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Soft drink and sweet food consumption and suicidal behaviours among Chinese adolescents

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ABSTRACT

Aim: Greater soft drink consumption was associated with increased risk of mental health problems in Western countries. The objective of the study was to examine the association between soft drink and sweet food consumption and suicidal behaviours among adolescents in China.

Methods: In 2005, a population-based cross-sectional study was conducted in 100 schools in Jiangsu Province, China. Participants were aged 12–19 years old (n = 23 976).

Results: Among the participants, 20.5% reported daily soft drink consumption; 18.6% reported having suicidal ideation. Soft drink consumption was significantly and positively associated with risk of suicidal plan or suicide attempt. Prevalence of suicidal plan was12.8% among those who consumed soft drink at least three times per day and 6.2% among those who did not consume any soft drinks. In multivariate analyses, compared with soft drink consumption less than once per day, consumption at least three times per day was associated with 80% increased risk for suicidal plan and more than 3.5-fold increased risk for suicide attempt. Of note, nonconsumption of soft drinks was also associated with about 32% elevated risk for suicidal plan and suicidal attempt. High frequency intake of sweet food was associated with increased risk of suicidal behaviours.

Conclusions: There is a positive association between consumption of soft drinks and sweet food and risks for suicidal behaviours among adolescents in China. Prospective studies are warranted to confirm these findings.

INTRODUCTION

Suicide among adolescents is an increasing public health problem worldwide (1). In China, suicide accounted for 3.6% of all deaths and was the fifth most important cause of death (2). Among younger age groups (15–34 years), 18.9% of all deaths were reported as being caused by suicide (2). In a recent national study, 2.7% of in-school adolescents reported a suicide attempt during the past year (3). Suicidal ideation among adolescents is not only related to suicide but also has long-term effects on health status when they become adults (4). Moreover, suicidal ideation was related to poor academic performance among Chinese adolescents (5). Both psychological and socio-demographical factors were related to suicide among Chinese (6–8); for instance, low socioeconomic status (SES) was associated with a higher risk of suicide than high SES (6). Among limited studies on lifestyle factors, cigarette smoking and drinking were related to suicidal behaviours (9). Dietary patterns were found to be related to mental health among adolescents (10). There is a strong link between mental health and suicide (11).

Soft drinks are the leading source of added sugars in western diets (12). With the influx of western diets into China since the 1980s, consumption of soft drinks increased substantially in the past three decades in China, especially among adolescents. In both animal models and human studies, high-sugar consumption was related to reduced insulin sensitivity (13,14), impaired insulin secretion (15)

Key notes

- A population-based cross-sectional study was conducted in 100 schools in Jiangsu Province, China. In total, 23 976 students aged 12–19 years old participated in the study. The study showed a positive association between consumption of soft drink and sweet food and risks for suicidal behaviours among adolescents in China. Both consumption at least three times per day and nonconsumption of soft drinks are related to an elevated risk.

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and elevated oxidative stress. All these conditions have been related to depression and related mental disorders. For instance, in a large study in Australia, greater soft drink consumption was significantly related to elevated risk for mental health problems including suicidal ideation, stress and psychological distress in adults (16). A positive association between soft drink consumption and mental health problems, including hyperactivity, mental distress and conduct problems, was also reported among adolescents in Norway (17). A study in India found an association between soft drink and mental health outcomes among those aged 17–23 years (18).

It is known that individuals with depression are more likely to crave for sweet foods such as soft drinks (19). The relationship between soft drink and sweet food consumption with suicidal behaviours could be bi-directional.

Despite that suicide is a major cause of death among younger generations in China, we are unaware of studies assessing the association between soft drink and sweet food consumption and suicidal behaviours in China. Using data from the Chinese National Youth Risk Behavior Surveillance (CNYRBS) in 2005, we investigated such associations among 23 976 Chinese adolescents.

METHODS

Study population

In 2005, Chinese Center for Disease Control and Prevention (CDC) launched a national survey in youth risk behaviour (20). A multistage cluster sampling method was used to select the participants. The data presented in this article are based on the sample from Jiangsu province, which is one of the economically prosperous areas of China with a population of 74 million. Students from urban areas were recruited from four prefecture capital cities (Nanjing, Suzhou, Xuzhou and Yanchen). Participants from rural areas were selected from four counties (Yixin, Sheyang, Kunshan and Tongzhou). In each city/county, 9–15 schools were randomly selected. In total, 100 schools (44 junior, 56 high schools) in the province participated in the study. In each school, 150–300 students were randomly selected. In total, 24 649 students aged 12–19 years participated in the study, with a response rate of 99%. In the current analysis, we included 23 976 participants having both information on soft drink consumption and suicidal behaviours. Verbal consent was obtained from each participating student before the survey. Ethical approval of the study as well as the procedure of seeking informed consent was obtained from Chinese CDC.

DATA COLLECTION

Measurement of soft drink consumption

The students filled in the questionnaire anonymously in the classroom within a 40-min period in the presence of the health workers from local CDCs who addressed questions raised by students. Instructions on filling in the questionnaire were given beforehand to students. Soft drink consumption was asked using the following question: 'How often did you drink soft drinks (e.g. Cola, Sprite) during the past 30 days?' Answers were categorized as none, <1 time/day, 1 time/day, 2 times/day, 3 times/day, 4 times/day and 5 times/day or more. As the majority of soft drinks sold in China are nondiet, diet soft drink consumption was not distinguished from nondiet soft drinks.

Measurement of suicidal behaviours

Suicidal behaviours were assessed by the following pretested question: 'During the past 12 months, did you consider suicide?' Answers to the question are as follows: (i) considered (yes/no); (ii) considered and made a plan (yes/no); (iii) tried to commit suicide (yes/no). Positive answer to response 1–3 was defined as suicidal ideation, suicidal plan and suicidal attempt, respectively. A similar question has been used to assess suicidal behaviours in Korea Youth Behavioral Risk Factor Surveillance (9).

Measurement of other variables

Information on demographical characteristics and health-related factors (school grade, school type (normal, distinguished, vocational), school performance, place of residence, smoking, drinking and physical activity, education of mother, overweight/obesity) was collected using standardized questionnaire. School grades were divided into two levels: junior school and high school. School performances were assessed using the following question: 'Compared with your classmates, how would you describe your school performance?' Responses were categorized as low, lower middle, middle, upper middle, high and do not know. Place of residence was classified as urban and rural. Perceived sadness/hopelessness was defined as a positive response to the following question: 'During the past 12 months, have you ever felt sad or hopeless for 2 weeks or more to the extent that you stopped some of your normal activities?' Smoking/drinking was assessed using the following question: 'How many days during the past 30 days did you smoke a cigarette/drink alcohol?' Answers were categorized as none, 1–9 days, 10–19 days, 20–29 days, and all 30 days. Frequency of physical activity during the past 7 days was asked. Frequencies of selected food (milk, Western fast food and sweet foods including candy, cakes and chocolate) and breakfast meal during the past 7 days were asked. A total sweet food frequency score was calculated as the sum of the frequencies of sweet foods and soft drinks consumption during the past 7 days. To assess distorted eating behaviours, fasting for 24 h and vomiting were assessed by the following two questions: (i) 'During the past 30 days, did you go without eating for 24 h or more to lose weight or keep from gaining weight?'; (ii) 'During the past 30 days, did you vomit to lose weight or keep from gaining weight?'. Body weight and height were also asked. Body mass index (BMI) was calculated as weight in kilograms divided by height in metres squared. Overweight/obesity was defined according to the standard for Chinese school-age children (21). The criteria used BMI cut-off corresponding to BMI of 24 and

Table 1 Characteristics of 23 976 Chinese adolescents, Jiangsu Province, China

	N	(%)	Suicidal ideation (%)	Suicidal plan (%)	Suicidal attempt (%)
Gender					
Boy	12 087	50.4	15.1	5.6	2.8
Girl	11 889	49.6	22.5	7.0	2.5
Residency area					
Urban	12 365	51.6	20.3	6.6	2.7
Rural	11 611	48.4	17.1	6.1	2.6
Year of school grade					
Junior school	10 081	42.0	18.5	6.8	3.1
High school	13 895	58.0	18.9	6.0	2.4
Educational level of mother					
Primary and under	3806	16.0	17.5	6.5	2.7
Junior school	9905	41.5	17.7	5.8	2.5
High school and higher	10 120	42.5	20.1	6.6	2.7
Type of school					
Normal	9824	41.0	18.6	6.9	3.0
Distinguished	10 104	42.1	19.4	5.9	2.3
Vocational	4048	16.9	17.4	6.0	2.7
Self-rated school performance					
Below middle	5763	26.3	23.1	8.9	3.8
Middle	7904	36.0	16.9	5.5	2.4
Above middle	8271	37.7	17.0	5.2	2.0
Body mass index (kg/m^2)					
Normal	16 603	91.9	18.5	6.2	2.4
Overweight/obesity[a]	1470	8.1	18.8	5.9	3.1
Cigarette smoking during past 30 days					
0	22 070	92.4	18.0	5.7	2.1
<10 days	1215	5.1	26.3	12.6	7.3
≥10 days	604	2.5	28.0	15.1	12.1
Alcohol drinking during past 30 days					
0	19 687	82.4	17.0	5.2	1.9
<10 days	3484	14.6	26.5	10.6	5.3
≥10 days	734	3.1	27.5	16.8	10.8
Physical activity during past 7 days					
<60 min	6501	27.2	22.8	7.4	3.0
At least 60 min in 1–4 days	11358	47.5	17.4	6.0	2.4
At least 60 min in ≥5 days	6063	25.3	17.0	5.7	2.8
Sweet food frequency (candy, cakes, chocolate) during past 7 days					
0	2590	10.8	16.4	5.7	2.9
<7 times	14 255	59.5	17.7	5.8	2.3
≥7 times	7131	29.7	21.7	7.5	3.3
Western fast food during past 7 days					
<3 days	23 032	96.4	18.4	6.1	2.4
≥3 days	857	3.6	28.5	13.3	10.4
Milk drinking during past 7 days					
<3 days	8490	35.4	18.5	6.6	3.0
≥3 days	15 473	64.6	18.9	6.2	2.5
Breakfast during past 7 days					
<3 days	1481	6.2	28.3	13.2	7.6
≥3 days	22 487	93.8	18.1	5.9	2.3
Total sweet food frequency including soft drink score (times/week)					
0–1	15 357	64.0	17.8	5.6	2.0
1.5–2	4356	18.2	18.2	6.1	2.6
3–4	3664	15.3	22.0	8.2	4.3
6	599	2.5	27.7	13.9	9.7

28 kg/m^2 in adults to define overweight and obesity, a method similar to International Obesity Task Force (IOTF) criteria (22).

STATISTICAL ANALYSES

Chi square tests were used to compare differences in categorical variables. The association between soft drink

consumption and the risk of suicidal behaviours was analyzed using logistic regression models, adjusting for multiple covariates. Covariates included in the logistic regression models were age (continuous), gender, mother's education, residence, smoking, alcohol consumption, milk, Western fast food, frequency of sweet food consumption, frequency of breakfast, physical activity and overweight. Tests of linear trends across groups of soft drink consumption were computed using ordinal scoring in the logistic regression. Statistical significance was considered when $p < 0.05$ (two sided). All the analyses were performed by using STATA software (version 10; StataCorp, College Station, TX, USA).

RESULTS

Overall, 23 976 adolescents aged 12–19 years (mean 15.7 years, 50% boys) participated in the study. The prevalence of suicidal ideation, suicidal plan and suicidal attempt was 18.6%, 6.2% and 2.6%, respectively.

In total, 28% of the participants reported no consumption of soft drinks, and 20% reported at least one drink a day (daily consumption) (Table 1). The prevalence of cigarette smoking was about 8%. Of the participants, about 18% reported alcohol drinking during the past 30 days. Among boys, those who consumed more soft drink were more likely to be physically active and less likely to be overweight or obese, whereas such associations were not observed among girls. In addition, the sweet food frequency score was significantly and positively associated with the prevalence of suicidal behaviours. Figure 1 shows the prevalence of vomiting/fasting to control weight by soft drink consumption among those with or without suicidal behaviour. Distorted eating behaviours were common among those with suicidal behaviours and were positively related to soft drink consumption. Among those with a suicidal plan and who had soft drink more than three times per day, 19% reported fasting and 17% reported vomiting as measures to control weight.

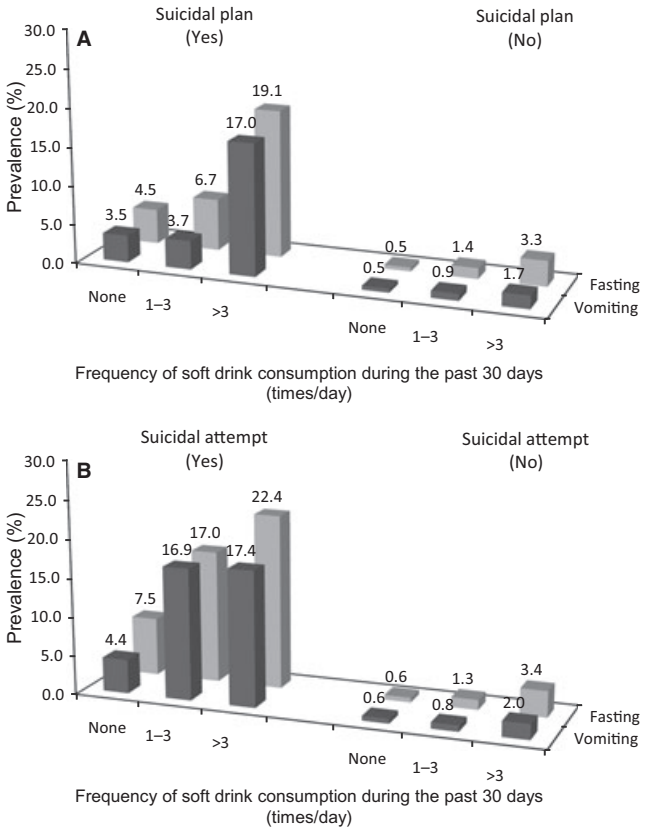

Figure 1 Prevalence of vomiting/fasting to control weight by soft drink consumption and (A) suicidal plan (yes/no) (B) suicidal attempt (yes/no).

Consumption of soft drink was positively associated with risk of insomnia, perceived sadness, suicidal plan and suicidal attempt (Table 2). Prevalence of a suicidal plan was about 13% among those who consumed soft drink at least three times per day and 6% among those who did not consume any soft drinks. The positive association between soft drink consumption and perceived sadness, suicidal plan and suicidal attempts were similar between boys and girls. In multivariate analyses (Table 3), after adjusting for sociodemographical and lifestyle factors, compared with soft drink consumption less than once per day, consumption at least three times per day was associated with 80% increased risk for suicidal plan (odds ratio (95% confidence interval) [OR (95% CI):1.8 (1.37–2.37)] and more than 3.5-fold increased risk for suicide attempt [OR (95% CI): 3.47 (2.48–4.87)]. Adjusting for age and gender, those who consumed soft drinks at least three times per day were associated with 34% increased risk for suicidal ideation as compared with those who did not consume any soft drinks. However, this association was attenuated and became nonsignificant in the fully adjusted model. Of note, nonconsumption of soft drinks was also associated with an elevated risk for suicidal plan and suicidal attempt (OR (95% CI) was 1.21 (1.04–1.41) and 1.32 (1.03–1.69), respectively).

We further examined whether the association of soft drink consumption with risks for suicidal behaviours was modified by other factors related to suicidal behaviours such as physical activity levels (high vs. low), BMI (overweight or obese vs. normal weight) and cigarette smoking (yes vs. no) by stratified analyses. The positive association of soft drink consumption with risks of suicidal behaviours persisted across different strata although the association was not significant for some strata because of the smaller sample size (data not shown).

The association of the total sweet food frequency score including soft drinks with suicidal behaviours is shown in Table 4. The total sweet foods frequency score was significantly and positively associated with suicidal ideation, suicidal plan and suicidal attempt (Table 4). Alcohol consumption was related to an increased risk for suicidal tendencies as compared with the nonconsumption of alcohol (data not shown).

Table 2 Prevalence of suicidal and health risk behaviours (%) by the frequency of soft drink consumption among 23 976 Chinese adolescents, Jiangsu Province, China

	Soft drink consumption (times/day)				
	None	<1	1–2	≥3	p
Both genders					
N (%)	6801 (28.4)	12171 (50.8)	4179 (17.4)	825 (3.4)	
Perceived sadness	13.8	13.4	17.0	18.7	<0.001
Suicidal ideation	18.7	18.8	17.8	22.9	0.007
Suicidal plan	6.2	5.6	7.2	12.9	<0.001
Suicidal attempt	2.4	2.0	3.5	10.4	<0.001
Smoking	3.8	7.1	12.9	19.8	<0.001
Alcohol drinking	10.8	17.9	26.1	33.3	<0.001
Overweight/obesity	8.3	8.2	7.5	8.4	0.547
High physical activity level*	24.5	24.3	28.5	31.5	<0.001
Boys					
N (%)	2890 (23.9)	6331 (52.4)	2373 (19.6)	493 (4.1)	
Perceived sadness	13.4	13.3	17.0	18.9	<0.001
Suicidal ideation	14.9	14.8	14.8	20.7	0.005
Suicidal plan	5.9	4.6	6.4	13.0	<0.001
Suicidal attempt	2.6	1.9	3.7	11.4	<0.001
Smoking	7.6	11.4	19.3	26.7	<0.001
Alcohol drinking	14.2	21.3	30.8	36.4	<0.001
Overweight/obesity	12.6	11.3	9.2	9.4	0.004
High physical activity level*	29.5	29.0	34.7	39.1	<0.001
Girls					
N (%)	3911 (32.9)	5840 (49.1)	1806 (15.2)	332 (2.8)	
Perceived sadness	14.2	13.6	17.1	18.4	0.002
Suicidal ideation	21.6	23.1	21.7	26.2	0.088
Suicidal plan	6.4	6.8	8.2	12.7	<0.001
Suicidal attempt	2.2	2.0	3.3	9.0	<0.001
Smoking	1.0	2.6	4.4	9.7	<0.001
Alcohol drinking	8.2	14.2	20.0	28.0	<0.001
Overweight/obesity	5.1	4.7	5.2	6.9	0.445
High physical activity level*	20.7	19.2	20.5	20.2	0.287

*At least 60 min in ≥5 days during the past 7 days.

Table 3 Odds Ratio (95% confidence interval) [OR (95% CI)] for suicidal behaviours according to the frequency of soft drink consumption among 23 976 Chinese adolescents, Jiangsu Province, China

		Frequency of soft drink consumption frequency (times/day)				
		None	<1	1–2	≥3	p for trend
Suicidal ideation	Model 1*	0.95 (0.88–1.03)	1.00	0.96 (0.87–1.05)	1.34 (1.13–1.59)	0.449
OR (95% CI)	Model 2†	1.05 (0.96–1.15)	1.00	0.87 (0.78–0.98)	1.05 (0.85–1.30)	0.249
Suicidal plan OR	Model 1*	1.08 (0.95–1.22)	1.00	1.31 (1.14–1.51)	2.53 (2.03–3.15)	<0.001
(95% CI)	Model 2†	1.21 (1.04–1.41)	1.00	1.06 (0.89–1.26)	1.80 (1.37–2.37)	0.002
Suicidal attempt	Model 1*	1.22 (1.00–1.50)	1.00	1.82 (1.48–2.24)	5.76 (4.44–2.24)	<0.001
OR (95% CI)	Model 2†	1.32 (1.03–1.69)	1.00	1.46 (1.13–1.88)	3.47 (2.48–4.87)	<0.001

*Model 1 adjusted for age and gender.
†Model 2 adjusted for age, gender, region, school type, school performance, education of mother, overweight, smoking, alcohol drinking, physical activity during past 7 days, Western fast food during past 7 days, milk drinking during past 7 days, having breakfast during past 7 days and sweet food consumption during past 7 days.

DISCUSSION

In the current study among adolescents in China, we observed a J-shape association between the frequency of soft drink consumption and risks for suicidal behaviours. The association was significant in both boys and girls and remained significant after the adjustment for SES and lifestyle factors. In addition, the total sweet food frequency score was positively associated with suicidal behaviours.

Studies on suicidal behaviours and soft drink and sweet food consumption among adolescents in mainland of China are scant. The prevalence of suicidal behaviours in the study

Table 4 Odds Ratio (95% confidence interval) [OR (95% CI)] for suicidal behaviours according to total sweet food frequency score among 23 976 Chinese adolescents, Jiangsu Province, China

		Total sweet food frequency score including soft drink				
		0–1	1.5–2	3–4	6	p for trend
Suicidal ideation	Model 1*	1.0	1.02 (0.93–1.11)	1.27 (1.16–1.38)	1.79 (1.49–2.16)	<0.001
OR (95% CI)	Model 2†	1.0	0.94 (0.85–1.04)	1.10 (0.99–1.23)	1.42 (1.14–1.77)	<0.013
Suicidal plan	Model 1*	1.0	1.09 (0.95–1.26)	1.49 (1.30–1.71)	2.75 (2.16–3.50)	<0.001
OR (95% CI)	Model 2†	1.0	0.95 (0.80–1.13)	1.24 (1.05–1.46)	1.72 (1.27–2.32)	<0.001
Suicidal attempt	Model 1*	1.0	1.28 (1.02–1.59)	2.24 (1.84–2.72)	5.19 (3.86–6.98)	<0.001
OR (95% CI)	Model 2†	1.0	1.03 (0.78–1.34)	1.63 (1.28–2.08)	2.53 (1.72–3.74)	<0.001

*Model 1 adjusted for age and gender.
†Model 2 adjusted for age, gender, region, school type, school performance, education of mother, overweight, smoking, alcohol drinking, physical activity during past 7 days, Western fast food during past 7 days, milk drinking during past 7 days having breakfast during past 7 days.

is comparable to another study in China (23). The prevalence of daily soft drink consumption was slightly higher than a study among school adolescents in 2002 in the province (20.5% vs. 17%) (24).

The increased risk of suicidal behaviours associated with greater soft drink consumption observed in the present study is consistent with findings from previous studies in adolescents and adults (16,17). Precise mechanisms underlying this association are unclear. We are aware of the criticisms on Lien's study as well as the interpretations (25). It is plausible that individuals with depression related to suicidal behaviours are more likely to crave sweet foods such as soft drinks (19). A significant linear association between the total sweet food frequency score and suicidal behaviour was found in the present study. Sugar addiction has been found in a few studies (26). A preference for sweet taste predicts mood altering effect of and impaired control over eating sweet foods (27). Increased intake of sugar (or decreased depending on the kind of mental health problems) could be a possible outcome, and a possible marker for mental health problems. Due to the cross-sectional data, we were not able to exclude the possibility that the association between soft drink consumption and suicidal behaviours was purely due to increased thirst among those with mental health problems. It has been observed that individuals with mental illnesses were more likely to report increased thirst (28,29) and therefore, greater soft drink consumption. It is also known that food selection changes by stress and mental problems (30). Some individuals may choose to consume more food to cope with stress and tension. The fact that high prevalence of distorted eating behaviours among those with suicidal behaviours may suggest that soft drink consumption (high or low) is a coping strategy for mental disorders.

However, we cannot rule out the possibility that soft drink consumption can cause suicidal behaviours by its impact on oxidative stress, inflammation and insulin resistance (16,17,31). Overweight/obesity is unlikely a strong mediator between soft drink and suicidal behaviours in the present study as a null or inverse association between soft drink consumption and overweight/obesity was observed in girls and boys, respectively.

Of note, different from previous studies conducted among non-Chinese populations, we also observed an increased risk for suicidal behaviours associated with nonconsumption of soft drinks; compared with a low-frequency soft drink consumption of less than once per day, nonconsumption of soft drinks was also associated with a moderately elevated risk of suicidal behaviours. Such an association could be explained by low social economic status related to both nonconsumption of soft drinks and suicidal behaviours. In China, soft drinks are more expensive than water and other traditional beverages. In contrast to Western countries, soft drink consumption was positively associated with SES in China in our previous study among school adolescents (24). It has been reported that more than 57% of the Chinese adolescents wanted to drink more soft drink if money was not a problem (24). It is plausible that adolescents who did not drink any soft drinks were more likely from families of low social economic status that could not afford soft drinks (24). Low social economic status, on the other hand, was related to a high risk of suicidal behaviours in another study in China (5).

Our study was limited by the cross-sectional feature of the data that precludes the possibility of establishing causal associations and inferring the direction of the association. The association between soft drink, sweet food consumption and suicidal behaviour could be bi-directional. Secondly, the absolute amount of soft drink consumption was not available in the present study although the frequency of the consumption was available. However, it has been shown that the frequency of the consumption of a given food item is closely related to the actual amount of consumed of this item (32). Thirdly, information on other fluid consumption including water, milk and hot drinks (tea and coffee) was not collected. Fourthly, we do not have the data to differentiate the type of soft drinks, for instance, sugar sweetened vs. diet soft drinks. However, it should be noted that the majority of the soft drinks sold in China are sugar sweetened.

The strengths of the study include its large and representative sample and the high response rate. Moreover, we are able to control a variety of confounding factors including cigarette smoking, alcohol drinking, physical activity and

school performance. Although we were not able to control total dietary pattern, we adjusted for milk, western fast food, sweet food frequency consumption as well as breakfast frequency in our analyses.

In conclusion, the current study showed a positive association between consumption of soft drink and sweet food and risks for suicidal behaviours among adolescents in China. Both consumption at least three times per day and nonconsumption of soft drinks are related to an elevated risk. Prospective studies are warranted to confirm these findings.

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CONFLICT OF INTEREST

The authors have no conflict of interest.

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