

RESEARCH ARTICLE

Preliminary evaluation of the Chinese version of the Baby Eating Behaviour Questionnaire

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Abstract

Background: This study was conducted to develop a Chinese version of the Baby Eating Behaviour Questionnaire (BEBQ) and to evaluate its reliability and validity.

Methods: The Chinese version of the BEBQ was developed by translation and back-translation of the original BEBQ, followed by revision according to experts on the most appropriate item content. Mothers of 300 infants aged <12 months were recruited for survey participation from the paediatric outpatient departments of two large general hospitals in Xi'an, China. Fifty of the mothers were selected randomly for retesting after 2 weeks. Face-to-face surveys included explanation of the process, administration of the Chinese version of the BEBQ with regard to the exclusive breast-feeding period, and demographic data collection. The reliability, validity and discrimination of the questionnaire were evaluated through correlation coefficient calculation, factor analysis, parallel analysis and other methods.

Results: The Chinese version of the BEBQ consists of 15 items in four dimensions (food responsiveness, enjoyment of food, slowness in eating and satiety responsiveness). The cumulative variance contribution rate was 58.4%, the Cronbach's α coefficient was 0.93, the Guttman split-half reliability coefficient was 0.87 and the test-retest reliability coefficient was 0.75. The satiety responsiveness and food responsiveness scores differed significantly according to gestational age at birth, infant sex and average monthly weight gain (all $P < 0.05$). The enjoyment of food score differed significantly according to average monthly weight gain ($P < 0.05$).

Conclusions: The Chinese version of the BEBQ showed good reliability and validity and can be used to evaluate infants' appetite through the assessment of eating behaviour.

KEYWORDS

appetite, eating behaviour, infant, questionnaire, reliability, validity

Abbreviations: BEBQ, Baby Eating Behaviour Questionnaire; GFI, goodness of fit index; P25, 25th percentile; P75, 75th percentile.

Hao Zhang and Xianjun Yang contributed equally to this study; they are co-first authors.

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1 | BACKGROUND

The period from pregnancy to 2 years after birth is defined as the window of opportunity for the prevention of chronic diseases (Barker et al., 2008). Some studies have shown that rapid weight gain in infancy is associated not only with obesity in adulthood (Bouret, 2010; Kroller & Warschburger, 2011), but also with adult metabolic diseases (e.g., type II diabetes) and the occurrence of cardiovascular disease (Smith et al., 2009). Thus, this stage plays a crucial role in chronic disease prevention in adulthood. Furthermore, infancy is a period of rapid fat cell growth, and excessive energy intake during this period may generate a risk of obesity in infancy, childhood and even adulthood (Li et al., 2008; Salgin et al., 2015). Healthy eating behaviours can foster balanced and adequate nutrition for babies, thus promoting growth. Unhealthy eating behaviours can cause malnutrition or overweight in infants and children, which can affect physical growth and intellectual development (De Kroon et al., 2011; Lefebvre & John, 2013). The initial stage of infant milk feeding has been found to be critical, with uninterrupted deep sucking and excessive appetite during breastfeeding associated with overweight and obesity in infancy (Li et al., 2008; Stunkard et al., 2004). However, infant appetite is not well understood, and further research is needed to identify the feeding behaviours that characterize a large appetite.

The Baby Eating Behaviour Questionnaire (BEBQ) is used to evaluate infants' eating behaviour in the exclusive milk-feeding period (0–3 months) (Llewellyn et al., 2010, 2011). The predictors and outcomes of variation in early infant appetite can be evaluated through parents' BEBQ responses. The BEBQ is the first standardized measure of infant appetite designed to characterize appetites that may confer susceptibility to excess weight gain; it has been used widely in the UK (Llewellyn et al., 2010, 2011).

No scale for the evaluation of infant appetite in China is available, which restricts the development of studies of, for example, relationships of infants' appetites to children's appetites and parental feeding habits. Thus, we created a Chinese version of the BEBQ. This questionnaire will serve as a reliable tool for the evaluation of infant appetite in China.

2 | METHODS

2.1 | Questionnaire source

The original BEBQ (Llewellyn et al., 2011) consists of 18 items in four dimensions—food responsiveness, enjoyment of food, slowness in eating and satiety responsiveness—with a single item assessing infants' general appetite. Responses are structured by a five-point scale ranging from 1 (never) to 5 (always). Dimension scores are determined by calculating the mean of item scores within each dimension, with higher scores representing more problematic eating behaviour. Higher food responsiveness and enjoyment of food scores are associated with greater appetite, and higher satiety responsiveness and slowness in eating scores are related to lesser appetite.

Key messages

- The Chinese version of the Baby Eating Behaviour Questionnaire (BEBQ) has good reliability and validity.
- The Chinese version of the BEBQ is the first tool developed for the evaluation of infant appetite during the exclusive milk-feeding period in China.

2.2 | Questionnaire translation and revision

After obtaining consent from the author of the BEBQ (Llewellyn et al., 2011), a paediatrician and a native-Chinese-speaking English teacher independently translated the questionnaire into Chinese. Item meaning and wording were compared between these two translated drafts, and after careful panel discussion the translated items that were most concordant with the originals were chosen for inclusion in the draft translated version of the BEBQ. The panel consisted of seven experts in paediatrics, statistics, the English language, child psychology and nutrition. A paediatrician and a medical statistics professor who had lived and studied in Canada for many years back-translated the Chinese version of the draft into English together. After comparison of the original and retranslated versions, items with differences were reported to the panel again, and a second round of translation and correction was carried out as necessary to yield items with meanings that were consistent with the original items.

Then, a survey was conducted to test the draft Chinese BEBQ with 100 family members of children who visited the paediatric outpatient departments of major hospitals in Xi'an during a 1-week period. Omission rates were high (>5%) and discrimination was low (skewness $\sim \pm 1$, coefficient of variation <0.25) for items 4, 7 and 10 (Table 1), which were removed after panel discussion to avoid misunderstanding or lack of precision in responses. These items reflect differences between Chinese and western cultures. The concept of appetite is not referred to often in Chinese culture, and many Chinese parents dote on their children due to the national one-child policy, which results in their unawareness of their children's satiety and a persistent feeling that their children do not eat enough. Thus, the final revised Chinese version of the BEBQ has 15 items. The scoring method is the same as for the original questionnaire.

2.3 | Scale assessment

2.3.1 | Sample selection

In May 2012, 300 infants aged <1 year who presented to the paediatric outpatient departments of two general hospitals in Xi'an for health examinations or consultations were selected for study inclusion. Fifty of these infants were selected randomly for retesting after 2 weeks using simple random sampling. The inclusion criteria were: (1) breastfeeding status, (2) no illness affecting appetite or eating

TABLE 1 Chinese Baby Eating Behaviour Questionnaire items and statistical characteristics

Item	Omission rate %	Coefficient of variation	Skewness
My baby seems contented while feeding.	3.45	0.21	-0.24
My baby frequently wants more milk than I provide.	1.72	0.45	0.35
My baby loves milk.	4.31	0.24	-0.92
My baby has a big appetite. ^a	6.89	0.19	-1.01
My baby finishes feeding quickly. ^b	4.31	0.40	0.48
My baby becomes distressed while feeding. ^b	3.45	0.22	-0.65
My baby gets full easily. ^a	5.17	0.21	0.74
If allowed to, my baby would take too much milk.	4.31	0.48	0.14
My baby takes more than 30 min to finish feeding.	2.58	0.45	0.50
My baby gets full before taking all the milk I think he/she should have. ^a	6.03	0.18	0.78
My baby feeds slowly.	4.31	0.41	0.24
Even when my baby has just eaten well, he/she is happy to feed again if offered.	1.72	0.40	0.40
My baby finds it difficult to manage a complete feeding.	2.58	0.34	-0.19
My baby is always demanding a feeding.	4.31	0.39	0.22
My baby sucks more and more slowly during the course of a feeding.	3.45	0.42	0.20
If given the chance, my baby would always be feeding.	3.45	0.41	0.31
My baby enjoys feeding time.	3.45	0.39	-0.83
My baby can easily take a feeding within 30 min of the last one.	2.58	0.42	0.50

^aDeleted items.

^bReverse-scored items.

behaviour in the previous 2 weeks and (3) mothers' agreement to participate in the study. The exclusion criteria were: (1) gastrointestinal disease, fever, liver or kidney disease, or other disease affecting appetite or dietary behaviour in the previous month; (2) cleft lip and/or palate, which could cause breastfeeding problems; and (3) mothers' refusal to participate or communication disorder. This study was approved by the Human Research Ethics Committee of the (No. v2.0.2012.03.10). All participants provided informed consent to participation.

2.3.2 | Survey content

The investigators were eight doctors and nurses who had worked in paediatric clinical or child nursing for >5 years; they were trained systematically and comprehensively before survey administration. The Chinese version of the BEBQ and a family demographic information questionnaire, developed based on a literature review and panel discussion, were administered face to face. Mothers completed the instruments under the investigators' guidance based on their infants' eating behaviour during the exclusive breastfeeding period. The investigators collected and checked the questionnaires. Those that lacked responses to all items and those with the same answers to all items

were considered to be invalid and were removed from the sample. Data on birth weight, gestational age (in weeks) and delivery mode were obtained from the infants' health records. At the time of survey administration, investigators measured the infants' weight and body length using standardized methods. The infants were categorized as having low body weight (birth weight <2500 g) or normal weight (birth weight 2500–3999 g) or as being overweight (birth weight ≥4000 g) (Marino & Fine, 2009). Monthly weight gain was calculated using the following formula:

$$[\text{Current weight} - \text{Birth weight (g)}].$$

$$\text{Age (months)}.$$

The 25th percentile (P25) and 75th percentile (P75) of average monthly weight gain were also calculated, and infants' weight increase was categorized as average <P25, P25 ≤ average < P75, and P75 ≤ average. Birth timing was classified as full term (≥37 gestational weeks) and preterm (<37 gestational weeks) according to the criteria of the World Health Organization (Wendland et al., 2012).

2.3.3 | Statistical analysis

The EpiData 3.0 software (the EpiData Association) was used to construct a database for this study. Analyses were performed using SPSS

18.0 (IBM SPSS Statistics). Dispersion tendency analysis, factor analysis and reliability tests were used for item analysis. Items were screened using standard deviations, factor loadings of item scores and Cronbach's α coefficient. Item deletion was considered when the standard deviation of the item score was <0.85 , the factor loading was <0.4 and the Cronbach's α coefficient of the whole scale was greater after the removal of the item than before its removal. The coefficient of correlation between a dimension score and the total score can be used to evaluate the content validity of a questionnaire. Exploratory factor analysis was conducted using the largest variation method and orthogonal rotation; half of the sample was selected randomly, and the number of extraction factors was determined by parallel analysis. When the actual eigenvalue of the data in the scree plot curve falls below the average eigenvalue of the curve of the random matrix, the extraction factor number can be determined. Confirmatory factor analysis of the extraction factor model was performed using data from the remaining half of the sample (Byrne, 2009; Hu & Bentler, 2009) with Mplus 6.0 (LindaMuthen, BengtMuthen). With these methods, we explored the factor structure and tested the scale's construct validity.

T tests and one-way analysis of variance were used to compare BEBQ scores among subjects with different characteristics, thereby examining the scale's discriminant validity. Cronbach's α , test-retest correlation and Guttman's partial reliability coefficients were calculated to evaluate scale reliability. The test-retest reliability coefficient is used to evaluate scale stability, and the alternate-form and split-half reliability coefficients are used to evaluate equivalence. Cronbach's α coefficient is used to evaluate internal consistency, with values >0.70 generally taken to indicate good reliability (Murphy & Davidshofer, 2001).

3 | RESULTS

3.1 | Sample characteristics

Of 300 questionnaires distributed, 288 questionnaires were collected and 270 questionnaires were valid (valid call-back rate, 93.75%). Twenty-two of the 30 invalid questionnaires were blank and eight had the same responses to all items. Among the valid questionnaires, 53.3% were completed for male infants and 46.7% were completed for female infants. The mean age of the infants was 5.4 ± 2.5 months, and the mean age at birth was 38.7 ± 2.0 gestational weeks. The general characteristics of the subjects are shown in Table 2.

3.2 | Item screening results

All items scores were >0.85 and factor loadings were >0.4 , and the Cronbach's α coefficient for the scale was not greater after the removal of any item. Thus, all BEBQ items were appropriate and screening did not result in the removal of any BEBQ item (Table 3).

3.3 | Scale validity

3.3.1 | Content validity

All coefficients of correlation between dimension and total scores (0.51–0.79) were greater than coefficients of correlation between dimension scores (0.16–0.45).

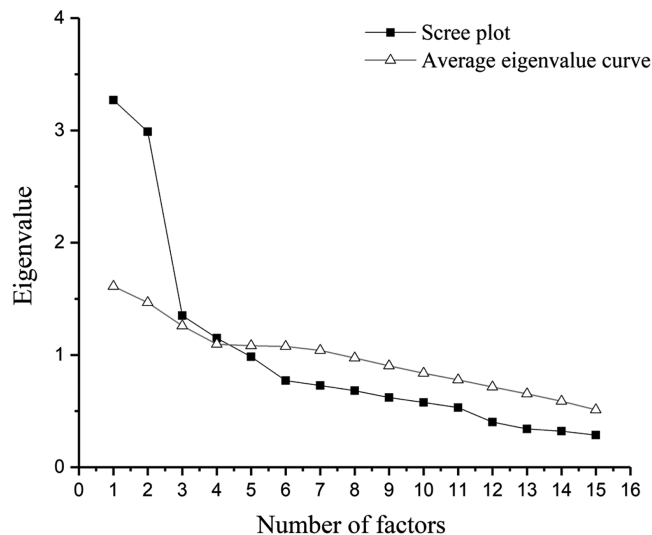
Characteristic		<i>n</i>	%
Gender	Male	144	53.3
	Female	126	46.7
Birth mode	Eutocia	136	50.4
	Caesarean section	134	49.6
Only child	Yes	208	77.0
	No	62	23.0
Feeding method	Breastfeeding	134	49.6
	Bottle feeding	92	34.1
	Mixed feeding	44	16.3
Gestational weeks	Full-term pregnancy	225	83.0
	Premature delivery	45	17.0
Birth weight	Low	70	26.1
	Normal	185	68.5
	Foetal macrosomia	15	5.4
Monthly weight gain (g/month)	Monthly weight gain $< P_{25}$	67	24.7
	$P_{25} \leq$ monthly weight gain $< P_{75}$	140	51.6
	Monthly weight gain $\geq P_{75}$	63	23.7
Mother's education level	Junior middle school or below	102	37.8
	High school (including secondary school)	90	33.4
	College and above	78	28.8

TABLE 2 Subject characteristics

TABLE 3 Chinese Baby Eating Behaviour Questionnaire item properties

Item	Standard deviation (S)	Factor loading	Cronbach's α coefficient after item deletion ^a	Item retained
T1	0.857	0.557	0.880	√
T2	1.026	0.458	0.880	√
T3	0.953	0.569	0.881	√
T4	0.934	0.498	0.881	√
T5	1.077	0.400	0.881	√
T6	0.971	0.402	0.881	√
T7	1.091	0.511	0.882	√
T8	1.146	0.436	0.881	√
T9	1.086	0.529	0.882	√
T10	1.019	0.485	0.881	√
T11	0.989	0.447	0.882	√
T12	1.098	0.425	0.881	√
T13	1.180	0.486	0.880	√
T14	1.095	0.479	0.880	√
T15	1.174	0.578	0.883	√

^aThe Cronbach's α coefficient before item removal was 0.93.

**FIGURE 1** Parallel analysis results

3.3.2 | Construct validity

Figure 1 shows the diagram generated by parallel analysis conducted as part of the exploratory factor analysis. The actual eigenvalue of the data in the scree plot curve falls below the average eigenvalue of the curve of the random matrix after the fourth factor. The data were found to be suitable for factor analysis [Kaiser–Meyer–Olkin value = 0.83, Bartlett's spherical test value = 425.771, concomitant probability = 0.00 (<0.05)], and four factors were extracted. The eigenvalues of the factors were 3.27, 2.99, 1.35 and 3.27, and the variance contribution rates were 21.79%, 19.93%, 9.0% and 21.79%. The cumulative variance contribution rate was 58.38% (Table 4). Based on the implied meanings of the items with the greatest loadings, the four

TABLE 4 Factor matrix for the Chinese Baby Eating Behaviour Questionnaire

Factor name and item	Loading
F1 food responsiveness (variance contribution rate, 21.79%)	
If given the chance, my baby would always be feeding.	0.81
Even when my baby has just eaten well, he/she is happy to feed again if offered.	0.79
My baby can easily take a feeding within 30 min of the last one.	0.71
My baby is always demanding a feeding.	0.53
F2 enjoyment of food (variance contribution rate, 19.93%)	
My baby loves milk.	0.76
My baby enjoys feeding time.	0.73
My baby seems contented while feeding.	0.66
My baby becomes distressed while feeding. ^a	0.62
F3 slowness in eating (variance contribution rate, 9.0%)	
My baby feeds slowly.	0.82
My baby sucks more and more slowly during the course of a feeding.	0.72
My baby finishes feeding quickly. ^a	0.48
My baby takes more than 30 min to finish feeding.	0.46
F4 satiety responsiveness (variance contribution rate, 7.66%)	
My baby frequently wants more milk than I provide. ^a	0.45
My baby finds it difficult to manage a complete feeding.	0.81
If allowed to, my baby would take too much milk. ^a	0.63

^aReverse-scored item.

factors were deemed to represent food responsiveness (four items reflecting infants' need for and response to milk), enjoyment of food (four items reflecting infants' enjoyment of milk), slowness in eating

(four items reflecting infants' speed of eating) and satiety responsiveness (three items reflecting infants' appetite and the amount of milk consumed). These factor labels match the original BEBQ dimensions (Table 4). In the confirmatory factor analysis, the structural validity of the questionnaire was found to be adequate [$\chi^2/df = 1.23 (<5)$, goodness of fit index (GFI) = 0.91, adjusted GFI = 0.86, non-normed fit index = 0.95, comparative fit index = 0.96, root mean square error of approximation = 0.04 (<0.08)]. The results of the reliability analysis are provided in Table 5.

3.3.3 | Discriminant validity

The satiety responsiveness and food responsiveness dimension scores differed significantly according to gestational age, infant sex and average monthly weight gain (all $P < 0.05$). The enjoyment of food dimension score differed significantly according to average monthly weight gain ($P < 0.05$). The slowness in eating dimension score did not differ significantly according to any subject characteristic (Table 6).

4 | DISCUSSION

4.1 | Scale reliability and validity

4.1.1 | Reliability

All reliability coefficients for the Chinese version of the BEBQ exceeded 0.70, indicating good stability, equivalence and internal consistency. The Cronbach's α coefficients for the scale dimensions obtained in this study are greater than those reported for the original BEBQ (0.73–0.81) (Llewellyn et al., 2011) and the Australian version of the scale (0.56–0.78) (Mallan et al., 2014), indicating that the Chinese version of the BEBQ has better reliability.

4.1.2 | Validity

The Chinese version of the BEBQ showed good content validity and better structural validity than reported for the original scale (Llewellyn

TABLE 5 Chinese Baby Eating Behaviour Questionnaire reliability coefficients

Dimension	Cronbach's α coefficient	Guttman split-half coefficient	Retest reliability coefficient
Food responsiveness	0.80	0.85	0.68
Enjoyment of food	0.81	0.74	0.80
Slowness in eating	0.88	0.76	0.69
Satiety responsiveness	0.84	0.80	0.58
Total	0.93	0.87	0.75

TABLE 6 Chinese Baby Eating Behaviour Questionnaire dimension scores according to subject characteristics

Factor		Food responsiveness	Enjoyment of food	Slowness in eating	Satiety responsiveness
Gender	Male	2.79 \pm 0.83 ^a	3.43 \pm 0.49	2.44 \pm 0.59	2.21 \pm 0.65 ^a
	Female	2.56 \pm 0.81 ^a	3.24 \pm 0.56	2.55 \pm 0.60	2.37 \pm 0.62 ^a
Birth mode	Eutocia	2.62 \pm 0.91	3.34 \pm 0.48	2.41 \pm 0.56	2.36 \pm 0.65
	Caesarean section	2.63 \pm 0.80	3.30 \pm 0.59	2.56 \pm 0.61	2.30 \pm 0.58
Feeding method	Breastfeeding	2.67 \pm 0.91	3.34 \pm 0.58	2.48 \pm 0.60	2.23 \pm 0.62
	Bottle feeding	2.54 \pm 0.78	3.35 \pm 0.45	2.46 \pm 0.52	2.35 \pm 0.56
	Mixed feeding	2.53 \pm 0.83	3.11 \pm 0.52	2.45 \pm 0.73	2.63 \pm 0.65
Gestational weeks	Full-term pregnancy	2.78 \pm 0.81 ^a	3.32 \pm 0.56	2.49 \pm 0.59	2.29 \pm 0.60 ^a
	Premature delivery	2.53 \pm 0.84 ^a	3.31 \pm 0.33	2.48 \pm 0.60	2.55 \pm 0.65 ^a
Birth weight	Low	2.60 \pm 0.74	3.37 \pm 0.46	2.47 \pm 0.55	2.31 \pm 0.61
	Normal	2.53 \pm 0.64	3.35 \pm 0.60	2.53 \pm 0.60	2.33 \pm 0.65
	Fetal macrosomia	2.65 \pm 0.87	3.46 \pm 0.45	2.42 \pm 0.53	2.34 \pm 0.56
Monthly weight gain (g/month)	Monthly weight gain < P ₂₅	2.48 \pm 0.83 ^a	3.22 \pm 0.51	2.44 \pm 0.46	2.41 \pm 0.40 ^a
	P ₂₅ \leq monthly weight gain < P ₇₅	2.59 \pm 0.98	3.26 \pm 0.54 ^a	2.45 \pm 0.52	2.20 \pm 0.62 ^a
	Monthly weight gain \geq P ₇₅	2.77 \pm 0.76 ^a	3.44 \pm 0.53 ^a	2.51 \pm 0.72	2.38 \pm 0.66

Note: Data are expressed as means \pm standard deviations.

^aItems with significant differences.

et al., 2010). The cumulative variance contribution rate for the four factors is close to that reported for the original BEBQ (59.7%) (Llewellyn et al., 2010).

4.2 | Discrimination of the questionnaire

The satiety responsiveness and food responsiveness scores showed significant sex-based differences in this study, consistent with the results reported for the original BEBQ (Llewellyn et al., 2011). Some studies conducted with older children have shown that boys have lower food satisfaction scores than do girls, and this difference can be inferred to have begun in infancy (Carnell & Wardle, 2008; Sleddens et al., 2008; Wardle et al., 2001). These two dimension scores also differed significantly between preterm and full-term infants, consistent with results reported for the original BEBQ and those of a study conducted by Cooke et al. (2004) and Cooke and Embleton (2000), suggesting that premature birth affects infants' appetites (Embleton et al., 2001). The satiety responsiveness, food responsiveness and enjoyment of food dimension scores differed according to monthly weight gain, perhaps because poor dietary intake affects infants' growth and development (De Kroon et al., 2011; Lefebvre & John, 2013; Li et al., 2008; Salgin et al., 2015). We found no significant difference in the enjoyment of food, slowness in eating or satiety responsiveness score according to birth weight, as was observed for the original BEBQ in a sample of babies in the UK, which is, in turn, consistent with other findings linking birth weight to eating behaviour (Baird et al., 2005; Ong et al., 2006). Our results may be related to the weight increase of only 5.6% from birth in our sample. Original BEBQ satiety responsiveness and food responsiveness dimension scores also differed according to infants' feeding patterns, and epidemiological studies have yielded similar results (De Kroon et al., 2011; Gluckman et al., 2007; Harder et al., 2005; Owen et al., 2005), but we observed no such difference in this study.

4.3 | Study limitations

This study has some limitations. First, the subjects were recruited from two hospitals in Xi'an and only 270 questionnaires were valid, which limits the representativeness of the sample. Second, we could not evaluate the criterion validity of the scale because no other tool for the evaluation of babies' eating behaviour in China is available. Finally, our aim was to evaluate infants' eating behaviours during the exclusive milk-feeding period, but parents' responses may have been influenced by the current eating behaviours of older infants, especially those eating solid foods. This recall bias could not be avoided. All of these limitations might have influenced the accuracy of the study results. In the future, we will expand the test area and sample size, and select breastfeeding mothers to reduce selection and recall biases.

5 | CONCLUSION

The Chinese version of the BEBQ is the first tool developed for the evaluation of the appetites of infants in China through the assessment of eating behaviour. This tool has good reliability and validity, is suitable for the evaluation of infants' appetite in China and can be used in early screening for dietary and nutritional problems. To ensure the questionnaire's stability and universality, we will expand its testing in different areas of the country and further verify its reliability and validity. The findings from this study support future research on the relationship between infant eating behaviour and appetite in China.

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AUTHOR CONTRIBUTIONS

Lei Shang and Xun Jiang conceived and designed the study. Hao Zhang, Xianjun Yang, Tong Xu and Jing Yuan performed the study. Hao Zhang and Xianjun Yang analyzed the data. Lei Shang, Xun Jiang and Hao Zhang wrote the paper. Lei Shang, Xun Jiang and Yi Wan critically reviewed the manuscript and provided comments for revision. All authors contributed to the interpretation of the data and the writing of the manuscript. All authors read and approved the final manuscript.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

ETHICS STATEMENT

This study was approved by the Human Research Ethics Committee of the (No.v2.0.2012.03.10). All participants provided informed consent to participation.

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