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### Association of children's eating behaviors with parental education, and teachers' health awareness, attitudes and behaviors: a national school-based survey in China

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#### Abstract

**Background**—In China, childhood obesity is a growing health issue. Eating behaviors among children can be influenced by both the family and school environment. We examine the association between these environments and eating habits among children.

**Methods**—A total of 11 270 fourth to sixth grade school children, 11 270 of their fathers or mothers, and 1348 teachers from 48 schools were sampled using a multistage cluster random sampling method. Questionnaires collected information on eating behaviors among children, non-communicable chronic disease (NCD)-related health knowledge and behaviors among teachers, and education levels among parents. Mixed effect logistic regression models were used to describe the key associations between eating behaviors among children and teacher and parental characteristics.

**Results**—Health awareness, positive health attitudes, never-smoking and regular-exercise among teachers was positively associated with healthy eating behaviors among their students (having breakfast, vegetables and dairy products every day; P < 0.05), and negatively associated with the unhealthy behaviors (daily intake of fried foods and desserts and sugary beverages; P < 0.05). More than one parent having a high school level or above was positively related to healthy eating behaviors among their children (P < 0.05), but its associations with high-calorie eating habits were negative in urban and positive in rural areas (P < 0.05).

**Conclusions**—School-based interventions which target health-related awareness, attitude and behaviors among school teachers may help improve school-aged children's eating behaviors.

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Parental education levels may help guide efforts to target children at higher risk of unhealthy eating habits.

#### Introduction

Characterized by a slender population in the past, today China faces a major challenge with obesity, especially among children.<sup>1,2</sup> Globally, long-term follow up studies find obese children tend to become obese adults,<sup>3,4</sup> and an increased risk for hypertension, diabetes, cardiovascular disease, cancer and increased mortality.<sup>5</sup> Hence, effective prevention measures for childhood obesity are urgently needed.

Because children are growing in height, a reduction in adiposity may occur without reducing energy intake. However, good eating habits, a balanced diet and regular physical activity, are also critical elements to prevent childhood obesity.<sup>6–8</sup> Historically, most interventions that aim to prevent childhood obesity have focused on individual-level behavioral determinants.<sup>9,10</sup> However, these interventions find only low to modest effects on behaviors among children and have little effects on their weight.<sup>11</sup> Recently, family and school environments are providing avenues to promote healthy behaviors among children.<sup>12–14</sup> Childhood weight, eating behaviors and physical activity are often associated with health attitudes, lifestyles and socioeconomic status (SES) among their parents.<sup>15–19</sup> However, considering that school children spend considerable time in school, the school environment is also considered a key input to behavior development among children.<sup>20</sup> Although school environmental determinants have been frequently studied for their association with development of good eating habits among students,<sup>21–23</sup> the effect of school teachers on health behavior among school children has not been characterized. Assuming that teachers interested in their own health will tend to take more interest in the health among their students, teachers can serve as role models for developing healthy behaviors among their students.<sup>24,25</sup> However, among Western and Asian populations, few studies have examined the role of school staff in health behaviors and weight status among their students.

Therefore, our study examines eating behaviors of school-aged children from both rural and urban areas in China and their association with health awareness, attitudes and behaviors among school teachers and with education levels among their parents. Understanding the role of both school teachers and parents is needed to develop targeted public health efforts that will improve eating behaviors among school children and tackle the challenge of increasing childhood obesity in China.

#### Methods

#### Study participants

A national cross-sectional survey conducted during September and October, 2010. Participants were selected using a multistage cluster random sampling method. For the first stage of sampling (provincial level), eight provinces, autonomous regions or municipalities were selected from southern and northern China (figure 1). Each province, autonomous region or municipality, was classified into three strata of low-, middle- and the higheconomic levels, according to the gross domestic product (GDP) per capita. For the second

sampling stage, three counties or county-level cities were randomly selected in each stratum. For the third sampling stage, one urban and one rural primary school were randomly selected in each county/city. Finally, 12 811 fourth to sixth grade students and one parent for each student (either father or mother), and 1500 of their school teachers were sampled and recruited to participate in the study. Ultimately, 11 270 children, 11 270 parents (response rate 88.0%) and 1348 teachers (response rate 89.9%) from 48 schools participated. Ethics approval was obtained from the Ethics Committee of China Center for Disease Control and Prevention. All adults and children signed written informed consent forms.

#### Survey methods

All three types of participants (students, parents and teachers) had questionnaires administered by a trained interviewer. The student questionnaire collected information on age, sex and eight daily eating behaviors, including: eating breakfast, fruits, vegetables, dairy products, fried foods, western fast food, desserts and drinking sugary beverages. The parent questionnaire collected information on age, sex, occupation, non-communicable chronic disease (NCD)-related health knowledge and behaviors, the length of time living with their child each year, and their education level. Finally, the teachers' questionnaire collected information on age, sex, education and NCD-related health knowledge and behaviors. For parents and teachers, composite knowledge scores, ranging from 0 to 100, were calculated based on the responses to 21 questions (Appendix 1) on NCD-related health knowledge, with equal scores for each correctly answered question; the frequency of NCD prevention-related behaviors were including: smoking, measuring their body weight at least once a month, measuring their blood pressure at least once a year, having a medical examination at least once a year, and exercising at least once a week.

#### School-level variables

Eight school-level indicators measured teachers' NCD-related health knowledge and behaviors. Considering possible correlations among these indicators, factor analysis was performed to build comprehensive variables which could represent characteristics among schools independently. Three factors were identified according to the initial eigen values (>1) given by this analysis, and each factor could be explained based on the load coefficients of the eight indicators acquired from the rotated component matrix (Appendix 2). In the final two-level logistic regression models, factor scores for each identified factor generated by factor analysis process were included as the school-level variables. These variables included: the average level of NCD-related health knowledge and positive health attitude among school teachers (factor 1), the concentration of teachers who never smoked (factor 2) and the concentration of teachers who exercised regularly (factor 3). Factor 1 was characterized by three indicators: (i) teachers' average health knowledge score in each school, (ii) percentage of teachers measuring their weight at least once a month and (iii) percentage of teachers measuring their blood pressure at least once a year. A higher score for factor 1 represented better average health awareness and attitudes among teachers in that school. Factor 2 was characterized by two indicators: (i) percentage of female teachers and (ii) percentage of teachers who had no history of smoking. A higher score for factor 2 represented a higher concentration of never-smoking teacher. Factor 3 was characterized by two main indicators: (i) the average age of teachers and (ii) the percentage of teachers who exercised at least once

a week. A higher score for factor 3 represented a higher concentration of regularlyexercising teachers.

#### Statistical methods

Continuous measures were presented as mean  $\pm$  standard deviation (SD) and categorical variables as percentages. *T* test and Chi-square test ( $\chi^2$  test) were performed to compare urban and rural areas, and to compare teachers with different education levels (middle or high school vs. college and above). These analyses were conducted using Statistical Package for the Social Science version 15.0 (SPSS Inc., Chicago, IL, USA). Associations of health awareness, attitudes and behaviors among school teachers as well as education level among parents with children's eating behaviors were estimated using multilevel logistic models with a binomial distribution assumption and a logit link. In each model, factor 1, factor 2, factor 3 and urban vs. rural status were included as school-level variables, and students' age, sex, length of time living with parents per year, and the education level among parents were included as individual-level variables. The effect of each variable are expressed as odds ratios with their 95% confident intervals (95% CI). Multilevel analyses were performed using the software packages MLwiN version 2.1.<sup>26</sup> All tests for statistical significance were two-sided and the significance level was set as  $\alpha = 0.05$ .

#### Results

#### **Description of study participants**

Among 11 270 participating primary school children, the proportions of fourth, fifth and sixth graders were 33.1%, 33.6% and 33.2%, respectively; 52.6% were boys; and the mean age was 10.8 years (range 8–14 years). Eating breakfast, fruits, vegetables and dairy products every day, were more common for children in urban areas compared with those in rural areas (all P < 0.001) (Table 1). In contrast, children living in rural areas more commonly reported drinking sugary beverages every day (P < 0.001). We did not find statistically significant differences between urban and rural students for the other three behaviors (eating fried foods, western fast foods and desserts each day).

Among 11 270 parents (52.9% were mothers), the health knowledge score, the percent with NCD prevention behaviors (e.g. never smoked, measuring weight at least once a month, measuring blood pressure at least once a year and exercising every week), were all higher in urban than in rural areas (all P < 0.05) (table 1). With respect of parental education level, those living in urban areas had higher education levels (29.0% college-educated fathers and 22.2% college-educated mother in urban areas vs. 6.8% college-educated fathers and 4.4% college-educated mother in rural areas, P < 0.001). Additionally, the length of time during the last year their child lived with them was lower in rural parents compared to urban parents (P < 0.001).

Among the 1348 teachers, compared to rural areas, teachers in urban areas had a higher average health knowledge score (55.4 and 53.5, P = 0.042, respectively), higher education levels (93.1% and 86.9% were college educated, P < 0.001, respectively) and more healthy NCD-related behaviors, including never smoking (85.7% and 81.2%, P = 0.028,

respectively) and having a medical examination at least once a year (42.1% and 35.5%, P = 0.012, respectively) (table 2).

#### Association of teachers' characteristics with children's eating behaviors

The associations between children's eating behaviors and teachers' health awareness, attitudes and behaviors are found in table 3. At the school level, the average level of NCDrelated health knowledge and attitude among teachers (factor 1), was positively associated with four healthy eating behaviors (eating breakfast, fruits, vegetables and dairy products daily) among children (each behaviors P < 0.05), and was negatively associated with their sugary beverage intake behavior (P < 0.05). Never smoking among teachers (factor 2), was positively associated with children's intake of fruits (OR = 1.20, 95% CI: 1.15-1.26, P <0.05), vegetables (OR = 1.14, 95% CI: 1.09–1.19, P < 0.05) and dairy product (OR = 1.12, 95% CI: 1.06–1.18, P < 0.05), and negatively associated with intake of fried foods (OR = 0.85, 95% CI: 0.75–0.96, P < 0.05). Regular exercise among teachers (factor 3) was positively associated with children's intake of vegetables (OR = 1.07, 95% CI: 1.03-1.12, P< 0.05), and was negatively associated with their eating desserts (OR = 0.89, 95% CI: 0.81– 0.96, P < 0.05) and intake of fruits (OR = 0.88, 95% CI: 0.84–0.92, P < 0.05). Finally, urban school children were more likely to daily eat breakfast (OR = 1.15, 95% CI: 1.05-1.27, P <0.05), dairy products (OR = 1.43, 95% CI: 1.29–1.59, P < 0.05) and western fast foods (OR = 1.48, 95% CI: 0.96–2.26, *P* < 0.05).

#### Association of parents' education level with children's eating behaviors

Having higher parent education levels (high school and above) was strongly associated with healthy eating behaviors among their school children, such as daily eating breakfast, fruits and vegetables and dairy product (table 3). Among the entire study population, parental education level was not associated with unhealthy eating behaviors among children. However, when stratified by residence status, in urban areas, unhealthy eating behaviors (daily intake of fried foods, western fast food, desserts and drinking sugary beverages) among school children were negatively associated higher parents education levels (OR < 1, P < 0.05), while in rural areas, high education level was positively associated with unhealthy behaviors(daily intake of fried foods, western fast food and drinking sugary beverages) (OR > 1, P < 0.05) (Appendix 3–1, 3–2). Furthermore, length of time living with their parents was also shown to be positively related to school children's fruits (OR = 1.03, 95% CI: 1.01–1.04, P < 0.05) and dairy products intake (OR = 1.05, 95% CI: 1.02–1.07, P < 0.05), and was negatively associated with dessert intake (OR = 0.95, 95% CI: 0.92–0.98, P < 0.05) (table 3).

#### Discussion

#### Main results

This is the first national study in China to examine primary school teachers' health awareness, attitudes and behaviors and their associate with their student's eating behaviors. We found that teachers' average health awareness, positive health attitudes, never-smoking and regular-exercising behaviors, were all positively associated with their students' healthy eating behaviors, and negatively associated with the unhealthy ones. In addition, we found

that a higher level of education among school children's parents was positively associated with their child's healthy eating behaviors, but its associations with high-calorie eating habits were negative in urban and positive in rural areas (P < 0.05).

## School-level associations with health awareness, attitude and behaviors among teachers and their student's eating behaviors

The school environment is a good setting for health promotion interventions among schoolage children.<sup>27,28</sup> School-based strategies to control childhood obesity, in synergy with family-based interventions,<sup>29</sup> focused on dietary and physical activity have been widely studied as a means to control weight gain among children.<sup>21,23,28</sup> However, some suggest that healthy food choices in schools are made by the children themselves, regardless of the intensity that schools take to promote children's eating habits.<sup>30</sup> Thus, the school environment, which can support students making good choices is a potential target for school-based interventions for childhood obesity prevention and control. Teachers, while spending considerable time with students, can become powerful role models.<sup>24,31</sup> and should be considered as one point of intervention. However, few studies have characterized how health attitudes and behaviors among teachers affect obesity-related risk factors in students. Hence, this study has added to this evidence-base, being the first to report that health awareness, positive health attitude and healthy behaviors among school teachers are associated with healthy eating behaviors among their students, and negatively associated with their unhealthy eating behaviors. Our findings suggest that, in China, school-based prevention of childhood unhealthy eating behaviors, should aim at improving school teachers' health awareness, attitude and behaviors. Additionally, we found healthy behaviors (i.e. regular exercise) among rural teachers was negatively related to children's fruit intake, but positively related to vegetable intake. While seeming inconsistent, rural teachers who exercise regularly may put much more importance on vegetable intake rather than on fruit intake. This hypothesis needs further study.

#### Associations of parental education level with children's eating behaviors

Childhood obesity and behaviors related to obesity among children, have been extensively studied and found associated with several parental characteristics. Child weight is associated with parent weight<sup>32</sup> and family SES. Family SES, usually determined family income and parental education level, might influence weight among children, through impact their eating behaviors. For example, in western populations, lower SES families have higher use of pressuring feeding practices, which would lead the children to consume more high-calorie foods.<sup>15,18,33,34</sup> In China, despite the westernization in fast economically growing regions, dietary habits are still greatly different from those in western countries,<sup>35</sup> suggesting the relationship between family SES and children's eating behaviors in Chinese population might also be different. In this study, we did find that, in urban settings, children in lower SES families (i.e. low parental education level) had more unhealthy and high-calorie eating behaviors, which is consistent with findings from western countries. However, in contrast, children among higher SES families in rural areas had more high-calorie eating habits. This finding may be due to the unbalanced education quality and health environment among different areas in China. In our study population, parents with higher education levels living in urban had better healthy awareness, attitude and better eating habits (data not shown)

compared to those in rural areas with the same education level, which might help to explain the regional disparities. On the other hand, family with more than one higher educated parents were found positively associated with children's healthy eating habits in both urban and rural areas.

#### Limitations

There are important limitations to our study. First, we not able to make casual inferences because of the cross-sectional study design. To help better understand the teacher–student impact, long-term follow-up studies are needed to further explore school- and family-based interventions. Second, much of our information collected is self-reports and may include some recall bias. Additionally, our school-based survey was completed within 45 min, leaving health awareness, attitude, behaviors and eating habits, assessed with a limited number of questions. In order to address some of these limitations, a follow-up study has already being considered. Third, our study is limited and unable to compare maternal and paternal education level separately. However, earlier studies find that mothers play a more important role in parent–child correlations compared to fathers, due to their great impact on their child's dietary behavior,<sup>17</sup> especially on children's intake of energy-dense food and vegetables,<sup>36,37</sup> while fathers impact their child's intakes of fruit but not vegetables,<sup>38</sup> suggesting mothers and fathers both influence development of good eating habits but in different ways.

#### Summary

This is the first study to demonstrate the association between health awareness, attitude and behaviors among primary school teachers and their student's eating habits, showing these school-level determinants were positively associated with children's most healthy eating habits, and negatively related to the unhealthy ones. In addition, we found that higher family SES was positively associated with good eating behaviors among children, although the pattern is not consistent across urban and rural settings. Our findings provide important insights for developing childhood obesity prevention efforts currently and also for future family interventions studies that include school-based components.

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### Appendix 1. Questions on non-communicable chronic disease (NCD)related health knowledge in questionnaires for parents and teachers

- 1. Do you know how to calculate the body mass index (BMI)? (Correct: B)
  - **A.** Height(m)/weight(kg)
  - **B.** Weight(kg)/height<sup>2</sup>( $m^2$ )
  - **C.** Waist circumference(m)/weight(kg)
  - **D.** I don't know

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2.	What is the BN	I standard for	obesity for	Chinese? (	Correct: B)	)

- **A.** 24
- **B.** 28
- **C.** 30
- **D.** I don't know
- **3.** What is the standard for central obesity for Chinese? (Correct: B)
  - A. Waist circumference: female 75 cm, male 80 cm
  - **B.** Waist circumference: female 80 cm, male 85 cm
  - C. Waist circumference: female 85 cm, male 90 cm
  - **D.** I don't know
- 4. Could overweight and obesity lead to hypertension, diabetes, cardiovascular disease (stroke, coronary heart disease) and cancer? (Correct: A)
  - A. Yes
  - **B.** No
  - C. I don't know
- 5. Could childhood obesity lead to adult obesity and early onset of other chronic diseases? (Correct: A)
  - A. Yes
  - **B.** No
  - C. I don't know
- 6. Which is the correct standard for adult hypertension (SBP/DBP, mmHg)? (Correct: C)
  - **A.** 120/80
  - **B.** 130/85
  - **C.** 140/90
  - **D.** 160/95
  - E. I don't know
- 7. Could the following factors cause hypertension?

7.1	Hereditary	A. Yes	B. No	C. I don't know	Correct: A
7.2	Overweight/obesity	A. Yes	B. No	C. I don't know	Correct: A
7.3	Regular exercise	A. Yes	B. No	C. I don't know	Correct: B
7.4	Diabetes	A. Yes	B. No	C. I don't know	Correct: A

7.5	High-salt diet	A. Yes	B. No	C. I don't know	Correct: A
7.6	Smoking	A. Yes	B. No	C. I don't know	Correct: A
7.7	Excessive alcohol consumption	A. Yes	B. No	C. I don't know	Correct: A

8. Could the following interventions prevent or control hypertension effectively?

8.1	Measure blood pressure regularly	A. Yes	B. No C. I don't know	Correct: A
8.2	Weight control	A. Yes	B. No C. I don't know	Correct: A
8.3	Control of smoking	A. Yes	B. No C. I don't know	Correct: A
8.4	Control of salt intake	A. Yes	B. No C. I don't know	Correct: A
8.5	Control of alcohol consumption	A. Yes	B. No C. I don't know	Correct: A
8.6	Eating more aquatic products	A. Yes	B. No C. I don't know	Correct: B

**9.** According to Chinese dietary guidelines, what is the recommendation for salt intake per person per day? (Correct: B)

- A. No more than 3 g
- **B.** No more than 6 g
- **C.** No more than 10 g
- **D.** No more than 16 g
- E. I don't know
- **10.** According to Chinese dietary guidelines, what is the recommendation for oil intake per person per day? (Correct: B)
  - A. No more than 20 g
  - **B.** No more than 25 g
  - **C.** No more than 30 g
  - **D.** No more than 35 g
  - E. I don't know

# Appendix 2. Rotated component matrix from the factor analysis of teachers' characteristics at the school level#

	Factor 1	Factor 2	Factor 3
Percentage of female teachers	-0.004	<u>0.951</u> **	-0.012
Average age	-0.143	-0.192	<u>0.767</u> **
Percentage of teachers with college education and above	0.228	0.332	- <u>0.403</u> *
Teachers' average health knowledge score	<u>0.798</u> **	-0.050	-0.267
Percentage of teachers who had no history of smoking	0.022	<u>0.908</u> **	-0.156
Percentage of teachers measuring weight at least once a month	<u>0.781</u> **	0.155	-0.025

	Factor 1	Factor 2	Factor 3
Percentage of teachers measuring blood pressure at least once a year	<u>0.750</u> **	-0.032	0.248
Percentage of teachers who exercised at least once a week	0.250	0.078	<u>0.807</u> **

<sup>#</sup>These three could explain 68% of the total variance.

\*\* the main indicators (load coefficient > 0.7) that each factor is measured by.

\* The load coefficient of the indicator is much weaker (load coefficient  $\sim 0.5$ ) than the main indicators.

# Appendix 3-1. School-level correlation from teachers and individual-level correlation from parents with children's daily eating behaviors in urban areas (N = 5779)a

	Having breakfast	Having fruits	Having vegetables	Having dairy products	Having fried food	Having western fast food	Having dessert	Drinking sugary beverage
School-level factor	's							
Factor1	1.38 (1.33, 1.43) *	1.03 (0.99, 1.06)	1.41 (1.36, 1.46) *	1.41 (1.36, 1.46) *	0.96 (0.86, 1.07)	0.97 (0.87, 1.07)	1.02 (0.95, 1.10)	0.88 (0.81, 0.95) *
Factor2	1.11 (1.06, 1.17) *	1.31 (1.25, 1.38) *	1.54 (1.47, 1.61) *	1.31 (1.24, 1.38) *	0.79 (0.69, 0.91) *	1.03 (0.93, 1.13)	1.08 (0.98, 1.18)	0.80 (0.72, 0.88) *
Factor3	1.02 (0.99, 1.05)	0.84 (0.81, 0.87) *	0.97 (0.93, 1.01)	0.95 (0.89, 1.01)	1.02 (0.93, 1.12)	0.96 (0.87, 1.07)	0.90 (0.85, 0.96) *	1.02 (0.96, 1.09)
Individual-level fac	ctors							
Child's age	0.85 (0.82, 0.87) *	0.93 (0.90, 0.96) *	1.10 (1.06, 1.13) *	0.93 (0.90, 0.96) *	0.96 (0.88, 1.05)	1.05 (0.95, 1.15)	0.97 (0.91, 1.03)	0.98 (0.92, 1.05)
Boys(vs. girls)	0.78 (0.73, 0.83) *	0.70 (0.66, 0.75) *	0.74 (0.70, 0.79) *	1.01 (0.95, 1.07)	1.23 (1.02, 1.49) *	2.08 (1.68, 2.59) *	1.09 (0.97, 1.23)	1.25 (1.09, 1.44) *
Time living with parents	1.06 (1.04, 1.07) *	1.04 (1.02, 1.05) *	1.03 (1.01, 1.04) *	1.02 (0.98, 1.04)	0.99 (0.95, 1.04)	0.96 (0.92, 0.99) *	0.97 (0.94, 1.00)	0.98 (0.95, 1.01)
Number of higher-	educated parents $C$							
None	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Only one	1.23 (1.14, 1.34) *	1.23 (1.13, 1.33) *	1.07 (0.99, 1.15)	1.30 (1.19, 1.42) *	0.70 (0.54, 0.92) *	1.32 (0.95, 1.65)	1.15 (0.98, 1.33)	0.96 (0.81, 1.15)
Both	1.62 (1.50, 1.75) *	1.55 (1.45, 1.67) *	1.32 (1.23, 1.42) *	1.94 (1.80, 2.10) *	1.03 (0.83, 1.28)	0.72 (0.55, 0.96) *	0.82 (0.71, 0.95) *	0.78 (0.66, 0.92)*

P < 0.05 by Chi-square test.

<sup>a</sup>Results were presented as odds ratios and their 95% confidence intervals.

<sup>b</sup>Factor1 referred to average level of NCD-related health knowledge and attitude among school teachers; factor 2 referred to concentration of teachers who never smoke; and factor 3 referred to concentration of teachers who exercise regularly. <sup>c</sup>Higher educated' referred to having an education level of high school and above.

# Appendix 3-2. School-level correlation from teachers and individual-level correlation from parents with children's daily eating behaviors in rural areas (N = 5491)a

	Having breakfast	Having fruits	Having vegetables	Having dairy products	Having fried food	Having western fast food	Having dessert	Drinking sugary beverage
School-level factor	rs							
Factor1	0.93 (0.91, 1.01)	1.14 (1.11, 1.18) *	0.95 (0.93, 1.03)	1.08 (1.04, 1.12) *	0.95 (0.87, 1.03)	0.89 (0.76, 1.04)	1.02 (0.96, 1.08)	0.90 (0.85, 0.95) *
Factor2	1.01 (0.98, 1.04)	1.20 (1.16, 1.23) *	1.12 (1.09, 1.15) *	1.08 (1.04, 1.12) *	0.84 (0.77, 0.91) *	1.05 (0.91, 1.20)	0.91 (0.86, 0.96) *	1.00 (0.95, 1.05)
Factor3	0.94 (0.90, 1.00)	0.92 (0.89, 0.95) *	1.15 (1.12, 1.19)*	0.97 (0.93, 1.01)	0.77 (0.70, 1.00)	0.79 (0.66, 0.94)*	0.83 (0.78, 0.89) *	1.07 (0.98, 1.11)

	Having breakfast	Having fruits	Having vegetables	Having dairy products	Having fried food	Having western fast food	Having dessert	Drinking sugary beverage
Individual-level fac	tors							
Child's age	0.84 (0.82, 0.86) *	0.95 (0.93, 0.98) *	1.06 (1.03, 1.09) *	0.91 (0.88, 0.94) *	1.04 (0.96, 1.13)	0.87 (0.76, 1.00)	0.90 (0.85, 0.95) *	1.05 (0.99, 1.11)
Boys(vs. girls)	0.93 (0.88, 0.99) *	0.81 (0.76, 0.86) *	0.80 (0.76, 0.85) *	1.15 (1.07, 1.24) *	1.06 (0.88, 1.26)	1.98 (1.43, 2.75) *	1.08 (0.96, 1.22)	1.14 (1.01, 1.29) *
Time living with parents	0.99 (0.98, 1.00)	1.02 (1.01, 1.03) *	0.99 (0.77, 1.01)	1.07 (1.06, 1.09) *	1.02 (0.99, 1.06)	0.97 (0.92, 1.02)	0.94 (0.92, 0.96) *	0.98 (0.96, 1.00)
Number of higher-e	educated parents $C$							
None	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Only one	1.07 (1.00, 1.15) *	1.14 (1.06, 1.22) *	1.03 (0.96, 1.10)	1.13 (1.03, 1.23) *	1.36 (1.12, 1.65) *	1.93 (1.39, 2.67) *	0.92 (0.80, 1.06)	1.37 (1.20, 1.56) *
Both	1.26 (1.13, 1.40) *	1.39 (1.26, 1.54) *	1.09 (0.99, 1.20)	1.72 (1.54, 1.92) *	0.97 (0.71, 1.33)	1.38 (0.86, 2.23)	0.88 (0.72, 1.08)	0.82 (0.63, 1.01)

\*P < 0.05 by Chi-square test.

 $^a\!\mathrm{Results}$  were presented as odds ratios and their 95% confidence intervals.

<sup>b</sup>Factor1 referred to average level of NCD-related health knowledge and attitude among school teachers; factor 2 referred to concentration of teachers who never smoke; and factor 3 referred to concentration of teachers who exercise regularly.

 $^{c}$ Higher educated' referred to having an education level of high school and above.

#### Key points

- Health awareness, attitudes and behaviors among primary school teachers are positively associated with healthy eating behaviors among their students, and negatively associated with the unhealthy ones.
- Better family SES (indicated by higher education level among parents) was positively related healthy eating behaviors among children, but when refers to the unhealthy eating behaviors the findings were inconsistent across urban and rural areas.
- This study provides a novel direction for intervention design, policy making and future research for addressing childhood obesity. Family-based environmental interventions should consider components that include schoolbased interventions targeted at improving health awareness, attitude and behaviors among primary school teachers.





Map of China with all 8 sampled provinces, autonomous regions and municipalities

#### Table 1

#### Characteristics of 11 270 children and 11 270 parents in China

	Region		Total	P-value*
	Urban areas N = 5779	Rural areas N = 5491	<i>N</i> = <b>11 270</b>	
Children				
Age (mean ± SD, year)	$10.6\pm1.0$	$10.8 \pm 1.1$	$10.8 \pm 1.1$	< 0.001
Male (%)	52.6	53.7	53.1	0.227
Time living with parents per year (mean $\pm$ SD, month)	$11.3\pm2.0$	$10.6\pm2.7$	$10.9\pm2.4$	< 0.001
Daily eating behaviors (%)				
Having breakfast every day	73.3	65.3	69.4	< 0.001
Having fruits every day	40.2	32.3	36.4	< 0.001
Having vegetables every day	63.1	58.9	61.1	< 0.001
Having dairy products every day	32.9	18.9	26.1	< 0.001
Having fried food every day	2.4	2.7	2.6	0.373
Having western fast food every day	1.1	0.9	1.0	0.275
Having dessert every day	5.8	5.8	5.8	0.874
Drinking sugary drinks/soda every day	5.3	7.2	6.2	< 0.001
Father's education level $(\%)^a$				< 0.001
Primary school and below	9.2	23.3	16.0	
Middle or high school	61.9	69.9	65.7	
College and above	29.0	6.8	18.3	
Mother's education level $(\%)^a$				< 0.001
Primary school and bellow	14.8	37.7	25.7	
Middle or high school	63.0	57.9	60.6	
College and above	22.2	4.4	13.7	
Participating parent <sup>b</sup>				
Age (mean ± SD, year)	$37.3\pm4.0$	$37.8 \pm 4.5$	$37.5\pm4.2$	< 0.001
Health knowledge score (mean $\pm$ SD)	$43.4\pm21.8$	$33.2\pm21.4$	$38.4\pm22.2$	< 0.001
NCD prevention-related behaviors (%)				
Never smoking	66.3	58.4	62.5	< 0.001
Measure weight at least once a month	39.3	34.1	36.8	< 0.001
Measure blood pressure at least once a year	61.6	58.7	60.2	0.002
Having medical examination at least once a year	49.1	47.7	48.4	0.214
Doing exercise at least once a week	70.4	65.5	68.0	< 0.001

\* Compared between cities and rural areas.

 $^{a}$ Education levels of both parents of each participant child were collected from the participant parent.

<sup>b</sup>Only one parent participated in the interview.

	Urban areas				<b>Rural areas</b>				P-value#
	Middle or high school N = 46	College and above $N = 621$	<i>P</i> -value <sup>*</sup>	Total	Middle or high school N = 89	College and above $N = 590$	<i>P</i> -value <sup>*</sup>	Total	
Age (mean $\pm$ SD, year)	$48.6 \pm 7.5$	37.0 ± 7.7	<0.001	$37.8 \pm 8.2$	$46.3 \pm 11.3$	$35.6 \pm 7.9$	<0.001	$37.0 \pm 9.2$	0.103
Male (%)	31.10	19.30	0.056	20.1	41.60	28.80	0.015	30.5	<0.001
Health knowledge score (mean $\pm$ SD)	$44.1 \pm 23.2$	$56.4 \pm 17.2$	0.001	$55.4 \pm 18.0$	$52.7 \pm 16.1$	$53.7 \pm 16.6$	0.578	$53.5 \pm 16.6$	0.042
NCD prevention-related behaviors (%)									
Never smoking	68.9	86.9	0.001	85.7	74.2	82.3	0.067	81.2	0.028
Measure weight at least once a month	29.5	43.6	0.069	42.7	34.8	40.7	0.294	39.9	0.307
Measure blood pressure at least once a year	8.9	11.3	0.614	11.2	18.0	13.5	0.256	14.1	0.111
Having medical examination at least once a year	40.0	42.3	0.763	42.1	33.7	35.7	0.711	35.5	0.012
Doing exercise at least once a week	77.8	70.7	0.314	71.2	76.4	67.6	0.096	68.8	0.336

Compared among different education revers, using *t* test or  $\chi^{-\pi}$  where  $\pi^{-\pi}$  Compared between cities and rural areas, using *t* test or  $\chi^{2}$  test.

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# Table 3

School-level correlation from teachers and individual-level correlation from parents with children's daily eating behaviors<sup>a</sup>

	Having breakfast	Having fruits	Having vegetables	Having dairy products	Having fried foods	Having western fast foods	Having dessert	Drinking sugary beverage
School-level factor	$q^{ m SI}$							
Factor1	$1.08\left(1.03,1.14 ight)^{*}$	1.21 (1.16, 1.27)*	$1.09 \ (1.04, 1.13)^{*}$	$1.22\ (1.16,1.28)^{*}$	0.97 (0.85, 1.10)	0.95 (0.78, 1.16)	1.00 (0.92, 1.09)	$0.91\ (0.84,1.00)^{*}$
Factor2	1.00 (0.96, 1.04)	$1.20(1.15,1.26)^{*}$	$1.14(1.09,1.19)^{*}$	$1.12\ (1.06,1.18)^{*}$	$0.85\ (0.75,\ 0.96)^{*}$	0.99 (0.81, 1.21)	0.96 (0.88, 1.05)	0.94 (0.86, 1.03)
Factor3	0.99 (0.95, 1.03)	$0.88\ (0.84,0.92)^{*}$	$1.07 \ (1.03, 1.12)^{*}$	$0.94\ (0.89,\ 0.98)$	0.90 (0.79, 1.02)	0.95 (0.78, 1.15)	$0.89\ (0.81,\ 0.96)^{*}$	1.04 (0.95, 1.14)
Urban areas (vs. rural areas)	$1.15(1.05,1.27)^{*}$	1.03 (0.94, 1.13)	0.98 (0.89, 1.07)	$1.43 \left( 1.29, 1.59 \right)^{*}$	0.92 (0.70, 1.22)	$1.48\ (0.96,\ 2.26)^{*}$	1.07 (0.89, 1.29)	0.84 (0.69, 1.02)
Individual-level fa	ctors							
Child's age	$0.83 \ (0.80, \ 0.87)^{*}$	$0.95\ (0.90,\ 0.98)^{*}$	$1.07 (1.03, 1.11)^{*}$	$0.91\ (0.87,0.96)^{*}$	1.00 (0.89, 1.13)	1.02 (0.84, 1.24)	$0.93 \ (0.86, 1.01)^{*}$	1.03 (0.94, 1.12)
Boys(vs. girls)	$0.86\left(0.79, 0.94 ight)^{*}$	$0.75\ (0.69,0.82)^{*}$	$0.77$ (0.71, 0.84) $^{*}$	1.06 (0.97, 1.17)	1.14 (0.89, 1.47)	$1.97\ (1.28, 3.06)^{*}$	$1.10\ (0.93, 1.30)$	$1.18\ (0.99,\ 1.40)$
Time living with parents	1.01 (0. 99, 1.03)	$1.03(1.01,1.04)^{*}$	1.00 (0.98, 1.01)	$1.05 (1.02, 1.07)^{*}$	1.01 (0.96, 1.07)	0.96 (0.89, 1.03)	$0.95\left(0.92,0.98 ight)^{*}$	0.98 (0.95, 1.02)
Number of higher-	educated parents <sup>c</sup>							
None	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Only one	$1.14(1.03,1.27)^{*}$	$1.18\left(1.06, 1.30 ight)^{*}$	1.05 (0.95, 1.16)	$1.22 (1.08, 1.37)^{*}$	1.05 (0.77, 1.43)	$0.80\ (0.44,1.40)$	$1.20\ (0.84, 1.25)$	1.19 (0.97, 1.46)
Both	$1.54 \left( 1.37, 1.74 \right)^{*}$	$1.52 \left( 1.36, 1.69 \right)^{*}$	$1.32 (1.18, 1.47)^{*}$	$1.89 \left( 1.68, 2.12  ight)^{*}$	1.09 (0.78, 1.53)	$0.57\ (0.23,1.41)$	0.83 (0.66, 1.04)	0.80 (0.63, 1.03)
P < 0.05 by Chi-sq	uare test;							

results were presented as odds ratios and their 95% confidence intervals.

b Eactor 1 referred to average level of NCD-related health knowledge and attitude among school teachers; factor 2 referred to concentration of teachers who never smoke; and factor 3 referred to concentration of teachers who exercise regularly.

 $c_{\rm Higher}$  educated' referred to having an education level of high school and above.