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Cross-cultural adaption and validation of the Chinese version of the Child Food Neophobia Scale

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ABSTRACT

Objective To adapt the Child Food Neophobia Scale (CFNS) cross-culturally for use among 12-36-month-old Chinese toddlers and to perform a preliminary assessment of its construct validity and reliability.

Background Food neophobia is the fear of eating new or unfamiliar foods, which affects the type and quality of individual dietary intake, especially during early childhood. However, measurements of child food neophobia have rarely been reported in China due to a lack of reliable and valid measurements.

Methods The CFNS was translated and adapted into a Chinese version (CFNS-CN) through a forward translation, reconciliation, a back translation, expert review and pretesting. The construct validity and reliability of the CFNS-CN were tested in 390 caregivers of 12–36 months old Chinese toddlers through convenience sampling in Changsha Maternal and Child Health Care Hospital, Hunan Province, China. The internal consistency, confirmatory factor analysis (CFA) and reliability were estimated.

Results The kappa coefficients indicated moderate to perfect agreement between the test and retest, and Cronbach's α coefficient was 0.91. A normal χ^2/df, CMIN/DF=3.302, Comparative Fit Index, CFI=0.993, Tucker-Lewis Index, TLI=0.986 and root mean square error of approximation, RMSEA=0.077 were found. The CFA results showed that the model indicators were acceptable. High food neophobia was observed in 25.1% of individuals.

Conclusion The CFNS-CN showed good internal consistency reliability and construct validity. The CFNS-CN may become an effective tool for assessing food neophobia in Chinese toddlers.

Trial registration This trial was pre-registered at the China Clinical Trial Registration Center under registration number ChiCTR1800015890.

BACKGROUND

Food neophobia was first proposed by the Canadian researchers Pliner and Hobden in 1992,[1] and the term literally means 'fear of new foods'; it is the condition of individuals who do not want to eat and/or avoid eating novel or unknown foods. It partially overlaps with specific components of picky eating. Food neophobia is a common feature in birds and mammals, which have been widely studied. Its cause[2] is assumed to be a protective

Strengths and limitations of this study

► The original Child Food Neophobia Scale was successfully translated and cross-culturally adapted from English to Chinese.
► The reliability and the construct validity of the scale were verified by a large sample, which was the advantage of this study.
► The limitation was that only Changsha City was selected as the survey site, and there might be regional differences in food cultures and parenting styles, which could lead to insufficient sample representation.
► Another limitation was that we need more studies to verify the relationship between toddlers' food neophobia and actual eating behaviours in the future.

mechanism related to the dilemma of omnivores, in that each new food represents both an opportunity and a risk. When presented with new foods, humans must protect themselves from potentially toxic foods, which thus limits an individual's choice or intake of food.

The sensitive period for food preference habit development in early childhood[3] is also the peak period for food neophobia, which will gradually decrease and stabilise in adulthood. Thus, early childhood is the best time for intervention. According to one study,[4] 18-month-old children who show negative emotions towards the presentation of new food are more prone to high levels of food neophobia by the time they are 4–5 years old. Food neophobia in children is closely related to a preference for unhealthy food. Cooke, etc.[5 6] found that in children aged 2–6, a high degree of food neophobia is associated with low consumption of fruits, vegetables and meat. Several studies[7–10] on children as young as 2 years old have shown that in addition to deficiencies in vitamin E, protein, monounsaturated fatty acids and magnesium, the children in the food neophobia group also had lower energy intake than the normal group. They are more likely to choose foods with

higher energy densities and lower nutrient contents to increase energy intake, resulting in a higher risk of overweight/obese children in the food neophobia group than in the normal group. Higher food neophobia affects the nutritional status of toddlers. Early life nutrition[11] is critical to child development, and malnutrition has multiple effects on growth and neurobehavioural development, resulting in growth retardation, anaemia, disease and even an increased risk of death in young children. Lifelong effects include impaired learning and productivity and impaired intellectual development.[12]

Studies have shown[13] that food neophobia can be alleviated by repeated exposure to foods to develop an increased acceptance of that food. Therefore, understanding the food neophobia of children is of great significance for implementing targeted dietary health intervention strategies.[14] There are[15] currently 15 valid tools for evaluating food neophobia and individuals' attempts to try unfamiliar food. The most widely used and most reliable tool for evaluating food neophobia is the Food Neophobia Scale (FNS), which was developed in 1992 by Pliner and Hobden.[1] Two years after, Pliner[16] designed a 10-item Child Food Neophobia Scale (CFNS) to assess children's food neophobia. Four items were excluded on the basis that they were inappropriate for the age range of our sample (eg, "My child likes to eat in ethnic restaurants", "Ethnic food looks too weird to eat", "At dinner parties, my child will try a new food (R)", "My child likes foods from different countries (R)"). Cooke et al[6] simplifies his adjustment to the six-item version of the CFNS, which is more concise and has been shown to have good reliability[17] (Cronbach's α=0.91). It is suitable for, and has also been widely used, for children[18 19] as young as 2 years old. Literature on food neophobia first addresses the second half of the first year of life, during the period when caregivers start transitioning from food supplements to solid food,[20 21] then gradually increased and peaked in early childhood.[22] Thus, we included children as young as 12 months old in our study. The scores on the CFNS scale provide a good predictive level for children's food neophobia. The higher the score is, the higher the level of a child's food neophobia.[19] The CFNS is an effective tool for measuring young children's willingness to try new foods. It has been widely used to measure children's food neophobia, and it has been adapted and translated into many languages, including French, Italian, Finnish and so on.[14 18 23 24] These studies have also found that children's choices and willingness to try new foods were significantly associated with the CFNS score.

However, there is currently no research on food neophobia in China. Different people and cultures make different meanings and explanations for the FNS. It is necessary to verify the applicability of this scale to the Chinese population. Therefore, this study introduced a six-item version of the CFNS for cultural adaptation. We analysed the reliability and construct validity assessments of the CFNS in a sample of 12–36 months old Chinese toddlers, and we present a preliminary discussion of food neophobia in these toddlers.

MATERIALS AND METHODS
Translation and cross-cultural adaptation
The cross-cultural adaptation process was performed in accordance with the translation and adaptation of instrument guidelines recommended by WHO.[25] After the original scale was obtained with the permission of the author (Pliner), a forward–backward translation method was used to develop a preliminary Chinese version of the six-item CFNS. The forward translation was performed by two bilingual translators. The synthesis of the forward translations was discussed by a consensus panel, which consisted of multi-principle senior experts (two nutritionists, two researchers at child health departments, two paediatricians and two psychologists). The back-translation was performed by a bilingual translator who was blinded to the original version of the CFNS. As much as possible, the translated English was accurately expressed in Chinese. If the differences between the back-translated version and the original scale item were great, the translation and back-translation process was repeated until both the team members and the translators approved the translation. The back-translated scale was then sent to Dr Pliner for his additional suggestions and to assess its conceptual equivalence. The second version of the CFNS was discussed by a consensus panel to arrive at a prefinal version. In-depth interviews were performed for seven primary caregivers to investigate the acceptability of the CFNS and to compile the final version.

Participants
Convenience sampling was used to select healthy toddlers aged 12–36 months in Changsha Maternal and Child Health Care Hospital, Hunan Province, China. After the toddlers' routine health check, our investigators asked the primary caregiver for the toddlers' general information, including their age (months), birth situation and physical condition. If the inclusion criteria were met and if the primary caregiver agreed to sign the informed consent form, then the toddlers and their primary caregivers could be included in the investigation, and 30 primary caregivers were selected to assess the test–retest reliability of the CFNS.

Inclusion criteria for toddlers
1. 12–36 months old toddlers with full-term births (37–42 weeks).
2. Birth weights ranging from 2500 g to 4000 g.
3. No congenital diseases.
4. No serious illness from after birth to the time of enrolment.
5. No acute infections at the time of the study, such as diarrhoea and inflammation.
6. No postnatal suffocation, intracranial haemorrhage, ischaemic encephalopathy or other medical history during maternal pregnancy and delivery time.

Inclusion criteria for primary caregivers

1. Willing to sign the consent form.
2. The primary caregiver of the observed toddlers who was familiar with the daily dietary situation and feeding practices of the toddlers.
3. Able to understand and answer questions.

Data collection

A test–retest study was conducted among 30 caregivers of toddlers (12 boys, 18 girls). The caregivers were asked about the food neophobia of the toddlers, and then they completed the questionnaire. Two weeks later, the caregivers were asked to fill out the CFNS again to measure the test–retest reliability.

At the time of the formal investigation, 390 (no missing data) primary caregivers of toddlers (217 boys and 173 girls) were selected for the investigation to assess the construct validity of the scale. Investigators interviewed the child caregivers one-on-one, using electronic questionnaires to investigate and record information in addition to the CFNS, including the demographic characteristics of the toddlers (age, gender, ethnicity, etc) and the demographic characteristics of the caregivers (gender, age, relationship to young children, etc).

In this study, the scoring criteria for food neophobia were based on the study by Laureati et al.[14] The options were based on the child's attitude towards new foods (such as fear/resistant/picky), and another six entries were given answer options from 1 ("strongly disagree") to 7 ("strongly agree") out of seven subscales, with the score being obtained over a range from 6 to 42. Item 1 and item 6 were scored in reverse order. The scores were divided into three groups by quartiles; less than or equal to P25 was graded as having a low level of food neophobia, and P75 was graded at a high level of food neophobia. The rest of the children were graded as having a medium level of food neophobia.

Data analysis

1. The data were statistically analysed with SPSS (version 20.0; IBM Corp, Armonk, NY, USA) and AMOS (version 21.0; Chicago, IL, USA) software.
2. Reliability: The internal consistency of the scale was reflected by calculating Cronbach's coefficient (α), which should be ≥0.70. The test–retest interval was 2 weeks. Kappa statistics were used to assess the consistency between the test and retest for each item separately. Kappa coefficients above 0.6 are considered to indicate substantial agreement, and above 0.8 are considered perfect agreement.
3. Validity: The construct validity of the scale was verified by confirmatory factor analysis (CFA). AMOS software was applied for the CFA. The primary measurement indicators were the χ^2/df (CMIN/DF), the Comparative Fit Index (CFI), the non–norm-fitting index (Tucker-Lewis Index, TLI) and the approximate error root mean square (RMSEA), which were used to verify the fit, goodness and acceptability of the model. Using the maximum-likelihood method to test the model, when CMIN/DF <4, CFI >0.9, TLI >0.9 and RMSEA <0.08, the model was considered to have a reasonable degree of goodness of fit and acceptability.
4. A χ^2 analysis was used to understand the food neophobia of toddlers of different ages and genders.

Patient and public involvement

This research was performed without patient involvement. The participants were not invited to comment on the study design and were not consulted to develop the relevant outcomes or interpret the results. The participants were not invited to contribute to the writing or editing of this document for readability or accuracy.

RESULTS

General characteristics of the study population

A set of questionnaires was administered to 390 toddlers' primary caregivers, resulting in a valid response rate of 100.0%. Table 1 shows the sociodemographic characteristics of the study population. More than half of the toddlers were boys (55.6%), of Han ethnicity (98.7%), and 74.6% of them were the only child in their family. With respect to breast feeding for the first 6 months, 70.3% of the toddlers were exclusively breastfed. Parents as the primary caregivers of toddlers accounted for a large proportion (63.8%) of the children. Most of the primary caregivers surveyed were female (99.2%) and 53.6% of them had a degree from college and above. The average age of the primary caregivers was 39.6±12.9, and approximately 35% of them reported more than 15 000 RMB as their monthly family income. There was no significant difference in demographic information between different age groups.

Cross-cultural adaption

After the forward–backward translation and discussion within the consensus panels, only a minor change in item 1 was made, as follows: "My child is constantly sampling new and different foods" was changed to "My child is constantly sampling new and different (variety) foods". The Chinese-translated final version of the CFNS is shown in online supplementary table S1. All the caregivers agreed that the scale was easy to understand during the pretest period.

Internal consistency and test–retest reliability of the CFNS

The internal consistency of the six-item version of the CFNS was ideal (Cronbach's α=0.91; n=6). As shown in table 2, the kappa coefficients of six items in the CFNS-CN ranged from 0.616 to 0.834, which indicated substantial-to-good agreement between the test and retest. The correlation coefficient between each item and the total score of the scale was 0.726–0.902 (p<0.01), indicating that each item had a higher correlation with the toddlers' food neophobia score (see table 3).

Table 1 Sociodemographic characteristics of the study population (N=390)

	12–24 months (n=249)	25–36 months (n=141)	Total sample (n=390)
	Mean±SD or n (%)	Mean±SD or n (%)	Mean±SD or n (%)
Toddler			
Sex			
Boy	133 (53.4%)	84 (59.6%)	217 (55.6%)
Girl	116 (46.6%)	57 (40.4%)	173 (44.4%)
Ethnicity			
Han	246 (98.8%)	139 (98.6%)	385 (98.7%)
Other minorities	3 (1.2%)	2 (1.4%)	5 (1.3%)
Only child			
Yes	190 (76.3%)	100 (71.4%)	291 (74.6%)
No	59 (23.7%)	40 (28.6%)	99 (25.4%)
Exclusively breast feeding for the first 6 months			
Yes	178 (71.5%)	96 (68.1%)	274 (70.3%)
No	71 (28.5%)	45 (31.9%)	116 (29.7%)
Primary caregiver			
Relationship to toddler			
Parents	154 (61.8%)	95 (67.4%)	249 (63.8%)
Grandparents	90 (36.1%)	45 (31.9%)	135 (34.6%)
Other	5 (2.0%)	1 (0.7%)	6 (1.5%)
Sex			
Female	247 (99.2%)	140 (99.3%)	387 (99.2%)
Male	2 (0.8%)	1 (0.7%)	3 (0.8%)
Age (years)	39.8±12.9	39.1±13.0	39.6±12.9
Education			
Primary school	17 (6.8%)	8 (5.7%)	25 (6.4%)
Middle school	34 (13.7%)	20 (14.2%)	54 (13.8%)
High school	63 (25.3%)	39 (27.7%)	102 (26.2%)
College and above	135 (54.2%)	74 (52.5%)	209 (53.6%)
Family monthly income level (RMB)			
2000–5000	13 (5.2%)	10 (7.1%)	23 (5.9%)
5000–10 000	67 (26.9%)	35 (24.8%)	102 (26.2%)
10 000–15 000	82 (32.9%)	48 (34.0%)	130 (33.3%)
≥15 000	87 (34.9%)	48 (34.0%)	135 (34.6%)

Construct validity of the CFNS

The CFNS extracted two common factors (online supplementary figure S1), and the factor load values for each item in the dimension ranged from 0.85 to 0.99. The CFA results showed that each fitting index (χ^2/df, CMIN/DF; CFI; TLI; RMSEA) met the requirements. CMIN/DF was 3.302; CFI was 0.993; TLI was 0.986; RMSEA was 0.077. A 90% CI was 0.05 to 0.11, which suggested that the Chinese version of the CFNS

Table 2 Kappa coefficient for all items within the Chinese version of the Child Food Neophobia Scale (N=30)

Item	Kappa	P value
Item 1: My child is constantly sampling new and different (variety) foods.	0.616	<0.01
Item 2: My child does not trust new foods.	0.717	<0.01
Item 3: If my child doesn't know what's in a food, s/he won't try it.	0.639	<0.01
Item 4: My child is afraid to eat things s/he has never had before.	0.873	<0.01
Item 5: My child is very particular about the foods s/he will eat.	0.718	<0.01
Item 6: My child will eat almost anything.	0.834	<0.01

Table 3 Inter-item and total-item correlation matrix of the Child Food Neophobia Scale (N=390)

Item 1	1.000						0.851
Item 2	0.793	1.000					0.869
Item 3	0.822	0.893	1.000				0.902
Item 4	0.786	0.820	0.880	1.000			0.892
Item 5	0.422	0.418	0.466	0.487	1.000		0.743
Item 6	0.412	0.400	0.426	0.472	0.926	1.000	0.726
Total score	0.852	0.870	0.902	0.892	0.743	0.726	1.000

contained six items that fit well into the two-dimensional model, which was consistent with the model structure. The degree of acceptance indicated that the construct validity of the scale was good.

Descriptive results of the CFNS scores

The score for the toddlers' food neophobia was 21.55±7.81 (mean±SD). There were 98 toddlers in this study who displayed high-level food neophobia (25.1%), 175 who displayed medium-level food neophobia (44.9%) and 117 who displayed low-level food neophobia (30.0%). The distribution of food neophobia levels in boys was similar to that in girls. A larger proportion of the toddlers aged 25–36 months displayed high-level food neophobia than did 12–24 months old toddlers (35.5% vs 19.3%, table 4).

DISCUSSION

The negative impact of food neophobia on the quality of toddlers' diets has been demonstrated repeatedly. The CFNS has been the primary tool for predicting children's willingness to try new foods. To date, there has been no research on food neophobia in China, so creating a CFNS assessment suitable for the cultural background of the country was necessary. Due to cultural, custom-related and language differences, the translation of western scales had to follow certain standards and requirements. By strictly following the process for international Chinese scale rules, the present study entailed a cross-cultural adaptation of the CFNS into Chinese and provided an evaluation of this tool's adequacy in a sample of 12–36 months old Chinese toddlers and their caregivers at a Chinese city's Maternal and Child Health Care Hospital. The results showed that the Chinese CFNS is adequate

for evaluating food neophobia in this sample of Chinese toddlers, and it has good construct validity and reliability.

After the first step in the adjustment, the CFNS retained all six items, and only some of the text was adjusted to form a CFNS with a Chinese version of the six items. In our study, the reliability and construct validity of that scale was initially evaluated in 12–36 months old toddlers . The internal consistency coefficient (Cronbach's α) of the original 10-item version of the CFNS was 0.84,[16] and Cronbach's α of foreign language versions of the CFNS was between 0.79 (USA)[26] and 0.95 (Norway).[27] Cronbach's α of the Chinese CFNS was 0.91, and the same result was also consistent with the study by Marrone and Russell and Worsley,[17 28] which suggests the Chinese version of the CFNS has good reliability in this population. Differences in the internal consistency may be due to differences in the cognition and patterns of understanding regarding neophobia among different cultures or populations. For example, the proportion of neophobic individuals differs between countries, and the observed differences between countries are explained by the association with specific eating habits.[29] Studies have found that Koreans were characterised by a significantly higher level of food neophobia than individuals from the USA,[30] while USA-based and Finland-based individuals were characterised by a similar level of food neophobia, and they are more food neophobic than individuals from Sweden.[31] In urban areas,[32] the food neophobia level was lower than it was in rural areas, which might be another explanation.

The original version of the CFNS includes 10 items that differ from the Chinese version. The CFNS was filled out by the primary caregivers, and differences in the educational degree, age, socioeconomic status and so on among

Table 4 Basic description by food neophobia level of 12–36 months old toddlers(N=390)

	Level of food neophobia				
	Low level (n, %)	Medium level (n, %)	High level (n, %)	χ^2	P value
Age					
12–24 months (n=249)	82, 32.9%	119, 47.8%	48, 19.3%	12.665	0.002
25–36 months (n=141)	35, 24.8%	56, 39.7%	50, 35.5%		
Gender					
Boy (n=217)	66, 30.4%	96, 44.2%	55, 25.4%	0.08	0.960
Girl (n=173)	51, 29.5%	79, 45.7%	43, 24.8%		

the primary caregivers[32 33] may have caused differences in their understanding and influence when giving answers for the children's food neophobia scale, which was one of the reasons for the difference. Parents who are more neophobic allow their child less autonomy in self-feeding and also offer fewer new foods to their children. There is a certain correlation between parental food neophobia and that of their children.[34] In addition, parental feeding practices, such as urging a child[34] to eat or pressuring them to eat,[35] could result in increased food neophobia. The literature has suggested that older subjects and subjects possessing a higher level of education had less food neophobia.[33] Flight *et al*[32] found that exposure to diverse cultures and higher socioeconomic status (SES) might increase knowledge of a wide variety of stimuli, including food, and it could be negatively associated with food neophobia. Macnicol *et al*'s[36] study seemed to indicate that lower SES was associated with an increased tendency to possess higher food neophobia levels.

In this study, the kappa coefficient and intraclass correlation coefficient were used to assess the test–retest reliability. The correlation coefficients between the Chinese CFNS items and the total score of the scale were 0.73–0.90, which were significantly higher than they were in the original CFNS (0.48–0.60).[16] We also found that the kappa coefficients of six items in the CFNS-CN ranged from 0.616 to 0.834. These results indicated evidence of the repeatability of construct measurements between two time points. Therefore, it is suggested that this scale has good homogeneity reliability and good internal consistency. The results were consistent with other studies,[14 37] which indicates that the CFNS has time stability.

The results of the CFA show that each item has a factor load that is greater than 0.85 in its dimension. The results of this study were higher than the factor load of Damsbo-Svendsen *et al*'s[38] (0.57–0.78). The four indicators CMIN/DF, CFI, TLI and RMSEA once again confirmed that the Chinese version of the CFNS had good adaptability, which was consistent with the French research results for children aged 2–7 years.[18] The same scale is used for different studies. In different research environments (a laboratory environment and a real environment), there might be different effects. A construct validity test must be completed on a large scale over several studies or by testing different samples. The larger the sample size of the study, the more information is covered in the factor analysis, and the more the relationship between the variable information is reflected; thus, the more reliable the factor analysis results will be.

After completing the appropriate revision of the Chinese-version CFNS and the evaluation of the reliability and construct validity, it is necessary to determine whether the scale has a use value in China. The average score of the Chinese CFNS was 21.55 (SD=7.81), and the incidence of toddler food neophobia was 25.1%. Zalilah and Rodríguez-Tadeo's study found that the incidences of food neophobia in primary school students were 18.4% and 16%, respectively.[8 39] In southern Poland, low neophobia was observed in 12.3% and high neophobia was found in 10.8% of the examined preschool children.[40] Norwegian researchers obtained a CFNS score of 18.2 (SD 9.3) for toddlers aged 27.9±3.5 months,[26] which is similar to our results. Swedish studies have shown that[41] the FNS scores of children in different age groups from 7 to 20 years old gradually decreased with the increase in the age group; the score for children aged 7–11 was 36, the score for the group 12–14 years old was 35 and the score for the group 15–20 years old was 25. The higher the age group was, the lower the food neophobia score. Our study found that 25–36 months old toddlers displayed a higher proportion of food neophobia than 12–24 months old toddlers. Food neophobia arises during the transition to solid foods during infancy, and researchers tend to believe that[42] infant food neophobia appears at a fairly low level but increases and peaks during early childhood, then gradually decreases with age. A systematic review found that the incidence of food neophobia in children aged 0–18 years was between 40% and 60%.[43] Different population samples have different incidences, and the incidence of urban samples is significantly lower than that of rural areas.[33 44] No differences in gender effects were found in the Norwegian samples. However, the literature on gender-related differences in food neophobia scores is rare and contradictory. Especially for children, but in general,[42 45 46] boys are more likely than girls to have a high degree of food neophobia in young groups. There is a complex interaction between gender and food neophobia, but the specific mechanism has not yet been revealed. There are some strengths and limitations in our study. The original CFNS was successfully translated and cross-culturally adapted from English to Chinese. The consistency of the meaning of each item in both versions has been confirmed by the author of the original scale. In addition, the reliability and the construct validity of the scale were verified by a large sample, which was the advantage of this study. The limitation was that only Changsha City was selected as the survey site, and there might be regional differences in food cultures and parenting styles, which could lead to insufficient sample representation. Furthermore, the scale was completed by the toddlers' primary caregivers, which involved an increased risk of social desirability bias. The primary caregiver participants were mostly highly educated, employed mothers and had higher monthly incomes, which might result in a lower food neophobia trend. Another limitation was that food neophobia as measured by a scale reflected attitudes and intentions. However, it is suspected that attitudes and intentions do not reflect actual behaviour, so more studies are needed to discuss whether negative responses to a child food neophobia scale lead to hedonically negative responses towards novel foods.

CONCLUSION

In summary, the Chinese version of the CFNS is the first exploration of food neophobia in China. The

CFNS has shown good reliability and construct validity during the determination of toddler food neophobia, which indicates that the scale is available and feasible in China. Although the verification of the scale was strictly performed according to a standard, only a single test population was used, and there is no relevant research in the country. Thus, this study cannot be compared with others, but it can only be used as a preliminary attempt to introduce the scale. In the future, a larger and more varied sample will be needed for research, and some of the scale items will need to be adjusted and revised to determine the different versions of the food neophobia scale that will be appropriate for different ages in China. Another research direction for the future is application of the CFNS to Chinese toddlers to determine the impact of food neophobia on toddler food choices and eating behaviours and to fill in the gaps in food neophobia research in China. Through the exploration of Chinese toddlers' willingness to try new foods in different family environments and their reasons for rejecting new foods, appropriate interventions can be made in advance to prevent or alleviate the occurrence of food neophobia.

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