

Peer-Reviewed Research

Association Between Social Isolation and Eating Alone on Foods Consumed by Chinese Adolescents

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Abstract

Obesity is increasingly affecting Chinese adolescents due to trends in unhealthy eating, including lower fruit and vegetable consumption and increased consumption of processed foods. A cross-sectional study of adolescents was conducted in Wuhan, China, in October 2019 that included measurements of perceived social isolation, eating when anxious or depressed, diet composition, body weight, and height. Social isolation, eating when sad or anxious, and eating alone were significant predictors of processed food and sugar-sweetened beverage consumption, although only eating when sad or anxious was a significant predictor of fruit and vegetable consumption. Eating when anxious or depressed did not mediate these relationships. Social isolation was associated with consumption of processed foods and sugar-sweetened beverages by boys, but not by girls, and only eating home-cooked dinner was associated with fruit and vegetable consumption by female adolescents. Eating when sad or anxious, eating alone, and eating home-cooked meals were all associated with fruit and vegetable consumption among male adolescents. The effects of social isolation, anxiety, and depression could act to increase unhealthy eating through several mechanisms potentially mediated by chronic stress, while eating alone could also act to increase unhealthy eating due to effects of self-efficacy and food availability. The interplay between diet and outside factors, including environment, social factors, and personal psychology specific to Chinese adolescents needs to be better understood to develop comprehensive interventions for this population.

Keywords: eating; adolescent; social isolation; fast foods

Adolescent obesity is a complex multifactorial disease that is becoming increasingly prevalent worldwide (Seidell & Halberstadt, 2015). China has seen an increase in obesity in men from 2.9% to 11.4% and an increase in obesity in women from 5% to 10.1% between 1993 and 2009 (Xi et al., 2012). A recent study from 2018 indicates that although childhood obesity (ages 7–11) in China may have stabilized, adolescent obesity (ages 12–18) continued to worsen increasing from 5.2% to 9.3%, with a noted increase in prevalence of obesity among boys than girls (J. Zhang et al., 2018). Part of this increase can be attributed to changing dietary habits from concentration in large cities (Su et al., 2016; Y. Wang et al., 2016; Zhao et al., 2017). Trends in unhealthy eating, including lower than recommended fruit and vegetable (FV) consumption, increased consumption of Western energy-dense, low-nutrient foods, and increased consumption of sugar-sweetened beverages (SSB), have been shown to contribute

to adolescent obesity in Chinese and non-Chinese adolescents (Chan et al., 2014; Huang & Qi, 2015; Liu et al., 2019; Shan et al., 2010; C. X. Zhang et al., 2012). However, since obesity is a multifactorial disease, the interplay between diet and other factors, including environment, social factors, and individual psychology, needs to be better understood to develop comprehensive interventions. Currently, little is known about how these factors influence diet and obesity in Chinese adolescents.

One potential causative agent of unhealthy eating is adolescent social isolation, which has been extensively documented to be correlated with increased morbidity and mortality (Holt-Lunstad et al., 2015). Isolation has been an especially salient problem in light of the COVID-19 pandemic, where there have been increasing reports of social isolation due to the lockdown countries instituted to prevent spread of the virus (Loades et al., 2020). Adolescents with overweight or obesity are also more

likely to have mental health challenges that may be exacerbated by increased social isolation (Mannan et al., 2016). This interplay between body weight and mental health has also been observed in Chinese adolescents (S. Wang et al., 2019). Studies have indicated an association between better mental health and increased overall positive health practices, including diet and exercise in adolescents, but its effects on specific dietary habits are relatively unknown (Melnik et al., 2006). Previously, it has been found that increased social isolation was associated with decreased self-perceived health (Thompson et al., 2020). Eating alone is associated with being overweight or obese and with unhealthy dietary behavior in American adolescents (Reicks et al., 2019). Lower anxiety and depression have been associated with improved dietary habits in children and adolescents, although the causality and directionality of the relationship is an area of active investigation (Khalid et al., 2016).

The purpose of the present study is to determine the association between social isolation, eating alone, home cooking, and consumption of processed foods, sugar-sweetened beverages, and fruits and vegetables among Chinese adolescents. We hypothesize that social isolation and eating alone will predict unhealthy eating, and that this association will be mediated by eating when anxious or depressed. Secondly, we will examine if these associations differ by gender.

Methods

Participants

A cross-sectional study was conducted in Wuhan, China, in October 2019. The study was conducted in a school where the principal investigators had established a working relationship with school officials over several years. The research team presented study information to all adolescents enrolled in the participating school, and a study information sheet and parental consent forms were sent home with the students. Students whose parent/guardian provided consent were provided with assent forms and questionnaires to collect data on sociodemographic variables, psychosocial factors, perceptions of neighborhood characteristics, physical activity, body weight, and height. A total of 4,027 students consented to participate and provided data, of which 1,084 were excluded owing to missing data on one of the variables of interest. Finally, 2,943 adolescents (aged 10–19; 1,531 boys and 1,412 girls) were included in the analytic sample.

Measures

Adolescents reported their age, gender, ethnicity, body weight, and height. Psychosocial and perceived neighborhood factors were assessed using the questionnaires of the Family Life, Activity, Sun, Health, and Eating (FLASHE) Study (Nebeling et al., 2017), translated into Chinese.

Diet

Adolescent diet was evaluated using a 49-question survey (FLASHE Teen Diet Survey) which was separated

into eight sections: personal attitudes and opinions on food types, typical eating and drinking habits, food eaten away from home, food eaten at home, family meals, food and drink preferences, and parental impact on food choices, respectively. Typical eating and drinking habit questions were items quantifying the amount of certain food and drink choices consumed during a typical week (i.e., DURING THE PAST 7 DAYS, how many times did you eat fruit like apples, bananas, melon, etc.? COUNT fresh, frozen, canned and dried fruit. DON'T COUNT fruit juices.) These questions have been previously validated against 24-hour dietary recall interviews in American adolescents (Olsen et al., 2014), showing significant correlations for consumption ($r = 0.26\text{--}0.49$). Three variables were calculated from the food and drink questionnaires by adding the weekly servings across related food categories; servings of processed foods consumed in the past week, sugar-sweetened beverages consumed in the past week, and servings of fruits and vegetables consumed in the past week.

Social Isolation

Social isolation was assessed using two questions from the UCLA Loneliness Scale. Participants reported perceived degree of agreement with statements on a 1–5 scale with 1 being “never” and 5 being “always” in the FLASHE Teen Physical Activity survey. The statements used to measure this variable were “I feel left out” (6a) and “I feel isolated from others” (6b). In the analytical sample, the coefficient alpha for social isolation was .87.

Eating Alone

Eating alone was evaluated using the statement “I often eat alone” (45c) from the FLASHE Teen Diet Survey. The statement was rated on a scale from 1–5 with 1 being “strongly disagree” and 5 being “strongly agree.”

Eating When Anxious or Depressed

Eating when anxious or depressed was assessed in the FLASHE Teen Diet Survey by asking participants to rate on a 1–5 scale with 1 being “never” and 5 being “always” for how their mood influences excessive/continued food consumption. The questions used were “How often do YOU start or continue to eat when YOU'RE not hungry because you feel sad or depressed?” (7a) and “How often do YOU start or continue to eat when YOU'RE not hungry because you feel anxious or nervous?” (7b). In the analytical sample, the coefficient alpha for social isolation was .82.

Eating Home-Cooked Meals

Eating home-cooked meals was evaluated by asking participants the number of days, during a typical week, they consumed an evening meal at home (43d). The responses ranged from zero days per week to seven days per week.

Body Mass Index (BMI)

BMI was calculated using the FLASHE Annotated Teen Demographic Survey in which teens reported their height (cm) and weight (kg). BMI was then calculated by taking the participants weight in kilograms and dividing it by their height in meters squared. BMI was categorized using World Health Organization growth charts for the adolescent's age and sex.

Demographics

Demographics were compiled from the FLASHE Annotated Teen Demographic Survey. The participants reported their age and sex through two questions.

Analyses

Statistical analyses were performed in fall 2020 using Stata version 15.1. Descriptive statistics were used to describe the distribution of demographic, psychosocial, and dietary intake variables. Three multivariable linear regression models were developed to assess the associations of psychosocial factors with indicators of dietary intake, adjusted for confounding variables, including age, gender, and BMI. Mediation was assessed in accordance with the recommendations of Baron and Kenny (Baron & Kenny, 1986). Models were repeated by gender. Two-tailed statistical significance was set at $p < 0.05$.

Results

The study procedures produced a considerable amount of missing data from variables of interest. Data were most commonly missing for height and weight (used to calculate BMI; $n = 520$) and food frequency ($n = 395$). Those excluded from the analytic sample were more likely to be male and significantly differed from those included on four variables of interest (see Table 1). Participants with complete data differed from those with missing data in that they were older (14.7 years old vs. 14.5 years old, $p < .001$), they reported lower consumption of processed foods (3.6 vs. 4.1 servings/week, $p = .015$), they had lower sugar-sweetened beverage consumption (1.2 vs 1.6 servings/week, $p < .001$), and they reported less eating alone (2.0 vs. 2.2, $p < .001$). The analytical sample was 52% male and 97.9% Han ethnicity. Descriptive statistics for the analytical sample can be seen in Table 1. Regression analyses for servings consumed in the last week of processed foods, sugar-sweetened beverages, and fruits and vegetables can be seen in Table 2. The analyses suggested that all three models were a good fit for the data. Consistent with our hypothesis, social isolation, eating when sad or anxious, and eating alone were significantly associated with consumption of processed foods and sugar-sweetened beverages. Only eating when sad or anxious was significantly associated with fruit and vegetable consumption. Contrary to our hypothesis, eating when anxious or depressed did not mediate the relationship between social isolation and consumption in any of the three models. The contribution of BMI was not significant in any of the regressions. When the models were stratified by gender (see Table 3), differences were observed

between the models for male adolescents and female adolescents. Specifically, social isolation was associated with consumption of processed foods ($B = .51, p < .05$) and sugar-sweetened beverages among girls ($B = .12, p < .05$), but not boys. Similarly, only eating home-cooked dinner was associated with fruit and vegetable consumption among girls ($B = .11, p < .05$), while eating when sad or anxious ($B = .21, p < .05$), eating alone ($B = .15, p < .05$), and eating home-cooked meals ($B = .13, p < .05$) were all associated with fruit and vegetable consumption among boys.

Discussion

In the present study, social isolation, eating alone, and eating when sad or anxious were significantly associated with unhealthy eating, but social isolation was not associated with consumption of fruits and vegetables. These relationships were independent and eating while anxious or depressed did not mediate the relationship between social isolation and unhealthy eating as hypothesized. The relationships were modified by gender, with a significant relationship among boys that was not observed among girls.

The relationship between eating alone and unhealthy eating is consistent with findings that American adolescents who reported eating alone more often ate unhealthy evening meals such as those purchased from fast food restaurants, delivered, or made from a heat-and-serve boxed meal (Reicks et al., 2019). An inverse relationship between eating alone and fruit and vegetable consumption was observed in the American sample that was not observed in the Chinese adolescents enrolled in this study. It was hypothesized in the study of American adolescents that fruit and vegetable availability in the home was mediating the effect of eating alone on the frequency of fruit and vegetable consumption, as adolescents who reported eating alone also reported having less perceived availability of fruits and vegetables. In a study of Japanese adolescents, there was a significant relationship between frequency of eating more than one meal per week alone and being overweight in girls but not for boys (Shirasawa et al., 2018). This directly contrasts with the gender difference found in the present study of Chinese adolescents.

Eating alone could act to increase unhealthy eating due to several physiological and environmental mechanisms. When an adolescent eats alone, they have more autonomy to determine what they eat. This can increase the effect that the availability of healthy food in the home and the adolescent's self-efficacy has on diet, since adolescents are more likely to eat what is readily available (Cho & Kim, 2018). Adolescents may also lack agency in determining what groceries are stocked in the home or lack cooking skills require to prepare healthy food themselves (Leak et al., 2019). Eating alone also removes social influence that eating as a family may place on the adolescent to eat healthier, which may explain the association between fewer family meals and increased unhealthy eating (Fulkerson et al., 2014).

The relationship between eating while anxious or depressed and unhealthy eating is consistent with prior findings among Chinese junior high school students where increased consumption of foods classified as snack (mainly chocolate, candy, carbonated drinks) and meat (mainly red meat, processed meat, and fried meat) was observed in those with anxiety and depression. It was also reported that girls consumed more snack foods than boys, which is consistent with different dietary habits found in this study between adolescent girls and boys (Weng et al., 2012). The findings in this study are also consistent with a study of 14-year-old Australian adolescents that found increased “internalizing” measured with the Child Behaviour Checklist (CBCL; representing increased anxiety, depression, and withdrawal) in those who consumed diets with more takeout, red meat, and refined sugar (Oddy et al., 2009). Although there is an association, it is unclear if anxiety and depression cause increased consumption of unhealthy food or if the unhealthy diet is the cause of anxiety and depression.

It has also been previously reported that perceived social isolation in American adolescents is negatively correlated with self-perceived health, which can decrease motivation and self-efficacy to maintain a healthy diet. A study of Spanish adolescents corroborates this, finding that increased perceived loneliness is associated with decreased consumption of fruits, vegetables, fish, and dairy. The Spanish study also found that an increased perceived loneliness is associated with increased consumption of candy and commercial pastries—although it did not observe an increase in fast-food consumption, unlike what was found in this study (Ferrer-Cascales et al., 2018). Self-reported stress was found to mediate the effect of loneliness on diet, and there were no differences observed between girls and boys.

Social isolation, anxiety, and depression could act to increase unhealthy eating through several physiologic and psychological mechanisms. Increased isolation, anxiety, and depression are correlated with chronic stress and release of cortisol, which profoundly alters the hormonal balance and energy distribution (Chida & Steptoe, 2009; Torres & Nowson, 2007). Stress can trigger the release of hormones, including insulin, leptin, neuropeptide Y, and ghrelin, that modulate energy balance and hunger (Adam & Epel, 2007). Increased salivary cortisol awakening response has been associated with an unhealthier diet with more sweet and fatty foods and snacks (Michels et al., 2013). Psychological influences, such as the seeking of unhealthy comfort foods as a coping mechanism for increased stress, anxiety, and depression, may also exacerbate the physiologic changes and may result in a feedback loop (Ferrer-Cascales et al., 2018). Decreased self-efficacy as a result of stress can also decrease healthy eating behaviors (Nastaskin & Fiocco, 2015). These factors likely act in tandem to increase unhealthy dietary behavior in adolescents who are at a stage of development that is more vulnerable to these changes.

The effect modification by gender might be explained by inaccurate familial perception of weight between Chinese adolescent boys and girls. Multigenerational

homes are part of Chinese culture, and it is commonplace to have Chinese adolescents living with their parents and grandparents. A study of 1,405 Chinese school children showed that the odds ratio of being an overweight boy compared to an overweight girl was 57 percent higher (Li et al., 2014). Furthermore, when parents and grandparents were asked about their children/grandchildren’s weight status, it was shown that boys were more likely than girls to have their weight status underestimated. This relates to the current study because girls are more accurately identified by family members as being overweight or obese. This could explain why girls are less likely to indulge in unhealthy food options in isolation, when having anxiety/depression, and when eating alone compared to their male counterparts because they are more likely to have their weight perceived correctly by their parents/grandparents. If an unhealthy weight status is identified, then it can then be corrected through healthy food choices and exercise (i.e., if they are overweight a family member notices more frequently, and proper lifestyle modifications can be made).

Limitations


The results of the present study should be considered in light of several limitations. First, the cross-sectional nature of the data prohibits the establishment of directionality of the observed relationships. Second, while some items from the English version of the FLASHE questionnaire have established data for their reliability and validity, some items do not, and the Chinese versions of the scales lack data for validity and reliability, which could limit the validity of the current findings. Third, all variables utilized in the present study were subjective in nature and lack objective data to corroborate the observed relationships. Despite these limitations, the current study has a number of strengths, including a large sample of adolescents with complete data and balanced gender representation in the sample.


Conclusion


In conclusion, social isolation, eating when sad or anxious, and eating alone was associated with unhealthy eating patterns in Chinese youth. Some of these relationships differed by gender, suggesting that these relationships function differently in male and female Chinese youth. The behavioral mechanisms that explain these differences should be explored in subsequent studies. However, the present results suggest targets for intervention to prevent unhealthy eating among Chinese youth, and future investigators could use these findings to design interventions targeting at-risk youth.

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Author Contributions

Conceptualization, R.L and J.B.M.; Methodology, R.L. and J.B.M.; Writing—Original Draft, B.J.K., S.J., J.B.M., Writing—Review & Editing, R.L., J.E.M.

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Institutional Approval

The study was conducted in accordance with the Declaration of Helsinki, and all procedures were approved by the Wuhan University Ethics Board (ethical approval code: 2019YF2056) and the school district administrators.

Conflicts of Interest

M. Renée Umstattd Meyer served as the editor for this article in place of J. E. Maddock. No conflicts are declared by the authors.

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Table 1. Descriptive Statistics (Mean and SD) for the Analytic and Excluded Samples

Variable	Boys (n=1,531)		Girls (n=1,412)		Analytic sample (N=2,943)		Sample excluded due to missing data (N=1,084)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Age (years)	14.8	(1.8)	14.6	(1.7)	14.7	(1.7)	14.5*	(1.7)
BMI (kg/m ²)	21.3	(4.6)	20.9	(5.1)	21.1	(4.9)	21.1	(5.3)
Feel left out or isolated (1–5)	2.2	(1.0)	2.3	(1.0)	2.3	(1.0)	2.2	(1.0)
Eat when sad or anxious (1–5)	2.2	(1.1)	2.6	(1.1)	2.4	(1.1)	2.4	(1.2)
Servings of processed foods consumed last week (0–36)	4.0	(4.9)	3.2	(3.2)	3.6	(4.2)	4.1*	(4.8)
Sugar-sweetened beverages consumed last week (0–12)	1.5	(2.0)	0.9	(1.2)	1.2	(1.7)	1.6*	(2.0)
Servings of fruits and vegetables consumed last week (0–18)	3.7	(2.9)	3.3	(2.4)	3.5	(2.7)	3.6	(2.8)
Eat alone (1–5)	2.1	(1.2)	1.9	(1.1)	2.0	(1.2)	2.2*	(1.2)
Home cooked dinners consumed in the last week (0–7)	3.5	(3.1)	3.3	(3.1)	3.4	(3.1)	3.6	(3.0)

Note. Significant differences ($p < 0.05$) between the analytic sample and the sample excluded for missing data are indicated with an asterisk.

Table 2. Multivariable Linear Regression for the Associations of Food Consumption With Feelings of Isolation, Eating When Sad or Anxious, Eating Alone, and Cooking Dinner at Home

Variable	Servings of processed foods consumed last week		Sugar-sweetened beverages consumed last week		Servings of fruits and vegetables consumed last week	
	B	SE	B	SE	B	SE
Sex (male = 1)	-0.77*	0.15	-0.60*	0.06	-0.39*	0.10
Age (years)	-0.14*	0.04	0.00	0.02	-0.12*	0.03
BMI (kg/m ²)	-0.02	0.02	0.00	0.01	0.00	0.01
Feel left out or isolated	0.29*	0.08	0.09*	0.03	0.05	0.05
Eat when sad or anxious	0.47*	0.07	0.15*	0.03	0.14*	0.05
Eat alone	0.72*	0.06	0.22*	0.03	0.06	0.04
Home-cooked dinners consumed in the last week	0.04	0.02	0.00	0.01	0.12*	0.02
<i>R</i> ²	.09*		.08*		.04*	
<i>F</i> (7, 2935)	41.71*		35.67*		15.87*	

Note. Significant differences ($p < 0.05$) are indicated with an asterisk. B, unstandardized regression coefficient. SE, standard error

Table 3. Multivariable Linear Regression for the Associations of Food Consumption with Feelings of Isolation, Eating When Sad or Anxious, Eating Alone, and Cooking Dinner at Home by Gender

Variable	Servings of processed foods consumed last week				Sugar-sweetened beverages consumed last week				Servings of fruits and vegetables consumed last week			
	Boys		Girls		Boys		Girls		Boys		Girls	
	B	SE	B	SE	B	SE	B	SE	B	SE	B	SE
Age (years)	-0.16*	0.07	-0.12*	0.05	0.00	0.03	0.01	0.02	-0.14*	0.04	-0.09*	0.04
BMI (kg/m ²)	-0.02	0.03	-0.01	0.02	0.00	0.01	0.00	0.01	0.00	0.02	0.00	0.01
Feel left out or isolated	0.51*	0.12	-0.01	0.09	0.12*	0.05	0.03	0.04	0.07	0.07	0.03	0.07
Eat when sad or anxious	0.52*	0.11	0.40*	0.08	0.18*	0.05	0.12*	0.03	0.21*	0.07	0.06	0.06
Eat alone	0.94*	0.10	0.45*	0.08	0.31*	0.04	0.11*	0.03	0.15*	0.06	-0.05	0.06
Home-cooked dinners consumed in the last week	0.10*	0.04	-0.04	0.03	0.01	0.02	-0.01	0.01	0.13*	0.02	0.11*	0.02
<i>R</i> ²	.11*		.05*		.07*		.03*		.04*		.03*	
<i>F</i> (6, 1524)/(6, 1405)	32.35*		13.15*		18.02*		6.67*		10.62*		7.22*	

Note. Significant differences ($p < 0.05$) are indicated with an asterisk. B, unstandardized regression coefficient. SE, standard error.