

Rural Food Environment, Caregiver Influence and School-Aged Children's Unhealthy Food Choice: New Evidence From Rural China

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Abstract

Background

A large number of unhealthy foods with low nutrition content and safety issues exist in the rural food consumption environment of China. Guiding rural children to avoid eating unhealthy foods through family intervention has become much more critical. However, when current rural caregivers are once left behind by their parents and lack of family education in their childhood, how would they affect their children's unhealthy food choices? The purpose of this study is to highlight the new evidence of current rural caregivers' influences on children's unhealthy food choices in China.

Methods

Based on a survey of 5611 pairs of rural school-aged children and their caregivers in seven provinces, the significant effects of caregivers' types, parenting attitudes, and socio-demographic characteristics on children's unhealthy food choices were evaluated through an ordered probit model.

Results

This study found that rural parents did not perform positive influence than rural grandparents as conventionally believed. When the caregiver type changing from parents to grandparents, the percentage of children who mildly accept unhealthy foods increased 6.94%, while the percentage of children who moderately and severely accept unhealthy foods decreased 6.48% and 0.46%, respectively. In addition, this study underscored the significance of caregivers' neglectful parenting attitudes on the impact of children's unhealthy eating behavior. When caregivers' parenting attitudes changing from doting attitude to neglectful attitude, the percentage of children who mildly accept unhealthy foods decreased 9.75%, while the percentage of children who moderately and severely accept unhealthy foods increased 8.77% and 0.99%, respectively.

Conclusions

Our study proposes new evidence that the current rural parents' inherent intention and preference for those unhealthy foods formed in their childhood would be much higher than rural grandparents and might have performed a significantly negative influence on their children. Our findings also have policy implications for health promotion professionals who look for intervention targets of caregivers to improve their health education effectiveness for children. For the health education toward rural caregivers, instead of focusing on the caregiver types, segmenting those rural caregivers with neglectful parenting attitude would be the key step to identify the intervention targets.

Background

Evidence has indicated that the food environment in many rural areas is affected by high rates of poverty and limited access to sufficient and nutritious food compared to that in urban areas [1]. However, little attention has been paid to the rural food environment filled with foods with adequate supply but made with substandard components or are unhygienically prepared [2-3]. Rural China is facing this serious problem now and a large number of unhealthy foods with low nutrition content and safety issues exist in the rural food consumption environment. Under such circumstances, guiding rural children to avoid eating unhealthy foods through family intervention has become much more critical. Parents are usually recognized as crucial health promoters compared to other caregivers [4,5-6]. The parental migration from the rural area to the urban area of China for better employment opportunities has always been criticized in the literatures for causing the weakening role of rural parents [7-8-9]. However, considering parental migration phenomenon has occurred over forty years, those left behind children without parental influences have grown up and become new generation of parents. How would they influence their children? Would their eating perceptions and behaviors formed in their childhood further influence their children? Rural caregiver influence on children's unhealthy eating behavior need new evidence and further investigation.

School-aged children's unhealthy food choice under current rural food environment

In rural area of China, foods processed by small-scale manufacturers in unhygienic conditions with bad packaging material are widely distributed and sold by street vendors or grocery shops in unsanitary environments. In addition, food fraud problems, such as imitated foods and those with illegal ingredients and additives, commonly existed in the rural market which may result in serious public health consequences when the adulterant is toxic or allergenic [10-11]. It has been reported that more than 80% of food safety incidents and 90% of foodborne diseases originate in the rural areas of China [12-13]. The food environment in the rural area has posed the serious threat to the health of rural residents, especially the health of rural children. News have reported some rural children have experienced diarrhea, vomiting, and allergic reactions after eating unsafe foods, such as spicy strips [14-15]. In 2011, a one-year-old girl in rural area died after eating fried chicken to which an excessive amount of nitrite had been added [16].

However, when widely exposed in this food environment, rural school-aged children are extremely attracted to these unsafe foods because they are cheap, colorful and tasty [17-18]. After school, street vendors and grocery shops near to school are frequented by children who are looking for their favorite snacks [19]. It is a dangerous sign that rural children are accepting and preferring these unhealthy foods in their daily diets. Since eating habits formed during childhood have a life-long influence on health, protecting children from the access of the foods with poor quality and safety under the current rural environment have become critical and urgent.

Rural caregiver's influence on school-aged children's health and food choice

The significant family influences on children's eating behaviors have been widely studied [20-21,22]. However, the situation of caregiver influence in rural China is complicated. Over the past 40 years, millions of rural parents have left their hometown and migrated to urban areas for better employment opportunities, resulting an estimated 28.52% of children are left and cared by their grandparents or other relatives [23]. The long-term absence of parents has been widely reported as a negative influencing factor for rural children's both physical and mental health [24,25,26]. Many studies have reported that the left behind children's healthy dietary perception levels are significantly lower than other children [27,28,29]. Their common viewpoint is that the left behind children are less restricted by grandparents or other caregivers than by parents and more easily to access unhealthy foods [30,31]. However, there are also studies indicating no significant difference in the nutrition status, food safety perceptions and unhealthy eating behaviors between left behind children and children of non-migrants [32-33]. Zhou *et al.* even pointed out that both groups of children perform poorly on health and nutrition outcomes regardless of parental migration status [34].

A fact which should not be ignored is that the current generation of parents might once be left behind children who were lack of parental education in their childhood. When they become parents, how would they influence their next generation? Would the role of rural parents be still critical as health promoter as expected compared to other caregiver types? This study attempted to apply empirical studies to explore the caregiver influence on children's unhealthy food choice from the perspective of intergenerational effect.

In addition, caregivers' parenting attitudes, eating habits and other socio-demographic characteristics have been reported to influence children's eating difficulties and promote children's nutritionally-balanced diet [35,36]. However, what type of parenting attitude specifically negatively affect rural children's eating behavior toward unsafe foods has been also rarely discussed. Therefore, we proposed our research questions: could current rural parent in China perform better at influencing children to make healthier and safer food choices than the other caregiver types? What factors of rural caregivers significantly affect children's safe eating behavior?

To summarize, the aim of this study was to (1) assess the new evidence of how caregiver types affecting their children's unhealthy food choice in the current rural food environment; (2) explore the significant influencing factors of caregivers on children's unhealthy food choices.

Methods

Participants

This study utilized a cross-sectional design. To ensure better representativeness of the Chinese population, a large-scale survey was launched in the rural areas of 7 provinces located in the north (2 provinces), east (2 provinces), central (1 province), southwest (1 province) and south area (1 province) of China in 2018. A total of 6203 pairs of fourth to sixth grades children and their caregivers from 13

elementary schools were recruited as study participants. After excluding 592 refusals or invalid responses, 5611 valid questionnaires were obtained with an effective response rate of 90.5%. The socio-demographic characteristics of the surveyed children and their caregivers are presented in Table 1. In total, 2872 boys and 1739 girls with an average age of 11.4 years ($SD = 1.02$ years) participated in the survey. Furthermore, 56.1% of the caregivers were female and 89.2% were aged less than 60 years. Most caregivers were the children's parents (80.7%), 17.8% were their grandparents and 1.5% were children's relatives or others, indicating the existence of left behind children. In addition, 56.3% of caregivers were farmers, 82.2% did not receive a high school education, and 83.7% of their families had a monthly income of less than 6,000 RMB. These demographic characteristics are representative of current conditions in the rural areas of China.

Procedures

Since the participants in the study are both children and their legal guardians, addressing ethical considerations, at the beginning of the questionnaire a statement was clearly explained the purpose of the study and informed that all participants (including caregivers and their children) completing the questionnaire was optional and if caregivers completed and returned the questionnaires, we would assume that they approved us to use the information both they and their children provided. Therefore informed consent to participate in the study has been obtained from all participants, including legal guardians of minors.

Trained researchers explained to the children of fourth to sixth grades how to complete the questionnaires. Children completed their part independently at school and took the rest of the questionnaire home. The major caregivers were asked to complete their sections and then children returned them to teachers within three days. The researchers collected all the returned questionnaires.

Measures

Rural caregivers' parenting attitudes related to children's eating habit and their segmentation

The rural caregivers' parenting attitudes related to children's eating habit was first determined. We gave a full consideration of the general requirements of the parental attitudes in the child feeding questionnaire in the literature [37] and the actual conditions of rural China and designed nine statements. Specifically, the descriptive statements with random number explored rural caregivers' attitudes toward developing eating habit for nutritionally-balanced diet (Nos 1, 2, 3, 7 and 8) and food safety assurance (Nos 4), knowledge level toward obesity (Nos 5) and food safety (Nos 6), and attitudes about the necessity to guide children to properly purchase foods (Nos 9). The caregiver participants were asked to score their answers on a five-point Likert scale (1=strongly disagree, 2=fairly disagree, 3=agree, 4=fairly agree, 5=strongly agree) to indicate their agreement with each statement. An exploratory factor analysis was conducted to summarize rural caregivers' parenting attitudes along major dimensions. Thereafter, K-means cluster methods were used to segment the participants into distinctive, homogeneous clusters based on their agreements with the dimensions.

Rural children and their caregivers' unhealthy food choices under designed eight scenarios with safety risks.

Eight scenarios, all closely related to the real food consumption environment in the rural areas of China, were designed. Each of the eight scenarios involved one type of unhealthy food with safety risk, including foods that were moldy, dirty, unpackaged, foul smelling, imitated, out-of-date, sold by unsanitary street vendors, and had caused problems pertaining to foodborne diseases before. Both children and caregivers' food choices under each scenario were examined and compared.

Effect of rural caregivers' types, parenting attitudes, unhealthy food choice and other socio-demographic characteristics on their children's unhealthy food choice

Caregiver factors influencing children's choices on the unhealthy foods in the eight scenarios were examined. Since the sum of each child's positive responses toward the eight scenarios takes values of (0-8), which are not interval in nature, we expressed the children's choice for unhealthy foods as an ordinal ranking with three categories of arbitrary width: positive choices in zero to one scenario, positive choices in two to four scenarios, and positive choices in five to eight scenarios. Thus an ordered probit estimation technique was applied to assess the impacts of caregivers factors on the children's choice. All of the analytic plan, including the construction of variable scales, was pre-specified. We chose the caregivers' types, parenting attitudes, unhealthy food choice and other socio-demographic characteristics (sex, age, education level, occupation, and income) as independent variables. Children's age and sex were set as control variables. The marginal effects of the independent variables and control variables on children's intention were also analyzed. When more unsafe foods were selected, a change in the sign of the marginal effect from negative to positive reflects an increase in marginal utility, while a positive to negative change indicates a decrease in marginal utility. We also applied the data in the ordered logit model and OLS model and the results showed that the regression coefficients and significant regression results of each model were consistent with those of the ordered probit model and the robustness test was passed.

Statistical analysis

Factor-cluster analyses and children's difference comparison were conducted using SPSS v21 (SPSS, Inc., Chicago). The ordered probit model analysis and marginal effects were evaluated in STATA 15.0.

Results

Rural caregivers' parenting attitudes related to children's eating habit and their segmentation

We investigated rural caregivers' parenting attitudes toward healthy and safe eating behavior. According to participants' agreements with the nine statements, we applied factor analysis to group them into three major dimensions that accounted for 58.38% of the total variance (Table 2). The Kaiser-Meyer-Olkin test value was 0.857, and the result of Bartlett's test was 9357.166 ($p < 0.001$), indicating that the data matrix

was suitable for a factor analysis. Cronbach's alpha coefficients were above or around 0.6, confirming acceptable internal consistency. Dimension 1 contained four statements that reflected caregivers' very casual attitudes regarding shaping children's healthy and safe eating habits. Thus, Dimension 1 was named a "casual attitude." Dimension 2 consisted of three statements expressing that caregivers' parenting attitudes were affected by their lack of knowledge on food safety and nutrition. Therefore, it was called an "ignorant attitude." Dimension 3 included two statements and was entitled a "children-oriented attitude", because the caregivers indulged their children and allow them to do whatever they wanted.

A K-means cluster analysis was used to segment parents with similar sensitivities along the three attitude dimensions. The respondents were distributed into four clusters (Table 3). A discriminant analysis confirmed that the resultant clusters significantly varied in all three dimensions ($p < 0.01$), proving the reliability of the segmentation. Rural caregivers in Cluster 1 ($n=1148$) were mainly affected by the children-oriented attitude, and thus referred to as "doting caregivers." The caregivers in Cluster 2 ($n=1326$) were named "unknowledgeable caregivers," because they mainly accepted the viewpoint proposed in the ignorant attitude statements. While those in Cluster 3 ($n=452$) agreed with all three attitude dimension statements and demonstrated extremely negative parenting attitudes. Thus, they were called "neglectful caregivers." Finally, almost half the caregivers in Cluster 4 ($n=2685$) disagreed with all three attitude dimension statements. They were named "qualified caregivers." The segmentation process provided an in-depth understanding of the parenting attitudes of rural caregivers on the importance of both nutrition and food safety. Regarding rural parents, almost half of them demonstrated negative parenting attitudes.

Rural children and their caregivers' unhealthy food choices under designed eight scenarios with safety risks

Table 4 provides the results of both rural children and caregivers' food choices under eight scenarios. Rural children showed a relatively higher percentage for accepting foods that were partly moldy (37.1%), unpackaged (35.8%), and foul smelling (24.7%), which all could potentially threaten children's health. Unsurprisingly, children and caregivers illustrated similar tendency at unhealthy food choice. Both rural children and caregivers showed the higher percentage for accepting unpackaged foods with lower prices but high risk of cross contamination and moldy foods.

Effect of rural caregivers' types, parenting attitudes, unhealthy food choice and other socio-demographic characteristics on their children's unhealthy food choice

We further investigated the caregiver influence on children's unhealthy food choice using ordered probit model. All the variables were defined in Table 5 with their mean value and standard deviation. The multicollinearity test showed that all the variance inflation factors of the variables were less than four, indicating there was no multicollinearity problem.

Our empirical results were showed in Table 6. Estimated ordered probit model was statistically significant with a Likelihood Ratio Test Probability <0.0001 , indicates joint significance of all coefficient estimates.

The influence of caregiver types on children's unhealthy food choice was examined. Compared to children cared for by their parents, those cared for by the left-behind parent and relatives did not significantly differ in terms of being accepting of foods with safety risks. Surprisingly, children cared for by grandparents showed significantly lower acceptability for unhealthy foods than those cared for by their young parents ($p < 0.05$). When the caregiver type changing from parents to grandparents, the percentage of children who mildly accept unhealthy foods increased 6.94%, while the percentage of children who moderately and severely accept unhealthy foods decreased 6.48% and 0.46%, respectively, which indicated that the factor of caregiver type could better influence children with mild or moderate intention on unhealthy foods. Our results showed that contrary to the popular belief, children cared by grandparents did not show any worse performance at unhealthy food choice than those cared by parents, but even better.

Our results also confirmed the significant influence of caregiver's parenting attitudes. Compared to doting attitudes, caregivers with qualified parenting attitudes on healthy eating behavior significantly help children keep away from those unhealthy foods ($p < 0.01$). The effect of caregivers' doting parenting attitudes and unknowledgeable parent attitudes on children's unhealthy food choice showed no significant difference. However, children raised by caregivers with neglectful parenting attitudes showed significantly worse performance than children of caregivers with other negative parenting attitudes. The results of marginal effect showed that when caregivers' parenting attitudes changing from doting attitude to neglectful attitude, the percentage of children who mildly accept unhealthy foods decreased 9.75%, while the percentage of children who moderately and severely accept unhealthy foods increased 8.77% and 0.99%, respectively. Our results indicated that it was caregivers' neglectful parenting attitude which significantly contributed to children's unhealthy food choice compared to other negative parenting attitudes.

Unsurprisingly, caregivers' acceptability toward unhealthy foods positively affected their children's acceptance. When their acceptability increased from mild to moderate, the percentage of children who mildly accept unhealthy foods decreased 11.39%, while the percentage of children who moderately and severely accept unhealthy foods increased 10.54% and 0.85%, respectively. In addition, our empirical results showed that the caregivers' sex, job type and family income also significantly affect children's choice. Children cared for by female caregivers tended to accept unhealthy foods more often than did those cared for by male caregivers ($p < 0.05$). Children from higher-income families demonstrated a better capability to recognize foods with health issues than those from lower-income families. Compared to farmers, caregivers who once were rural migrant workers had a significant positive influence on their children's performance. While caregivers running businesses seemed to be the worst role models, likely because they had limited time to spend with their children. Our results showed that caregivers' age and level of education were not significant factors. Children's sex and age also significantly affected their choice. Boys were more easily to accept unhealthy foods than girls and younger children preferred to unhealthy foods.

Discussion

This study aimed to provide contemporary insights into the protection of rural children's health from eating those cheap but unhealthy and unsafe foods through the contribution of rural caregivers. Children cared by grandparents are usually reported to have food perception bias and incline to access unhealthy foods compared to children cared by parents, because grandparents have lower level of education, older age, and tendency to indulge their grandchildren [30]. However, our results showed that caregivers' age and level of education were not significant factors influencing children's intention. Surprisingly, rural parents did not necessarily perform better in terms of shaping better eating habits of their children than did other types of caregivers. Rather, rural grandparents even performed significantly better than the parents, which seems to be contrary to the common viewpoints that parents were the best food educators [6].

We provided a different insight to explain the failure of the current generation of rural parents in being good role models to their children. The average age of rural children in our survey is about 11 years old and the range of their parents' ages were between 35-45 years old. The generation of current parents has experienced a completely different childhood from their parents and even grandparents. From a historical perspective, when current rural parents were children about 40 years ago, the rapid development of the economy and limited regulatory resources in rural China promoted the explosive growth of unhealthy foods in the rural market [38], which indicates that the current rural parents were much more familiar with those unhealthy foods than their parents because they might start to eat them at their young age. On the other hand, parental migration began to appear at the same period in rural China, resulting in the absence of parental education and control toward healthy eating behaviors. Both of these two historical backgrounds contributed to the same consequence that the current parents become the first generation who had unrestricted access to plenty of tasty and colorful foods but with substandard components or are unhygienically prepared, which never happened at their parents' childhood [39]. Thus current parents' inherent intention and preference for those unhealthy foods would be much higher than current grandparents, which could further negatively affect the performance of their education toward their children. Therefore, under the background of Chinese specific historical period and culture, we propose a new evidence related to rural caregivers' influence on children's unhealthy food choices, which was that the current rural parents' unhealthy eating perceptions and habits have started to exert intergenerational effects on their children's food choice. The main contribution of our findings was that the current policies of encouraging rural children to grow up with their parents might help to solve most of the problems of being left-behind, however, they could not effectively protect rural children to keep away from the foods with safety and health risks.

We further investigated the influence of caregivers' parenting attitudes and found that the children cared for by different caregiver clusters differed significantly in terms of their unsafe food intention and preference. The cluster of neglectful caregivers demonstrated the most passive parenting attitudes and their children performed much worse performance for unhealthy foods even than children of doting caregivers and unknowledgeable caregivers. This result implied that in rural areas, caregivers' doting

attitude and lack of related knowledge due to a lower level of education, were not the key barriers for effective health education for children. Rather, the key barrier was their neglectful attitude. We propose segmenting the population based on their parenting attitudes toward health education and start from those caregivers with neglectful attitude as the key intervention target group.

The significance of sociodemographic factors showed similar results with those in previous studies [40-41]. In general, children cared by female caregivers more likely choose unhealthy foods than children cared by male caregivers, which might be because female caregivers were more indulgent and obedient to children. Rural children from the family with higher income condition performed better indicating that a family environment with a better economic condition may help children stay away from unsafe foods [42]. Caregivers used to be rural migrant workers showed better education effect perhaps because they have gained more food safety and health knowledge when living in the big city.

Conclusions

In summary, based on a large-scale survey on rural children and their caregivers in rural China, the findings of this research highlighted the new evidence of how rural caregivers significantly affected their children's unhealthy food choices. Rural parents did not perform positive influence compared to rural grandparents as conventionally believed. Our study provided new insights to explain this phenomenon under the background of Chinese specific historical period, which was that the current rural parents were the first generation who had unrestricted access to plenty of unhealthy foods in their childhood in China and their inherent intention and preference for those unhealthy foods would be much higher than current grandparents and might have performed a significantly negative influence on their children. In addition, this study underscored the significance of caregivers' neglectful parenting attitudes on the impact of children's eating behavior. This finding suggests that launching comprehensive food safety and health education toward rural children to intervene their food choices at early time is urgent to minimize the intergenerational effects in the future. Our findings also have policy implications for health promotion professionals who look for intervention targets of caregivers to improve their health education effectiveness for children. For the health education toward rural caregivers, instead of focusing on the caregiver types, segmenting the rural caregivers with neglectful parenting attitude would be the key step to identify the intervention targets.

Study Limitations And Future Research

There are several constraints in this study. First, the research did not investigate the living conditions of rural parents in their childhood, for example, whether they were left-behind children, which could help confirm our viewpoints. Future research is needed to develop the study and confirm our research conclusions. Second, this study focused only on the family influence on rural children's intention and preference. However, for school-aged children, school education on food safety was also an important aspect. The next step in this research would be examining the effectiveness of both family and school education in rural children's intention, preference, and behavior change for unhealthy foods. Third, our

study has not been examined by the intervention practice. We will launch the real health education intervention practice to evaluate their effectiveness in the future research.

Declarations

Ethics approval and consent to participate:

The present study proposal has been approved by the institutional academic board of Renmin University of China. Since only a questionnaire survey was employed to obtain the data, the study was considered to belong to exempt category review for ethical approval due to minimal risk to respondents. Waiver from approval was granted by the institutional academic board of Renmin University of China. Since the participants in the study are both children and their legal guardians, addressing ethical considerations, at the beginning of the questionnaire a statement was clearly explained the purpose of the study and informed that all participants (including caregivers and their children) completing the questionnaire was optional and if caregivers completed and returned the questionnaires, we would assume that they approved us to use the information both they and their children provided. Therefore, informed consent to participate in the study has been obtained from all participants, including legal guardians of minors.

Consent for publication

Not applicable.

Availability of data and materials

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

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

JL designed the study, analyzed and interpreted the data, discussed the results, wrote, edited and drafted the paper. WM participated in the design of questionnaire, collected and complied the data. TY collected and complied the data. All authors have read and approved the final version of the manuscript.

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Tables

Table 1. Socio-demographic profile of children and their caregivers (n=5611)

Demographics	Percent (n)	Demographics	Percent (n)
<i>Child Sex</i>		<i>Caregiver Sex</i>	
Male	51.2 (2872)	Male	43.9 (2464)
Female	48.8 (2739)	Female	56.1 (3147)
<i>Child Age</i>		<i>Caregiver Type</i>	
8-10	19.8 (1113)	Parents	80.7 (4529)
11-12	66.2 (3716)	Grandparents	17.8 (997)
13-15	14.0 (782)	Relatives and others	1.5 (85)
<i>Caregiver education level</i>		<i>Family Monthly Income (RMB)</i>	
Primary school or below	30.6 (1715)	< 2000	32.5 (1826)
Junior high school	51.6 (2894)	2000-6000	51.2 (2871)
High school	14.2 (798)	> 6000	16.3 (914)
Bachelor's degree or above	3.6 (204)	<i>Caregiver Age</i>	
<i>Caregiver Occupation</i>		≤30	3.2 (180)
Farmer	56.3 (3157)	31-40	43.6 (2445)
Rural migrant worker	17.7 (993)	41-50	33.3 (1867)
Civil servant	7.1 (398)	51-60	9.1 (511)
Businessman	18.9 (1063)	≥61	10.8 (608)

Table 2. Factor loadings, variance explained and Cronbach alpha for the three parenting attitude factors.

	Factor loading
Factor 1: <i>Casual attitude</i> ($\alpha=0.714$, variance explained=23.38%)	
3. It does not matter whether my kids have breakfast or not. It could be made up for by eating more at lunch anyway.	0.751
4. It is fine not to wash hands before eating food.	0.732
7. When children are full with snacks, they might skip dinner.	0.708
9. I give the children pocket money as much as possible to buy their own snacks in case they get hungry.	0.571
Factor 2: <i>Ignorant attitude</i> ($\alpha=0.594$, variance explained=17.94%)	
5. It is fine if children become fat. Being fat will not affect their growth and development.	0.773
6. As long as the food is safe for an adult, it should be safe for children too.	0.697
8. Children should only eat food beneficial to their health every day.	0.614
Factor 3: <i>Children-oriented attitude</i> ($\alpha=0.587$, variance explained=17.06%)	
1. I will keep purchasing my child's favorite foods for him/her.	0.790
2. I do not guide or regulate my child's eating. They can eat more of what they love and less of what they hate.	0.749

Table 3. Segmentation results of the caregivers based on k-means cluster analysis.

	Cluster 1	Cluster 2	Cluster 3	Cluster 4
	Doting caregivers	Unknowledgeable caregivers	Neglectful caregivers	Qualified caregivers
	(n=1148, 20.4%)	(n=1326, 23.6%)	(n=452, 8.1%)	(n=2685, 47.9%)
Factor				
Casual attitude	-0.3654	-0.3883	2.1953	-0.0216
Ignorant attitude	-0.2602	1.1963	0.2182	-0.5163
Children-oriented attitude	1.3797	-0.2827	0.2607	-0.4942

Table 4. Description of 8 scenarios with food safety issues and the descriptive statistics of the responses of children and caregivers (n=5611).

NO.	Scenarios	Children	Caregiver
		Accept [n(%)]	Accept [n(%)]
1	MOLDY FOODS: If half of an apple is moldy, would you cut off the bad part and eat the rest of it?	2084 (37.1)	953 (17.1)
2	UNPACKAGED FOODS: Bulk snacks are always cheaper than the same one with packages. If they both appeared in the shop, would you choose to buy prepackaged snacks instead of bulk snacks?	2006 (35.8)	1460 (26.0)
3	FOUL SMELLING FOODS: If the food has been stored for a long time with unpleasant smell, is throwing the food away a behavior of wasting food?	1387 (24.7)	211 (3.8)
4	IMITATED FOODS: If a snack has a brand name similar to a famous brand with a much cheaper price, would you buy it?	576 (10.3)	987 (17.6)
5	OUT-OF-DATE FOODS: If you found that your favorite food was out of date, would you give up buying or eating?	568 (10.1)	279 (5.0)
6	STREET VENDOR FOODS: If you love a street vendor food, but it has sanitary problems, would you often go for it?	305 (5.4)	571 (10.2)
7	FOODS WITH FOODBORNE DISEASE PROBLEM BEFORE: If you have encountered foodborne disease such as diarrhea or bellyache, would you continue to eat the same food after healing?	208 (3.7)	185 (3.3)
8	DIRTY FOODS: Do you agree with the saying of <i>No illness comes from dirty foods?</i>	184 (3.3)	288 (5.1)

Table 5. Definition and sample descriptive statistics.

Variables	Description	Mean	S.D.
<i>Dependent variable</i>			
C_choice	Children's acceptability of unhealthy foods (1= mild (choosing unhealthy foods under zero to one scenario), 2= moderate (choosing unhealthy foods under two to four scenarios), 3= severe (choosing unhealthy foods under five to eight scenarios)).	1.3980	0.5113
<i>Independent variables</i>			
Care_type	Caregiver type (1 = parents, 2 = left-behind parent, 3 = grandparents, 4 = relatives)	1.4520	0.8331
Care_attitude	Caregiver's parenting attitudes (1 = doting caregivers, 2 = qualified caregivers, 3 = unknowledgeable caregivers, 4 = neglectful caregivers)	1.9189	0.5000
Care_choice	Caregivers' acceptability of unhealthy foods (1= mild (choosing unhealthy foods under zero to one scenario), 2= moderate (choosing unhealthy foods under two to four scenarios), 3= severe (choosing unhealthy foods under five to eight scenarios)).	1.2417	0.4702
Care_sex	Caregiver sex (1 = male, 0 = female)	0.4391	0.4963
Care_age	Actual age of caregivers	43.7808	10.6082
Care_edu	Caregiver's education level (1 = primary school or below, 2 = junior high school, 3 = high school, 4 = college degree, 5 = bachelor degree, 6 = master degree or above)	1.9093	0.7650
Care_job	Occupation of the caregivers (1 = farmer, 2 = rural migrant worker, 3 = civil servant, 4 = businessman)	1.8881	1.1762
F_income	Family monthly income (1 = below 2000 RMB, 2 = 2000-4000 RMB, 3 = 4000-6000RMB, 4 = 6000-8000 RMB, 5 = 8000-10000 RMB, 6 = above 10000 RMB)	1.8375	0.6797
<i>Control variables</i>			
C_sex	Children sex (1 = male, 0 = female)	0.5119	0.4999
C_age	Actual age of children	11.4312	1.0243

Table 6. Estimation results of the ordered probit model.

Variables	Coefficients	St.Error	Marginal Effects		
			C_safe = 1	C_safe = 2	C_safe = 3
Care_type					
Parents (base)					
Left behind parent	0.0060	0.0768	-0.0022	0.0020	0.0002
Grandparents	-0.1940**	0.0807	0.0694**	-0.0648**	-0.0046**
Relatives	-0.0243	0.1385	0.0089	-0.0082	-0.0007
Care_attitude					
doting caregivers (base)					
qualified caregivers	-0.1508***	0.0449	0.0553***	-0.0516***	-0.0037*
unknowledgeable caregivers	-0.0145	0.0504	0.0054	-0.0050	-0.0004
neglectful caregivers	0.2558***	0.0692	-0.0975***	0.0877***	0.0099***
Care_choice	0.3120***	0.0367	-0.1139***	0.1054***	0.0085***
Care_sex	-0.0730**	0.0358	0.0266**	-0.0247**	-0.0020**
Care_age	0.0015	0.0030	-0.0006	0.0005	0.0000
Care_edu	0.0346	0.0227	-0.0126	0.0117	0.0009
Care_job					
Farmer (base)					
Rural migrant worker	-0.1770***	0.0479	0.0629***	-0.0590***	-0.0039***
Civil servant	0.1585***	0.0471	-0.0591***	0.0541***	0.0050***
Businessman	0.0262	0.0715	-0.0096	0.0089	0.0007
F_income	-0.1129***	0.0146	0.0412***	-0.0382***	-0.0031***
C_sex	0.1605***	0.0343	-0.0586***	0.0543***	0.0044***
C_age	-0.1182***	0.0168	0.0432***	-0.0400***	-0.0032***
Number of observations	5611				
Log likelihood	-3851.66				
Pseudo R ²	0.0426				
LR chi2 (<i>p</i> -value)	342.72 (0.000)				

Single, double, and triple asterisks (*, **, ***) denote statistical significance at the 10%, 5%, and 1% levels, respectively.