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# Factorial validation of the children's eating behavior questionnaire and the association between the eating behaviors assessed and BMI Z score in Chinese preschoolers aged 2–5 years

Jinsong Mou<sup>1\*</sup>, Haishan Zhou<sup>1</sup>, Shiya Huang<sup>1</sup> and Zhanguai Feng<sup>1</sup>

## Abstract

**Objective** This study aimed to evaluate the validity and reliability of the Children's Eating Behavior Questionnaire (CEBQ) among Chinese preschool children aged 2–5 years. Additionally, we investigated the associations between eating behaviors assessed by the CEBQ and body mass index (BMI).

**Methods** A cross-sectional study was conducted with a sample of Chinese preschool children aged 2 to 5 years ( $n = 11,780$ ). The CEBQ was employed to assess participants' eating behaviors, and factor analysis of the CEBQ was conducted; sex and age differences in eating behaviors were examined. Correlations between children's BMI z scores and eating behaviors were analyzed via linear regression analysis controlling for age; sex; ethnicity; maternal age, education level, ethnicity and BMI; paternal age, education level, ethnicity and BMI.

**Results** The factor analysis confirmed the eight-factor structure of the CEBQ, which explained 67.57% of the total variance. Two items were excluded owing to low factor loadings. The subscales showed satisfactory internal reliability (Cronbach's alpha range: 0.76–0.90). Significant sex and age differences were observed for several CEBQ subscales, and BMI z scores were found to be associated with various eating behavior subscales.

**Conclusions** This study's findings support the validity and reliability of the CEBQ for assessing eating behaviors among Chinese preschool children, and children's eating behaviors might be affected by age and sex. Furthermore, BMI was found to be associated with specific eating behaviors. Understanding these associations can inform interventions that promote healthy eating habits in this population.

**Keywords** Children, Eating behaviors, Children's eating behavior questionnaire, Factorial validation, Body mass index

\*Correspondence:

Jinsong Mou  
moujs@foxmail.com

<sup>1</sup>Pingshan District Maternal & Child Healthcare Hospital of Shenzhen,  
Shenzhen 518118, China



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## Introduction

Childhood obesity is a growing public health concern worldwide [1], and China is no exception. According to the 2015 Global Burden of Disease report, an estimated 15 million Chinese children aged 2–19 years old are overweight or obese [2]. A review revealed that 6.8% of children under six years of age are overweight and that 3.6% are obese, an alarming increase from the values of 2.3% and 1.6% in 1992 [3, 4], respectively. A national report from December 2020 indicated that the prevalence of overweight or obese among children under six years of age in China has risen to 10.4% [5]. In comparison, childhood obesity rates in Japan and Korea range from 3 to 6.8% [6, 7]. This increasing trend is alarming, as early childhood obesity is linked to long-term health issues such as type 2 diabetes and cardiovascular diseases, and the risk can arise in early childhood when eating behaviors are established.

Eating behaviors have been suggested to influence weight gain. Unhealthy eating behaviors are known to contribute to the development of overweight and obesity during early childhood [8, 9]. To address this issue effectively, understanding the eating behaviors of preschool-aged children and their associations with children's BMI Z scores is important.

The Children's Eating Behavior Questionnaire (CEBQ) is a well-established tool for assessing various aspects of eating behaviors in young children [10]. Developed by Wardle et al. (2001), the CEBQ comprises eight dimensions that capture different aspects of eating behavior, including food responsiveness, enjoyment of food, emotional overeating, desire to drink, satiety responsiveness, slowness in eating, emotional undereating, and food fussiness. The CEBQ has been widely used in research to explore associations between eating behaviors and an increased risk of overweight in children [11–13].

The CEBQ has been validated for Dutch, Portuguese populations, Swiss, and Norwegian populations [14–17]. However, cultural and environmental factors may influence eating behaviors differently among Chinese preschoolers than among their Western counterparts. Research validating the factorial structure of the CEBQ, specifically in the Chinese context, and exploring the association between eating behaviors and children's BMI Z scores in this population is limited. We reviewed two similar studies: one investigating Chinese children aged 12–18 months, which reported Cronbach's alpha values ranging from 0.52 to 0.80 [18], and another focusing on urban preschoolers, which reported Cronbach's alpha values between 0.62 and 0.90 [19]. However, notably, both studies' samples were limited, with fewer than 400 participants in each study.

Therefore, this study conducted a factorial validation of the CEBQ among Chinese preschoolers aged 2–5 years,

ensuring its applicability and relevance in this population. Moreover, children's eating behaviors evaluated by the CEBQ were analyzed and compared by sex and age group. Additionally, this study investigated the associations between eating behaviors, as captured by the CEBQ subscales, and BMI Z scores among Chinese preschoolers. The collection of child-related variables (age, sex, and ethnicity) and parental factors (age, education level, ethnicity, and BMI), allowed us to control for these variables in the analysis, thereby providing a clearer understanding of the direct associations between children's eating behaviors and their BMIs. Understanding these associations can provide insights into potential risk factors for overweight and obesity and inform targeted interventions for the prevention and management of overweight and obesity in this age group.

## Methods

### Study design

A population-based study was conducted in Pingshan District, Shenzhen, targeting children aged 2–5 years attending 78 different kindergartens. To achieve a representative sample, every kindergarten in the district was included in the study. Participants were recruited voluntarily, with informed consent obtained from parents or legal guardians through electronic invitations sent via the kindergarten communication platform. Children with congenital or acquired deformities or any diagnosed chronic diseases were excluded from the study.

Sample size calculations via PASS 2021 software and the exact (Clopper-Pearson) method, assuming a population of 0.5, indicated that a minimum of 2690 participants was required to achieve a 99% confidence level with a two-sided confidence interval width of 0.05. To accommodate a 20% dropout rate, an inflated sample size of 3363 was needed, which corresponds to approximately 44 children per kindergarten (3363/78). To further increase representativeness and precision, the final sample size was increased to 11,780, resulting in calculated two-sided 99% confidence interval width of 0.02.

The children's height and weight data were obtained from routine physical measurements regularly conducted as part of children's health examinations within the kindergartens, and informed consent was obtained from parents or legal guardians regarding the use of these existing data for research purposes.

Teachers informed the children about the study during classroom sessions to ensure that they understood the purpose of the project. Electronic invitations detailing the study's aims and requesting participation were sent to parents via the kindergarten communication platform. Comprehensive information about the study was provided, and informed consent was obtained from parents or legal guardians. The children's involvement was

limited to receiving general information about the study, whereas their parents were primarily engaged in the study. Electronic questionnaires that took approximately 10–15 min to complete were distributed to the parents, and were available for completion and submission over a two-week period in September 2023. To maintain confidentiality and anonymity, the survey was administered by the research team, and responses were anonymized with coded identifiers and handled according to secure data management protocols.

### Measurements

The CEBQ was employed to assess eating behaviors among the participants [10]. The CEBQ, which comprises 35 items, evaluates eight dimensions of eating behavior: food responsiveness (FR), enjoyment of food (EF), emotional overeating (EOE), desire to drink (DR), satiety responsiveness (SR), slowness in eating (SE), emotional undereating (EUE), and food fussiness (FF).

The CEBQ was translated into Chinese (Mandarin) and rigorously reviewed and corrected by native Chinese speakers with expertise in child healthcare and psychology. A separate team of bilingual experts translated the Mandarin version back into English, and compared it with the original version to identify and resolve any discrepancies. Adjustments were made to ensure that the translated version retained the original questionnaire's meaning. The parents rated their child's eating behavior via a five-point Likert scale with the following options: "Never," "Rarely," "Sometimes," "Often," and "Always".

The World Health Organization (WHO) classification was used to divide adult participants into the following four groups on the basis of their BMI: underweight ( $<18.5$  kg/m<sup>2</sup>), normal weight (18.5–24.9 kg/m<sup>2</sup>), overweight (25.0–29.9 kg/m<sup>2</sup>), and obese ( $\geq 30$  kg/m<sup>2</sup>) [20]. Additionally, children's BMI z scores provide a standardized measure of growth relative to a reference population, allowing for more accurate comparisons across different ages and sexes. Each child's BMI was converted to a standardized z score using the WHO growth reference data. The BMI z score was calculated using the formula: BMI z score = (BMI - median at age t) / standard deviation at age t. BMI z scores greater than 2 was indicative of overweight, while a BMI z scores greater than 3 was used to identify obesity.

### Statistical analyses

The survey data were analyzed via the SPSS statistical package. In this study, continuous variables are expressed as the means, along with their standard errors, and categorical variables are presented as proportions and frequencies. To verify the underlying structure of the questionnaire's Chinese version and determine whether it was similar to that of the original CEBQ, a principal

component analysis with direct oblimin rotation was performed on the 35 CEBQ items. As the original CEBQ had an eight-factor structure, the number of factors was set to eight. Following Svensson et al. [21], we employed a factor loading threshold of 0.4 for the factor analysis. However, we increased the threshold to approximately 0.6 to ensure greater rigor and reliability. The factors' reliability was assessed via Cronbach's alpha coefficient. In our study, a Cronbach's alpha cutoff of 0.7 to indicate a strong effect size was used to assess the internal consistency of the measures [22]. The eight dimensions of the CEBQ were systematically analyzed and compared across different sex and age groups to assess variations in eating behaviors. Linear regression was performed to examine the associations between the BMI z score and the CEBQ subscales. We constructed two sets of models and adjusted for different covariates to verify the stability of the results. The crude model was not adjusted for any variables. In Model 1, adjustments were made for age; sex, and ethnicity and parental factors, including maternal and parental age, education level, ethnicity, and BMI. These covariates were selected on basis of their potential impact on the BMI z score and CEBQ subscales, as indicated by relevant literature suggesting that these factors may influence outcomes [23, 24]. The p-values were two-sided, and a p-value  $\leq 0.05$  was considered significant.

## Results

### Characteristics of the participants

Among the 13,500 distributed electronic questionnaires, 12,218 were completed, yielding a response rate of 90.50%. After excluding 438 invalid responses due to missing data or inconsistencies, 11,780 valid responses were retained, resulting in an effective response rate of 96.42%. The participants were preschool children aged 2 to 5 years, with an average age of 3.58 years (SD=0.62). The sample comprised 5469 girls (46.43%) and 6311 boys (53.57%). The age distribution was as follows: 267 participants were 2 years old, 4992 were 3 years old, 5981 were 4 years old, and 540 were 5 years old. Of these participants, 93.48% belonged to the Han ethnic group, and 6.52% represented various minority ethnic backgrounds. The average BMI for the children was 15.34 kg/m<sup>2</sup> (SD=1.99). Detailed information on the parents' educational levels and BMIs is provided in Table 1.

### Factor analysis

The factor analysis yielded an eight-factor solution, thereby validating the original structure. Each of the eight dimensions demonstrated a single factor with an eigenvalue exceeding one, collectively accounting for 67.57% of the total variance. The number of items per factor ranged from 2 to 5. As Table 2 indicates, the items were loaded above 0.6, thus aligning with expectations.

**Table 1** Characteristics of the preschool children and their parents

Characteristics	N	%
Age (years, Mean $\pm$ SD)	3.58 $\pm$ 0.62	
<b>Child sex</b>		
Girl	5469	46.43
Boy	6311	53.57
<b>Child's ethnicity</b>		
Han	11,012	93.48
Minorities	768	6.52
<b>Maternal education</b>		
$\leq$ High school	3171	26.92
Technical secondary school/junior college	4127	35.03
$\geq$ Bachelor's degree	4482	38.05
<b>Maternal ethnicity</b>		
Han	11,062	93.90
Minority	718	6.10
<b>Paternal education</b>		
$\leq$ High school	3193	27.11
Technical secondary school/junior college	3452	29.30
$\geq$ Bachelor's degree	5135	43.59
<b>Paternal ethnicity</b>		
Han	11,228	95.31
Minority	552	4.69
<b>Parents' BMI</b>		
Maternal BMI (Mean $\pm$ SD)	21.86 $\pm$ 3.31	
Paternal BMI (Mean $\pm$ SD)	24.33 $\pm$ 4.33	
<b>Child's BMI</b> (Mean $\pm$ SD)	15.34 $\pm$ 1.99	

However, some items required attention. Specifically, the items “My child is difficult to please with meals” and “My child has a big appetite” had loadings below 0.4, and, thus, were excluded to for optimize the analysis.

#### Internal reliability

The CEBQ subscales exhibited satisfactory internal reliability, with Cronbach's alpha coefficients ranging from 0.76 to 0.90. Table 3 presents the results of the internal reliability coefficients (Cronbach's alpha) and average inter-item correlations for the eight CEBQ subscales.

#### Correlations between subscales

Our study revealed positive inter-correlations in three “food-approach” subscales (FR, EOE, and DD subscales) and the two “food-avoidant” scales (SR and SE subscales). Furthermore, we found that the food-approach EF subscale tended to exhibit negative correlations with the food-avoidant subscales and food-approach subscales, including the EUE and DD subscales. In addition, the food-avoidant FF subscale exhibited weak correlations with all other subscales, both within the food-avoidant and food-approach domains. The SE and SR subscales exhibited the highest correlation, with a correlation coefficient of 0.51. Table 4 presents the correlations between various subscales of the CEBQ.

#### Sex and age differences in eating behaviors

Significant differences ( $P < 0.05$ ) were observed for several CEBQ subscales, including SR, SE, EF, DD, and EUE subscales. However, no significant differences ( $P > 0.05$ ) were observed in the FF, FR, and EOE subscales (see Table 5).

Age differences exerted significant effects on the SR, FR, EF and EUE subscales (all  $p < 0.05$ ). However, no significant differences were observed in the SE, FF, DD, or EOE subscales (all  $p > 0.05$ ) (see Table 6).

#### Correlations between BMI z scores and CEBQ subscales

Table 7 displays the correlations between BMI z scores and CEBQ subscales. The regression analyses, adjusting for age, sex, ethnicity, and parental characteristics (maternal and paternal age, education level, ethnicity, and BMI), revealed significant associations ( $P < 0.05$ ) between children's BMI z scores and several eating behavior subscales, including the SR, SE, FR, EF, DD, and EUE subscales. However, no significant associations ( $P > 0.05$ ) were found between children's BMI z scores and the FF and EOE subscales.

#### Discussion

The results of this study provide valuable insights into the eating behaviors of Chinese children. To our knowledge, this study is the first to assess the validity and reliability of the CEBQ in a sample of Chinese preschool children aged 2–5 years. This study revealed that the Chinese version of the CEBQ has satisfactory psychometric attributes with respect to the factor structure, internal reliability and correlations between subscales. Additionally, our study benefited from a substantially larger sample size than did previous studies [10, 15, 16, 25], thereby enhancing the reliability of our findings.

The original study reported a variance accounted for of 58% of the total variance [10], and other previous studies have consistently reported that the variance accounts for approximately 50–60% of the total variance [18, 25]. However, similar to the original study's eight-factor structure(10), our factor analysis supported the original eight-factor structure of the CEBQ and reported a significantly greater variance, accounting for 67.57% of the variance. The original version of the CEBQ comprises 35 items; however, in this study, we selected and included 33 specific items for analysis, as outlined in Table 2. We ensured that each subscale included the items originally intended for it. However, two items—specifically “My child is difficult to please with meals” in the FF subscale and “My child has a big appetite” in the FR subscale—were not included in any of the identified factors because their loadings were below the threshold of 0.4. Ali H. Al-Hamad's analysis study also excluded the item—“My child has a big appetite” owing to its loading below the

**Table 2** Factor loadings for direct oblimin rotation in principal component analysis of eating behaviors

Subscale name and items	Loading	Subscale name and items	Loading
<b>Slowness in eating (SE; Factor 1: 20.97% Variance)</b>		<b>Food responsiveness FR (Factor 5: 5.48% Variance)</b>	
My child eats slowly	0.80	My child's always asking for food	0.72
My child takes more than 30 min to finish a meal	0.87	If given the chance, my child would always have food in his / her mouth	0.90
My child finishes his/her meal quickly	0.75	Given the choice, my child would eat most of the time	0.89
My child eats more and more slowly during a meal	0.68	If allowed to, my child would eat too much	0.76
<b>Enjoyment of Food (EF; Factor 2: 16.14% Variance)</b>		Even if my child is full up, s/he finds room to eat his /her favorite food	
My child enjoys eating	0.81	<b>Desire to Drink (DD; Factor 6: 4.83% Variance)</b>	
My child loves food	0.86	If given the chance, my child would always be having a drink	0.88
My child is interested in food	0.83	If given the chance, my child would drink continuously throughout the day	0.85
My child looks forward to mealtimes	0.77	My child is always asking for a drink	0.85
<b>Food Fussiness (FF; Factor 3: 7.50% Variance)</b>		<b>Emotional Undereating (EUE; Factor 7: 3.60% Variance)</b>	
My child enjoys tasting new foods	0.77	My child eats less when upset	0.79
My child enjoys a wide variety of foods	0.68	My child eats less when angry	0.89
My child is interested in tasting food s/he hasn't tasted before	0.75	My child eats less when s/he is tired	0.83
My child refuses new foods at first	0.74	My child eats less when s/he is tired	0.66
My child decides that s/he doesn't like food, even without tasting it	0.63	<b>Satiety Responsiveness (SR; Factor 8: 3.30% Variance)</b>	
<b>Emotional Overeating (EOE; Factor 4: 5.75% Variance)</b>		My child gets full easily	0.74
My child eats more when anxious	0.80	My child leaves food on his/her plate at the end of a meal	0.72
My child eats more when annoyed	0.97	My child gets full before his /her meal is finished	0.77
My child eats more when worried	0.97	My child cannot eat a meal if s/he has had a snack just before	0.58
My child eats more when s/he has nothing else to do	0.73		

**Table 3** Reliability analysis of the CEBQ subscales: Cronbach's alpha and item-total correlations (N = 11780)

Eating behaviors	Cronbach's alpha	Average item-total correlation
Satiety Responsiveness (SR)	0.76	0.45
Slowness in Eating (SE)	0.83	0.54
Food Fussiness (FF)	0.78	0.41
Food Responsiveness (FR)	0.86	0.56
Enjoyment of Food (EF)	0.90	0.69
Desire to Drink (DD)	0.84	0.64
Emotional Undereating (EUE)	0.82	0.53
Emotional Overeating (EOE)	0.90	0.71

threshold of 0.4 [25]. Although previous research has indicated that some items do not load onto the expected original factors, our study revealed satisfactory correspondence between the items and intended factors. The exclusion of the two items in our study was attributed to their potential lack of applicability among the participants, which could be related to environmental and cultural differences [26]. Environmental factors might include food availability and dietary habits that are prevalent in a specific community, whereas cultural factors could encompass beliefs about children's eating behaviors, such as attitudes toward appetite and food preferences [10, 27, 28]. These factors can significantly influence how certain behaviors, such as those captured

**Table 4** Pearson's correlation coefficients for Inter-subscale correlations in the CEBQ

Eating behaviors	SR	SE	FF	FR	EF	DD	EUE	EOE
Satiety Responsiveness (SR)	1.00							
Slowness in Eating (SE)	0.51**	1.00						
Food Fussiness (FF)	0.16**	0.15**	1.00					
Food Responsiveness (FR)	0.14**	0.04**	-0.09**	1.00				
Enjoyment of Food (EF)	-0.33**	-0.39**	-0.33**	0.19**	1.00			
Desire to Drink (DD)	0.29**	0.16**	0.06**	0.34**	-0.08**	1.00		
Emotional Undereating (EUE)	0.40**	0.28**	0.09**	0.28**	-0.05**	0.38**	1.00	
Emotional Overeating (EOE)	0.18**	0.08**	0.03**	0.40**	-0.01	0.31**	0.38**	1.00

\*\* Correlation is significant at the 0.01 level (two-tailed)

**Table 5** Sex differences in eating behavior scores among preschool children

Eating behaviors	Boys(N= 6311) Mean (SD)	Girls(N= 5469) Mean (SD)	Pvalue
Satiety Responsiveness (SR)	11.00(3.09)	11.38(3.17)	< 0.001
Slowness in Eating (SE)	12.41(3.55)	12.94(3.50)	< 0.001
Food Fussiness (FF)	14.48(3.86)	14.35(3.70)	0.07
Food Responsiveness (FR)	10.81(3.86)	10.91(3.87)	0.18
Enjoyment of Food (EF)	12.56(3.33)	12.40(3.27)	0.01
Desire to Drink (DD)	6.36(2.63)	6.16(2.52)	< 0.001
Emotional Undereating (EUE)	10.14(2.86)	10.24(2.87)	0.05
Emotional Overeating (EOE)	7.13(2.83)	7.15(2.85)	0.73

**Table 6** Age-related differences in eating behavior scores among preschool children

Eating behaviors	2 years	3 years	4 years	5 years	Pvalue
Satiety Responsiveness (SR)	11.46(3.32)	11.32(3.07)	11.06(3.17)	11.01(3.17)	< 0.001
Slowness in Eating (SE)	12.75(3.48)	12.71(3.48)	12.62(3.57)	12.44(3.73)	0.26
Food Fussiness (FF)	14.21(3.65)	14.37(3.81)	14.46(3.79)	14.47(3.54)	0.50
Food Responsiveness (FR)	14.21(3.65)	14.37(3.81)	14.46(3.79)	14.47(3.54)	< 0.001
Enjoyment of Food (EF)	12.08(3.33)	12.65(3.27)	12.4(3.3)	12.22(3.44)	< 0.001
Desire to Drink (DD)	6.24(2.73)	6.24(2.63)	6.29(2.56)	6.25(2.44)	0.74
Emotional Undereating (EUE)	10.28(3.01)	10.37(2.88)	10.07(2.86)	9.67(2.73)	< 0.001
Emotional Overeating (EOE)	10.28(3.01)	10.37(2.88)	10.07(2.86)	9.67(2.73)	0.32

by the CEBQ items, are perceived and manifested in different cultural contexts.

The Cronbach's alpha coefficient is an indicator of internal reliability, and its value may range from 0 to 1: the closer the value is to 1, the stronger the consistency observed among the items within a scale [29]. Carnell's study indicated that Cronbach's scores range from 0.73 to 0.88 for related questionnaires on feeding [30]. Additionally, the Cronbach's alpha of the original questionnaire

**Table 7** Correlations between BMI Z scores and CEBQ subscales: unadjusted and adjusted models

Eating behaviors	Unadjusted		Model I	
	β	p Value	β	p Value
Satiety Responsiveness (SR)	-0.27	< 0.001	-0.27	< 0.001
Slowness in Eating (SE)	-0.39	< 0.001	-0.37	< 0.001
Food Fussiness (FF)	-0.02	0.43	-0.03	0.21
Food Responsiveness (FR)	0.15	< 0.001	0.15	< 0.001
Enjoyment of Food (EF)	0.25	< 0.001	0.24	< 0.001
Desire to Drink (DD)	0.05	< 0.01	0.04	0.02
Emotional Undereating (EUE)	-0.08	< 0.001	-0.09	< 0.001
Emotional Overeating (EOE)	0.02	0.41	0.01	0.57

Unadjusted model adjusted for no variables

Model I was adjusted for the following variables: age, sex, ethnicity; maternal age, education level, ethnicity, and BMI

ranges from 0.74 to 0.91 [10]. In line with previous studies, our findings revealed strong internal reliability for the CEBQ subscales, as suggested by Cronbach's alpha coefficients ranging from 0.76 to 0.90. These high coefficients affirm the robustness of the CEBQ as a reliable tool for effectively assessing eating behaviors among Chinese preschool children.

The literature presents conflicting findings regarding sex differences in eating behaviors. Some studies have reported no significant sex differences [10, 21], whereas others have indicated that boys score higher than girls do on the DR subscale [18, 25]. Similarly, our study revealed significant sex differences in specific subscales of the CEBQ. Consistent with previous research [31], our study revealed significant effects of age differences on specific subscales of the CEBQ, including SR, FR, EF, and EUE subscales. These findings align with those of previous studies and highlight the importance of considering sex and age when assessing children's eating behaviors.

Furthermore, our study revealed significant associations between children's BMI z scores and several CEBQ subscales, including the SR, SE, FR, EF, DD, and EUE subscales, after adjusting for several variables. These findings align with those of previous studies [32, 33], indicating a significant association between specific eating behaviors and children's weight status. By controlling for general information about the children and their parents, we were able to disclose the relatively direct effects of children's eating behaviors on their BMI. Therefore, optimizing dietary behaviors is of paramount importance in achieving and maintaining a healthy nutritional status, particularly for controlling children's weight and promoting their overall health.

This study has several limitations. First, the restriction of the sample to a single district in Shenzhen limits the generalizability of the findings to other regions. Second, the use of self-report measures from parents could introduce biases such as recall and social desirability bias, impacting data accuracy. Third, the cross-sectional

design limits our ability to infer causality between eating behaviors and BMI, suggesting a need for longitudinal studies to explore causal relationships over time. Additionally, not including variables such as parental marital status and dietary frequency may limit the understanding of factors influencing children's eating behaviors and their context.

## Conclusion

In conclusion, this pioneering study applying the CEBQ to Chinese preschoolers aged 2–5 years and confirmed the eight-factor structure of the questionnaire. The modified CEBQ was shown to be valid and robust in assessing eating behaviors in this group, showing significant associations with sex, age, and BMI. These insights are crucial for designing targeted interventions to foster healthy eating habits in children, emphasizing the need to consider the influences of age, sex, and BMI on dietary behaviors. This study's implications can guide future research and interventions promoting better nutrition and well-being in young children.

## Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s41043-024-00634-z>.

Supplementary Material 1

Supplementary Material 2

Supplementary Material 3

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## Author contributions

Research conception and design: JM; conducting the survey: JM, HZ, and ZF; statistical analysis of the data: SH and ZF; interpretation of the data: HZ and SH; writing-original draft preparation: HZ and SH; writing-review and editing: JM. All authors approved the final version of the manuscript.

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## Data availability

The data used to support the findings of this study are available from the corresponding author upon request.

## Declarations

### Ethics statement and consent to participate

This study was approved by the Institutional Review Board (IRB) of Shenzhen Pingshan Maternal and Child Health Hospital and complied with the national legislation and the Declaration of Helsinki guidelines. Informed written consent was obtained from the caregivers who agreed to participate in this study, and their participation was voluntary.

### Consent for publication

Not applicable.

## Competing interests

The authors declare no competing interests.

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