarche (for > 3 glasses of milk/day vs. 1.1–4 glasses/week, HR: 0.93, 95% CI: 0.83, 1.04) (14). Therefore, regular consumption of milk in girls aged ≥ 9 years is unlikely to substantially affect the age at onset of menarche (14). Clearly, more research is warranted to examine the association between dietary intake and precocious puberty risk.

To our best knowledge, there is no study on the association between precocious puberty and dietary intake in the Chinese population. Therefore, our study was the first one to investigate the association between precocious puberty and the frequency as well amount of dietary intake in a paired case-control design in Chinese girls. The findings will provide valuable evidence in developing preventive dietary guidance for girls.

2. Material & Methods

2.1 Study Population

In this case-control study, we recruited 468 participants aged 5–12 years between March 2017 and August 2019 in the Department of Pediatric Endocrinology, Xinhua Hospital Affiliated to Shanghai Jiao Tong University School of Medicine. Among them, 408 girls (204 precocious puberty girls, 204 aged matched controls) agreed to complete the questionnaire. A total of 38 girls were excluded for either incomplete or implausible information. Consequently, 185 precocious puberty girls and 185 age-matched controls were included in the analysis. This study was carried out in accordance with the Declaration of Helsinki and was approved by the Institutional Review Board of the Xinhua Hospital Affiliated to Shanghai Jiao Tong University School of Medicine. Informed consent was obtained from guardians.

2.2 Selection of Cases and Controls

The case group were recruited girls diagnosed with precocious puberty. The diagnostic criteria for precocious puberty were as follows: 1) the development of secondary sexual characteristics (breast growth or sexual hair growth) before 8 years of chronologic age or menarche before 10 years of chronologic age. 2) advanced bone ages ≥ 1 year above the chronologic age; and (3) LH peak ≥ 5 IU/L at the GnRH stimulation test (16). The case group excluded girls with precocious puberty who had a clear cause due to mistaken use of contraceptives.

The inclusion criteria for the control group were as follows: 1). Healthy girls did not be diagnosed with precocious puberty in Xinhua Hospital and whose ages matched to the case group. 2). Girls did not reveal the development of secondary sexual characteristics. However, those with central system, endocrine, reproductive system, and digestive system diseases were excluded.

2.3 Anthropometric indices and dietary assessment

Information on demographic and lifestyle data of participants in both groups was collected through face-to-face interviews by trained dietitians using a structured questionnaire in the Department of Pediatric Endocrinology, Xinhua Hospital Affiliated to Shanghai Jiao Tong University School of Medicine. This included age, physical activity, sleep pattern, dietary habits, questions on parents, and questions on the usage of adult toiletries (such as cosmetics, body wash, and skin cleanser) and homework (consists of tasks that teachers assign students to perform at home). The questionnaire was completed by girls and their parents together.

As for sleep time, trained dietitians asked parents the following question: (a) “On average, how many hours do your children sleep per day?” Children were further grouped into 2 categories (< 8 h, and ≥ 8 h per day) based on their average daily sleep time.

Additionally, physical examination was done by trained dietitians to obtain the height and body weight of the participants, following a standardized protocol. Body mass index (BMI) was calculated as weight (kilograms) divided by the square of height (meters^2).

The amount and frequency of dietary intake, including meat, poultry, fish and shrimp, vegetable, fruit, dairy products, eggs, and soy products, were assessed through a validated semi-quantitative food frequency questionnaire (17). The assessment was conducted by a trained nutrition professional on a one-on-one basis.

2.4 Statistical analysis

SPSS 25.0 was used for data analysis. The paired *t* test was used to compare the difference of continuous data between the case and the control groups. The paired chi-square test was used to analyze categorical data between groups. The conditional logistic regression model was used to determine Odds Ratio (OR) of precocious puberty by tertiles of dietary variables., after adjusted for BMI, girls’ lifestyle (including physical activity, sleep time, sleep with light exposure, use adult toiletries, heavy homework burden, and dietary habits), mother's age at menarche, father’s age at first spermatorrhea, family income, and parents' educational level. We performed tests for linear trend with the use of tertiles of the dietary variable as a continuous variable by assigning the median values of the tertiles to the variable. Statistical significance was set at $P < 0.05$.

3. Results

3.1 Comparison of the general characteristics between the case group and the control group

The average age of girls in the case group and the control group was 7.84 ± 1.05 and 7.71 ± 1.48 years (P>0.05), respectively (Table 1). Despite a higher weight and height of girls in the case group than in the control group, there was no statistical difference in BMI between the two groups (P=0.077). The rate of sleeping with light exposure, use of adult toiletries, and percentage of participants claiming heavy homework burden was significantly higher in the case group than that in the control group (P<0.05). In addition, the percentage of participants having more meat and fewer vegetables was higher in the case group than in the control group. There were no significant differences in other characteristics between the two groups (Table 1).

3.2 The dietary pattern of girls in the case and the control groups

In this study, the vegetable intake of girls in the case group (163.99±122.61 g/day) was significantly lower than that of the control group (217.07±147.54 g/day) (P<0.05). There were no significant differences in the intakes of red meat and poultry, fish and shrimp, milk, eggs, and soy products between the two groups as shown in Table 2.

Recommendations on "Student Meal Nutrition Guidelines" were issued by China's Health and Family Planning Commission in 2017 (18). The dietary intake of children in the case and the control groups were compared to the recommended intake for girls aged 5-12. In both groups, the intakes of poultry and red meat were higher than the recommended intake (P<0.05) while the intakes of vegetables and soy products were lower than the recommended dietary intake (P<0.05). In addition, in the case group only the consumption of eggs was lower than the recommended amount (P<0.05).

3.3 Frequency of dietary intake and precocious puberty risk

Conditional logistic regression models were used to explore the effects of frequency of dietary intake on girls with precocious puberty (Table 3).

In model 3, after multivariate adjustment, higher fruit intake frequency was associated with lower risk of precocious puberty. Specifically, the adjusted ORs (95% CI) for the risk of precocious puberty in fruit intake of 7-10 times/week group and 10 times/week group were 0.36 (0.14, 0.91) and 0.21 (0.05, 0.94), respectively compared to the <7times/week group (P for trend = 0.024). There was no association between the frequency of red meat, poultry, fish, shrimp, soy products, milk, vegetables, and egg intakes and risk of precocious puberty after adjusted for potential confounders.

3.4 Amount of dietary intake and precocious puberty risk

Conditional logistic regression models were used to explore the amount of dietary intake on precocious puberty (Table 4).

In model 3, after multivariate adjustment, a higher amount of red meat intake was associated with an increased risk of precocious puberty (*P* for trend = 0.012). Specifically, compared with consuming <25 g/day red meat, the adjusted ORs (CI) for the risk of precocious puberty was 1.95 (0.87, 4.39), and 2.74 (1.25, 6.02), respectively when consuming 25-50 g/day and 50 g/day red meat.

Also in model 3, a higher amount of vegetables and fruits intake was inversely associated with precocious puberty risk (vegetables: *P* for trend = 0.002; fruits: *P* for trend = 0.033). Compared with consuming <112.5 g/day vegetables, the adjusted ORs (CI) for the risk of precocious puberty were 0.31 (0.12, 0.77), and 0.25 (0.11, 0.59), respectively when consuming 112.5-240.0g/day and 240.0 g/day vegetables. Furthermore, when comparing the amount of fruit intake 200 g/day with <150 g/day, the adjusted OR (95% CI) was 0.53 (0.26, 1.09). Notably, the amount of fish, shrimp, soy products, milk, and eggs intake had no significant effect on the risk of precocious puberty, after multivariate adjustment.

4. Discussion

The present study compared the dietary intake between 185 precocious puberty girls and 185 age-matched controls. The association between the frequency and amount of dietary intake and the risk of precocious puberty was examined. Several important findings were derived. To the best of our knowledge, this is the first study examining the relationship between seven food groups recommended by the diet pagoda and precocious puberty in Chinese girls.

This study for the first time showed that the intake of poultry and red meat of the children in the case group and the control group was higher than the recommended dietary intake, while the intake of vegetables and soy products were lower than the recommended dietary intake. Moreover, the vegetable intake in the case group was significantly lower than that of the control group. Additionally, the egg intake in the case group did not reach the dietary recommended intake standard. These results indicate that the current dietary structure of children is not reasonable enough, especially for girls with precocious puberty.

This study revealed that higher amount of red meat intake was associated with a greater risk of developing precocious puberty in girls. A recent cohort study showed that increased intake of meat by girls during childhood was related to early age menarche, which was consistent with our findings (13). Additionally, girls who consumed red meat 2 times or more per day were 64% more likely to develop early age menarche (13). Previous studies found that increased intake of animal protein may lead to early puberty (4, 19). This may be partially due to the protein-mediated secretion of the Insulin-like Growth Factor I (IGF-1). Increased intake of animal protein could potentially promote the secretion of IGF-1 (20). IGF-I might regulate the reproductive system via widespread effects on hypothalamus, pituitary, and ovaries through its endocrine, paracrine, and autocrine actions based on the developmental and hormonal state (21, 22). Additionally, animal models showed that IGF-1 could promote the production of GnRH (23). Therefore, the higher intake of red meat may increase the secretion of IGF-1, which in turn increases the risk of precocious puberty. Moreover, high fat content in red meat may contribute too as previous studies have reported that a high dietary fat intake led to early onset of pubertal growth in children (4, 24).

Additionally, our study found that a higher frequency of daily fruit and vegetable intake was associated with a lower risk of precocious puberty in girls. One study has suggested that dietary fiber may reduce the body's estrogen levels by inhibiting the dissociation of estrogen conjugates and increasing fecal excretion of estrogen, thereby delaying pubertal development (12). Furthermore, Koo *et al.* reported that the fiber intake in the highest quartile (= 25.5g/day) led to a 0.54-fold reduction in the risk of early menarche in 637 Canadian girls age 6–14 years compared to fiber intake in the lowest quartile (≤ 18.2g/day) (25). Similarly, Tian *et al.* showed that children and adolescents who had a higher dietary fiber intake, especially those derived from fruits, had a later onset of adolescence (26).

This study had some strengths. First, it is the first study to investigate the association between precocious puberty and the frequency as well as the amount of specific dietary intake in a paired case-control design. Second, it is the first study to examine the relationship between the seven food groups in the diet pagoda and precocious puberty in Chinese girls. Third, dietary assessments were conducted by trained and professional Chinese registered dieticians

However, a few limitations from the study can be pointed out. First, recall bias may exist due to the nature of the questionnaire survey. Second, dietary intake was only assessed by food frequency questionnaires. Therefore, some dietary intake such as total energy intake or fat intake could not be calculated, thereby limiting the interpretation of the results. In the future, a 3-day food record could be used for an accurate assessment of dietary intake. Another shortcoming was that the sample size was not large enough. An increased sample size would increase the power to test the association.

5. Conclusion

Consuming more fruits and vegetables and less red meat could potentially reduce the risk of precocious puberty in Chinese girls. It is crucial to advocate for proper nutrition in children in order to prevent the onset of precocious puberty.

Abbreviations

CPP: Central Precocious Puberty; PPP: Peripheral Precocious Puberty; HR: Hazard Ratio; OR: Odds Ratio

Declarations

Ethics approval and consent to participate

This study was carried out in accordance with the Declaration of Helsinki and was approved by the Institutional Review Board of the Xinhua Hospital Affiliated to Shanghai Jiao Tong University School of Medicine (No.2015-15). All participants provided written informed consent.

Consent for publication

Not applicable.

Availability of data and material

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors have no conflicts of interest to declare.

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Authors' contributions

Xiuhua Shen and Youmei Wu designed the study. Youmei Wu, Zhuowei Feng, Yimeng Chai, and Shan Hou contributed to acquire the data. Qiuyun Gu analysed the data. Qiuyun Gu and Youmei Wu wrote the manuscript. Zhiping Yu contributed to English editing. Xiuhua Shen had primary responsibility for final content. All the authors accepted the final version.

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Tables

Table 1. Comparison of the general characteristics between the case group and the control group

Characteristics[1]	Cases (n=185)	Controls (n=185)	*P* value
Girls			
Age, y	7.84 ± 1.05	7.71 ± 1.48	0.31
Height, cm	133.57±6.91	130.87±10.05	< 0.001
Weight, kg	30.30±6.36	28.48±6.96	0.006
BMI, kg/m^2	17.03 ± 3.14	16.49 ± 2.99	0.09
Physical activity, min/d	52.03 ± 36.17	53.15 ± 46.61	0.80
Sleep time (h), %			0.84
< 8	7.03	6.52	
≥ 8	92.97	93.48	
Sleep with light exposure(Yes) , %	16.22	7.61	0.01
Use adult toiletries (Yes), %	31.35	16.76	0.004
Heavy homework burden (Yes), %	31.52	17.39	0.002
Always live with mother (Yes), %			0.10
Yes	89.19	95.68	
No	10.81	4.32	
Always live with father (Yes),, %			0.50
Yes	84.32	88.11	
No	15.68	11.89	
Dietary habits, %			<0.001
Meat and vegetable balance	26.86	37.30	
More meat and less vegetable	58.86	38.92	
More vegetable and less meat	10.29	20.54	
Others	4.00	3.24	
Mothers			
Mother's age at menarche, y	13.38 ± 1.32	13.76 ± 1.28	0.06
Age at girl's birth, y	27.46 ± 3.95	27.87 ± 4.18	0.45
Illness during pregnancy (Yes), %	5.98	4.89	0.65

Illness during lactation (Yes), %	3.80	3.26	0.78
Exposure to toxic substances during pregnancy[2] (Yes), %	7.61	4.35	0.22
Mother's education level, %			0.26
Middle school or lower	9.19	11.41	
High school	18.38	12.50	
College or higher	72.43	76.09	
Father's			
Father's age at first spermatorrhea, y	13.08 ± 1.32	13.76 ± 1.28	0.46
Father's education level, %			0.74
Middle school or lower	9.19	11.41	
High school	15.68	14.13	
College or higher	75.14	74.46	
Family income (Yuan/month), %			0.98
<3000	1.66	1.70	
3000~5000	6.08	5.11	
5000~8000	16.02	15.34	
>8000	76.24	77.84	

[1]Mean (standard deviation), unless otherwise stated.

[2]Toxic and harmful substances include chemical pollutants (gasoline, paint, leather, etc.), and pesticides, etc.

Table 2. The dietary pattern of girls in the case and the control groups

Food parameter (g/d)	Cases (n=185)	Controls (n=185)	Recommended intake[3] (g)
Red meat	46.95±31.87	43.75±41.26	
Poultry	12.58±19.26	13.74±17.35	
Red meat and poultry	59.53±37.78[2]	57.49±51.11[2]	40
Fish and shrimp	38.23±44.60	38.99±39.73	40
Vegetables	163.99±122.61[1,2]	217.07±147.54[2]	350
Fruits	185.98±134.49	208.62±121.94	200
Dairy products	206.22±148.18	208.97±145.73	200
Eggs	41.15±33.70[2]	48.75±50.92	50
Soy products	13.72±24.45[2]	13.94±17.87[2]	32.5

[1]Compared to the control group, $P < 0.05$

[2]Compared to the recommended intake, $P < 0.05$

[3]Recommended intake was from "Student Meal Nutrition Guidelines" issued by China's Health and Family Planning Commission in 2017.

Table 3 Odds ratios for precocious puberty risk across the frequency of dietary intake

Food frequency	Cases,n	Controls,n	Model 1	Model 2	Model 3
Red meat					
< 4 time/week	39	66	1.0	1.0	1.0
4-10 time/week	84	76	1.89 (1.11, 3.23)	2.13 (1.23, 3.70)	1.73 (0.80, 3.75)
≥ 10 time/week	62	43	2.40 (1.36, 4.25)	2.67 (1.48, 4.82)	2.30 (0.99, 5.32)
P for trend			0.003	0.001	0.055
Poultry					
< 1 time/week	71	49	1.0	1.0	1.0
1-2 time/week	55	73	0.49 (0.29, 0.84)	0.48 (0.28, 0.84)	0.51 (0.26, 1.01)
≥ 2 time/week	59	63	0.66 (0.40, 1.09)	0.64 (0.38, 1.05)	0.68 (0.33, 1.40)
P for trend			0.113	0.083	0.261
Fish and shrimp					
< 2 time/week	63	64	1.0	1.0	1.0
2-3 time/week	52	42	1.21 (0.69, 2.11)	1.29 (0.72, 2.31)	1.83 (0.81, 4.11)
≥ 3 time/week	70	79	0.90 (0.56, 1.47)	0.90 (0.55, 1.48)	0.99 (0.51, 1.93)
P for trend			0.680	0.676	0.855
Soy products					
< 1 time/week	50	45	1.0	1.0	1.0
1-2 time/week	45	49	0.77 (0.43, 1.39)	0.73 (0.40, 1.33)	0.54 (0.22, 1.34)
2-3 time/week	45	45	0.92 (0.51, 1.65)	0.87 (0.48, 1.57)	0.63 (0.27, 1.49)
≥ 3 time/week	45	46	0.87 (0.49, 1.53)	0.81 (0.46, 1.45)	0.88 (0.39, 1.96)
P for trend			0.821	0.671	0.893
Fruits					
< 7 time/week	35	19	1.0	1.0	1.0
7-10 time/week	135	150	0.51 (0.28, 0.94)	0.49 (0.26, 0.91)	0.36 (0.14, 0.91)
≥ 10 time/week	15	16	0.50 (0.19, 1.32)	0.48 (0.18, 1.29)	0.21 (0.05, 0.94)

P for trend			0.068	0.060	0.024
Dairy products					
< 7 time/week	53	47	1.0	1.0	1.0
7-10 time/week	109	112	0.80 (0.50, 1.28)	0.72 (0.44, 1.17)	1.23 (0.64, 2.36)
≥ 10 time/week	23	26	0.74 (0.37, 1.49)	0.71 (0.35, 1.45)	0.94 (0.35, 2.49)
P for trend			0.329	0.237	0.902
Vegetables					
< 14 time/week	32	26	1.0	1.0	1.0
≥ 14 time/week	153	159	0.78 (0.43, 1.42)	0.79 (0.43, 1.44)	0.84 (0.35, 2.00)
Eggs					
< 7 time/week	93	72	1.0	1.0	1.0
≥ 7 time/week	92	113	0.61 (0.39, 0.95)	0.60 (0.38, 0.94)	1.14 (0.61, 2.14)

Model 1: Unadjusted model

Model 2: Adjusted for BMI

Model 3: Based on model 2, girls’ lifestyle characteristics (including physical activity, sleep time, sleep with light exposure, use of adult toiletries, heavy homework burden, and dietary habits), mother’s age at menarche, father’s age at first spermatorrhea, family income, and parents’ educational level were further adjusted

Table 4 Odds ratios for precocious puberty risk across the amount of dietary intake

Food amount	Cases,n	Controls,n	Model 1	Model 2	Model 3
Red meat					
< 25 g/day	43	68	1.0	1.0	1.0
25-50 g/day	52	48	1.81 (1.03, 3.21)	1.90 (1.06, 3.43)	1.95 (0.87, 4.39)
≥ 50 g/day	90	69	2.10 (1.23, 3.57)	2.06 (1.20, 3.53)	2.74 (1.25, 6.02)
P for trend			0.007	0.010	0.012
Poultry					
< 4.29 g/day	70	53	1.0	1.0	1.0
4.29-12.85 g/day	54	66	0.57 (0.33, 0.98)	0.54 (0.31, 0.94)	0.58 (0.28, 1.19)
≥ 12.85 g/day	61	66	0.71 (0.43, 1.16)	0.69 (0.42, 1.13)	0.82 (0.41, 1.65)
P for trend			0.194	0.159	0.584
Fish and shrimp					
< 15.71 g/day	71	51	1.0	1.0	1.0
15.71-37.50 g/day	54	69	0.49 (0.29, 0.83)	0.49 (0.29, 0.84)	0.62 (0.30, 1.30)
≥37.50 g/day	60	65	0.63 (0.37, 1.06)	0.68 (0.40, 1.15)	0.93 (0.45, 1.92)
P for trend			0.086	0.143	0.905
Soy products					
< 3.33 g/day	63	59	1.0	1.0	1.0
3.33-12.50 g/day	63	58	1.02 (0.62, 1.69)	0.98 (0.58, 1.64)	0.91 (0.44, 1.87)
≥12.50 g/day	59	68	0.85 (0.51, 1.42)	0.82 (0.48, 1.37)	1.02 (0.51, 2.04)
P for trend			0.527	0.440	0.934
Vegetables					
< 112.5 g/day	79	44	1.0	1.0	1.0
112.5-240.0 g/day	60	61	0.51 (0.29, 0.91)	0.49 (0.27, 0.87)	0.31 (0.12, 0.77)
≥ 240.0 g/day	46	80	0.32 (0.18,	0.31 (0.17,	0.25 (0.11,

			0.58)	0.56)	0.59)
P for trend			0.0001	0.0001	0.002
Fruits					
< 150 g/day	58	45	1.0	1.0	1.0
150-200 g/day	34	23	1.18 (0.58, 2.37)	1.18 (0.57, 2.44)	1.84 (0.66, 5.13)
≥200 g/day	93	117	0.64 (0.40, 1.04)	0.64 (0.39, 1.03)	0.53 (0.26, 1.09)
P for trend			0.040	0.035	0.033
Dairy products					
< 140 mL/day	66	57	1.0	1.0	1.0
140-220 mL/day	29	38	0.63 (0.33, 1.18)	0.59 (0.31, 1.13)	1.51 (0.62, 3.70)
≥220 mL/day	90	90	0.78 (0.49, 1.23)	0.72 (0.45, 1.15)	1.09 (0.57, 2.07)
P for trend			0.368	0.230	0.903
Eggs					
< 25.71 g/day	72	51	1.0	1.0	1.0
25.71-60.00 g/day	26	28	0.67 (0.34, 1.30)	0.65 (0.33, 1.28)	0.45 (0.17, 1.17)
≥ 60.00 g/day	87	106	0.59 (0.36, 0.95)	0.57 (0.35, 0.94)	0.94 (0.46, 1.91)
P for trend			0.031	0.028	0.950

Model 1: Unadjusted model

Model 2: Adjusted for BMI

Model 3: Based on model 2, girls' lifestyle characteristics (including physical activity, sleep time, sleep with light exposure, use adult toiletries, heavy homework burden, and dietary habits), mother's age at menarche, father's age at first spermatorrhea, family income, and parents' educational level were further adjust.