Validity and reliability of the Chinese version of the perceived insufficient milk questionnaire

Abstract

Background/Aims This study aimed to translate the perceived insufficient milk questionnaire into the Chinese language, Mandarin, perform cultural adaptation, and evaluate its validity and reliability. **Methods** The perceived insufficient milk questionnaire was translated using a forward-backward process. An expert panel evaluated content validity with both item and scale content validity indices. Construct validity was assessed by exploratory and confirmatory factor analysis. Internal consistency reliability was evaluated by the Cronbach alpha coefficient. With a 1-week interval, the test-retest reliability was assessed by intraclass correlation coefficient. **Results** A total of 328 participants were recruited. The item-level content validity index was as high (0.83–1.0), and the scale-level content validity index was 0.92, indicating excellent validity. A single-factor model was verified as acceptable with good fit indices. The internal consistency (Cronbach alpha coefficient=0.943) and test-retest reliability (intraclass correlation coefficient range: 0.870–0.974) were good. **Conclusions** The Chinese version of the perceived insufficient milk questionnaire had acceptable validity and reliability. It is helpful for healthcare providers to evaluate mother's beliefs about breastmilk quantity and nutritional quality, preventing early cessation of breastfeeding through timely interventions.

Keywords

Insufficient milk | Questionnaire | Reliability | Translation process | Validity

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Breastmilk provides ideal nourishment for infants. The health benefits of breastfeeding for mothers and their babies are unmatched. Breastfeeding can lower a mother's risk of breast and ovarian cancer, and diabetes (Chowdhury et al, 2015; Louis-Jacques and Alison Stuebe, 2018). Breastfeeding for 6 months can result in losing approximately 3kg of fat, helping mothers return to their prenatal weight (Del Ciampo and Del Ciampo, 2018). Breastfeeding can also help protect babies against sudden infant death syndrome and infant mortality (Adams, 2017). With a mix of vitamins, protein, fats and antibodies, infants fed with breastmilk have a lower risk of childhood obesity as well as atopic and infectious diseases (Brahm and Valdés, 2017; Qiao et al, 2020). The physiological and emotional connection formed during breastfeeding has a protective effect on maternal mood and stress, and the child's cognitive and emotional development (Safadi et al, 2016; Krol and Grossmann, 2018).

Breastfeeding for longer and with a higher intensity, in terms of the proportion of breastmilk in feedings (0%=no mother's milk, 100%=exclusive breastfeeding) provides significant health benefits (Chantry et al, 2006). The World Health Organization (WHO, 2001) recommends that infants should be exclusively breastfed for the first 6 months of life, followed by complementary (solid) foods with continued breastfeeding up to 2 years old or beyond. Nevertheless, many countries report that mothers have difficulty following breastfeeding recommendations and discontinue breastfeeding early (Kavle et al, 2017; Gianni et al, 2019).

Exclusive breastfeeding means that an infant is fed only breastmilk without other solids or liquids, except for drops or syrups consisting of vitamins, supplements, minerals or medicines. Worldwide, only 37% of infants less than 6 months old are exclusively breastfed (Jama et al, 2020). In Japan, although 90% of the mothers are expected to breastfeed their infants, only 37.4% continued exclusive breastfeeding for their infants up to 6 months postpartum (Inano et al, 2021). A report released by the Centers for Disease Control and Prevention

(2018) revealed that only 25% of infants in the US were exclusively breastfed, 57.6% for 6 months and 35.9% for 12 months. In China, the exclusive breastfeeding rate at 6 months ranges from 0.5–33.45%, and only 10.97–73.26% continue any breastfeeding at 12 months (Li et al, 2020). Only 0.26–0.38% of children are breastfed for up to 2 years (Li et al, 2020).

The decision to breastfeed is influenced by multiple factors that include breastfeeding knowledge (Wilson, 2018; Zhu et al, 2019), attitude (Nnebe-Agumadu et al, 2016; Wilson, 2018) and intention (De Jager et al, 2014; De Roza et al, 2019). Perceived insufficient milk is also one of the most common reasons for mothers to introduce formula feeding and cease breastfeeding completely (Hintz, 2019). The perception of insufficient milk refers to a mother's belief that her breastmilk supply is inadequate in quantity or nutritional quality to meet the infant's needs (Hintz, 2019). Almost all mothers can produce adequate milk, according to research, while nearly 50% of mothers in the US report perceived insufficient milk and cite it as an important reason to opt for breastmilk substitutes (Nobili et al, 2019). A study from Indonesia reported that 25–73% of mothers stop breastfeeding early because of perceived insufficient milk (Sandhi et al, 2020). In mainland China, Lou (2013) reported that 51–81% of mothers perceived that their milk supply was insufficient for their infants, leading to early weaning or supplementation. Another study indicated that 25–50% of mothers reported perceived insufficient milk (Hintz, 2019).

Perceived insufficient milk does not mean the supply is actually insufficient. Through objective measures, mothers with an adequate milk supply at 6 weeks postpartum reported perceived insufficient milk 2 weeks later (Nobili et al, 2019). Some normal infant behaviours, including crying, breastfeeding frequency and duration and wakefulness, can be misinterpreted as indicators of insufficient milk, regardless of whether they have an adequate breastmilk supply (Prabasiwi et al, 2013). In response to perceived insufficient milk, mothers may prefer to use supplementation to satisfy infants' needs. As a result of reduced milk removal and supply, providing supplemental feeding to infants can result in actual insufficient milk (Lau et al, 2015). Thus, perceived insufficient milk leads to reduced breastfeeding duration and exclusivity (Hintz, 2019).

To support optimal infant feeding practice and improve maternal and child health, it is crucial to identify mothers who perceive their milk supply to be inadequate and put in place effective strategies to address perceived insufficient milk. A validated questionnaire is needed to provide a consistent and accurate assessment of perceived insufficient milk. To the best of the authors' knowledge, only a few questionnaires are available

to measure perceived insufficient milk, especially in China. The perceived insufficient milk questionnaire developed by McCarter-Spaulding and Kearney (2011) assesses mothers' perception of insufficient milk. This self-report questionnaire has a global question on the mother's belief about milk adequacy (answered yes or no), followed by space for the mother to give reasons supporting their belief. Five subsequent questions with 10-point responses (ranging from 0=strongly disagree to 10=strongly agree) is used to measure mothers' perceived degree of breastmilk deficiency. Higher scores indicate a higher perception of adequate milk supply. Although the perceived insufficient milk questionnaire has been translated and validated as an effective tool in previous studies across different countries (Otsuka et al, 2008; Gökçeoğlu and Küçükoğlu, 2018), there is no Chinese version. This study aimed to translate the perceived insufficient milk questionnaire into the Chinese language, Mandarin, perform cultural adaptation and assess its validity and reliability.

Methods
Translation procedure
After obtaining permission to translate the original perceived insufficient milk questionnaire, a forward and backward process was used to ensure the quality of translation (Sousa and Rojjanasrirat, 2011). Initial translation from English to Mandarin was independently carried out by two translators, a nursing lecturer and an English lecturer, resulting in two translated versions.

The two translations and the original version were compared by a breastfeeding expert and discussed with the translators, regarding equivalence of meaning, ambiguities and discrepancies. Then the preliminary initial translated version was generated.

The preliminary version was independently back-translated to English by two translators, making two back-translated versions. The translators were a nursing professor and a native English teacher who had not seen the original questionnaire.

All four translators as well as the researcher and a senior obstetrician, who held a PhD, formed a multidisciplinary translation committee. The committee compared the items and responses of the backtranslated versions with the original questionnaire and found no inaccuracies. Although some words differed in items, they showed equivalence to the original meaning. The pre-final version was formed.

The pre-final version was piloted among 10 Chinese mothers using convenience sampling from a general tertiary hospital in Jiangsu Province, China. The pilot participants were from the target population of the study and the same inclusion and exclusion criteria applied, as outlined below. Based on the

time of questionnaire distribution in previous studies (McCarter-Spaulding and Kearney, 2011; De Roza et al, 2019), the 10 mothers were recruited and given a face-to-face survey before discharge. They were asked to assess instructions and items and check for clarity of the response format, answering that items were either 'clear' or 'unclear'. The instructions, items or responses rated unclear by over 20% of mothers may have required revision by the translation committee based on the mothers' suggestions (Unoki et al, 2021). Based on their feedback, the instructions and items were clear and easily understandable. At the same time, 40% of the mothers felt confused about making choices on the Likert scale responses.

Figure 1. Translation procedure

An expert panel of four nurses, a nursing educator, and an obstetrician was invited to evaluate the clarity following the same process as the pilot testing, via email. The panel suggested reducing the original initial responses (0=strongly disagree, 10=strongly agree) to 5-point responses (1=strongly disagree, 5=strongly agree). Based on the feedback from the pilot and the expert panel, the questionnaire was changed to a 5-point system, with a possible score ranging from 5–25. During pilot testing, no participants or experts reported that the questionnaire needed cultural adaptation. Therefore, the content was concluded to be suitable for the Chinese cultural background.

The expert panel was asked to assess content validity by classifying each item on a Likert scale, where 1=not relevant, 2=unable to assess relevance, 3=relevant but needs minor alteration and 4=very relevant and succinct. The content validity analysis was calculated based on the score of each item, as scored by the experts. The translation procedure can be seen in *Figure 1*.

Participants
The target population was mothers of a full-term singleton living in Jiangsu Province, China. Participants were mothers who gave birth in a level-III hospital in Jiangsu Province between July and September 2021. The inclusion criteria were:
- Age ≥18 years
- Having a healthy singleton at full-term (gestational age ≥37 weeks) and normal birth weight
- Having no serious health problems (eg COVID-19, HIV) that could affect milk supply or maternal feeding practice
- Had initiated breastfeeding with their infants
- Were able to speak, read and write Mandarin.

The exclusion criteria were having a history of receiving certain breast surgery (eg breast augmentation, reduction, mammaplasty), having special dietary needs or having previously been diagnosed with mental illness (eg bipolar disorder, depression, anxiety disorders).

The researchers recruited eligible participants to complete the paper-based questionnaires on the day before discharge. Recruitment continued until the desired sample size was reached (details of sample size calculation are below). All participants were numbered 1–328 in order of recruitment. To examine test–retest reliability, 51 participants were randomly selected using a lottery method. The selected participants completed the perceived insufficient milk questionnaire again 1 week after their first investigation. If a response was missing, the researcher returned the questionnaire to the participant to ensure completeness.

The 328 participants completed the questionnaires face-to-face before discharge, and the questionnaires
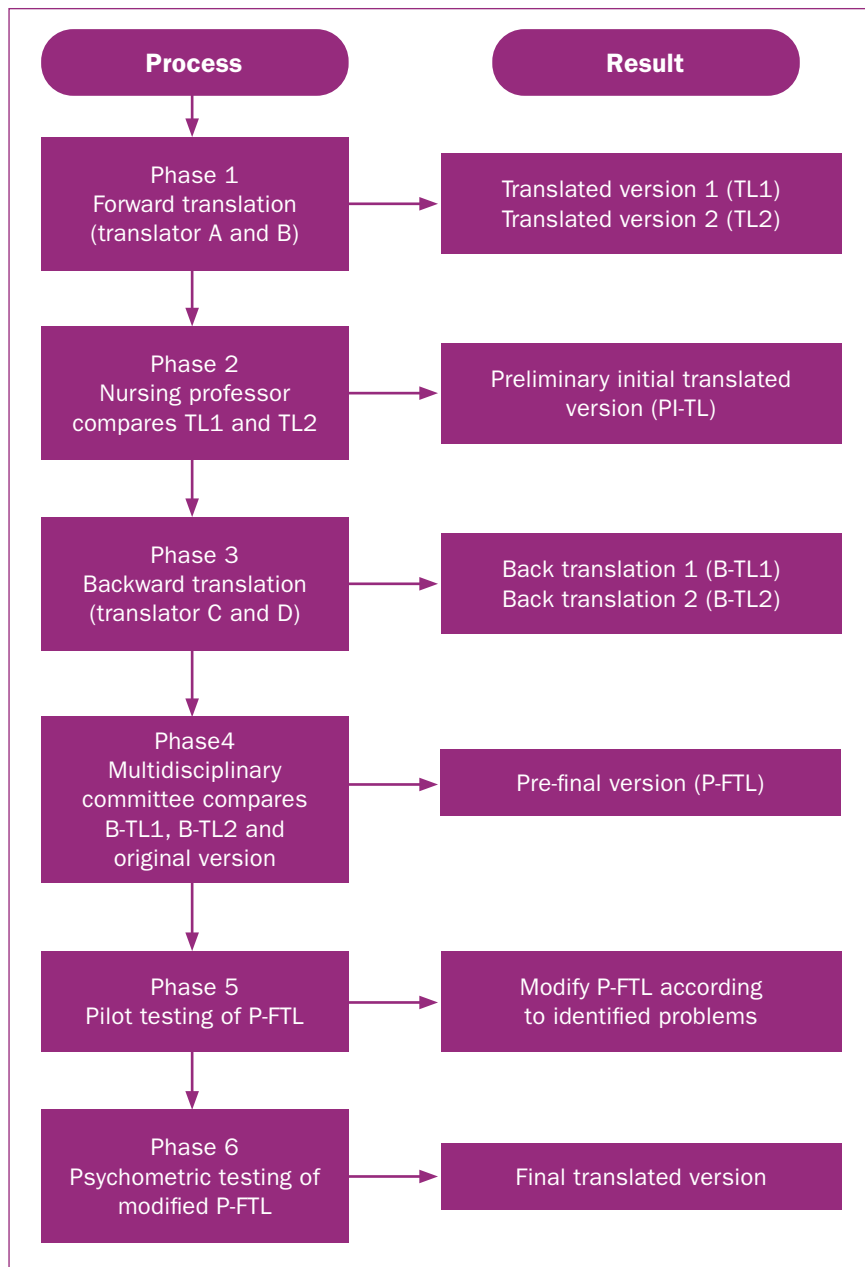
were returned immediately. The 51 retest participants completed electronic copies of the questionnaire through Wechat 1 week later. In both cases, the participants were given 5 minutes to complete the questionnaire.

Sample size
For general psychometric approaches, including exploratory factor analysis, it is appropriate to use at least 10 participants per item in an instrument (Sousa and Rojjanasrirat, 2011) and 200 participants for confirmatory factor analysis (Yang et al, 2021). Although the perceived insufficient milk questionnaire has six items, the first item is a global question, while items 2–6 are specific items that further measure a mother's perception. The developers used items 2–6 to validate the original questionnaire (McCarter-Spaulding and Kearney, 2011). Therefore, except for when assessing content validity, the present study used items 2–6 to evaluate validity and reliability. The present study required at least 50 participants for general psychometric approaches and 200 for confirmatory factor analysis. Accounting for a non-eligibility rate of 15% (Joo et al, 2021), the sample size for validation was 288.

Data analysis
Statistical analysis, including descriptive statistics and reliability and validity assessment, was performed with the Statistical Package for Social Sciences (version 17.0). Data were expressed as percentages, means and standard deviation for descriptive statistics. Content validity indexes were calculated to test content validity. and included item and scale indices. Item indices were computed as the number of experts who rated 4 (very relevant and succinct) for each item divided by the total number of experts (Rodrigues et al, 2017). Scale indices were calculated by the sum of item indices divided by the number of items. Item and scale indices higher than or equal to 0.78 and 0.90 respectively were considered excellent (Hoe, 2008; Rodrigues et al, 2017).

Exploratory factor analysis and confirmatory factor analysis were used to test the construct's validity. For exploratory factor analysis, a Kaiser-Meyer-Olkin value >0.60 and Bartlett's test of sphericity with a significant level under 0.05 suggests that the data are acceptable to proceed with factor analysis (Maat et al, 2011). For confirmatory factor analysis, the absolute fit indices, including chi-Squared tests, degrees of freedom, goodness-of-fit index), adjusted goodness-of-fit index, comparative fit index, normed fit index, root mean square error of approximation and root mean square residual are used to determine the model fit (Kline, 2015). For the goodness-of-fit, adjusted goodnness-of-fit, comparative fit index and normed fit index, values >0.90 confirm a good model. A root mean square error

of approximation between 0.05 and 0.08, root mean residual <0.50 and chi-Square/degrees of freedom ratio of 3 or less confirm a good model fit (Kline, 1998; Hoe, 2008; Kim et al, 2016; Chan and Idris, 2017; Unoki et al, 2021).

The internal consistency of the questionnaire was verified using Cronbach's alpha coefficient. A Cronbach's alpha >0.80 is considered good, and >0.90 is excellent (Anrijs et al, 2020). The intraclass correlation coefficient was used as the reliability index to examine the test-retest reliability. Values <0.50 are unacceptable, between 0.50 and 0.75 reflect moderate reliability, 0.75 and 0.90 indicate good reliability and >0.90 indicates excellent reliability (Koo and Li, 2016). In the sample size calculator (Walter et al, 1998), the researchers set the minimum acceptable reliability as 0.75, expected reliability as 0.90, significance level (2 tails) as 0.05, power as 80% and the expected attrition rate as 10%, making the sample size for the intraclass correlation coefficient at least 37.

Ethical considerations
The hospital's ethics committee approved the study (LS-2021107-03). All participants were informed of the purpose, process, method, benefits, possible risks and voluntary nature of this study before signing informed consent. The data and information collected in this study were kept confidential.

Results
Patients characteristics and perceived insufficient milk
A total of 350 mothers were invited to participate in this study, and 328 mothers responded (response rate=93.7%). Data from 120 mothers were used for exploratory factor and 208 mothers for confirmatory factor analysis. The baseline characteristics of all respondents are shown in *Table 1*. Of the 328 mothers, 60.4% reported a perceived insufficient milk supply. Most listed more than one indicator or reason to support their perception. Typical reasons included mothers feeling that their breast was not full (64.9%) and the breastmilk was too thin (70.4%). In addition, signs of insatiable babies after breastfeeding (baby's cries, frequent breastfeeding, short breastfeeding duration) made 77.7% of mothers feel that their breastmilk was insufficient.

Validity and reliability
Content validity
Following evaluation by six experts, the item content validity index of each item in the questionnaire ranged from 0.83 to 1.0, and the scale index was 0.92, as shown in *Table 2*. All the item indices were >0.78 and the scale index was approximately 0.90. Thus, the content validity of the questionnaire was assessed as excellent.

Research

Table 1. Characteristics of participants

Variable	Category	Frequency, n=328 (%)
Age (years)	≤25	97 (29.6)
	26–35	200 (61.0)
	≥36	31 (9.5)
Parity	1	176 (53.7)
	≥2	152 (46.3)
Mode of birth	Vaginal	146 (44.5)
	Caesarean section	182 (55.5)
Household monthly income per person (RMB)	≤3000	84 (25.6)
	3000–5000	155 (47.3)
	>5000	89 (27.1)
Education	College degree or below	184 (56.1)
	Bachelor degree	112 (34.1)
	Postgraduate degree or above	32 (9.8)
Residence	Urban	177 (54.0)
	Rural	151 (46.0)

Table 2. Content validity

Item	Expert rating						Item content validity index	Scale content validity index
	a	b	c	d	e	f		
1	4	4	4	4	4	4	1.00	0.92
2	4	3	4	4	4	4	0.83	
3	4	4	4	4	4	4	1.00	
4	4	3	4	4	4	4	0.83	
5	4	4	4	4	4	3	0.83	
6	4	4	4	4	4	4	1.00	

Table 3. Scores and factor loading for the perceived insufficient milk questionnaire exploratory factor analysis

Item	Score ± standard deviation	Factor loading
My breastmilk looks like it is nutritious enough to nourish my baby	2.98±1.15	0.85
My baby generally appears satisfied after feedings	2.88±1.29	0.87
My baby seems to like to breastfeed	2.98±1.34	0.82
My breastmilk is all the nutrition my baby needs to thrive	2.93±0.99	0.76
My breasts seem to have enough milk	2.86±1.34	0.82

Construct validity

The exploratory factor analysis showed a Kaiser-Meyer-Olkin value of 0.866 (>0.60), and Bartlett's Test of Sphericity found the identity matrix significantly differing from the correlation matrix (chi-squared=302.582, degrees of freedom=10 and $P<0.001$). The sample data were deemed sufficient and suitable for performing exploratory factor analysis. With principal axis factoring and varimax, the only factors with Eigenvalues >1.0 were extracted. One factor was extracted, explaining 68.2% of the total variance. The score and factor loading for each item are shown in *Table 3*.

In the model verification, confirmatory factor analysis was used to verify the suitability of the model. The goodness-of-fit, adjusted goodness-of-fit, comparative fit index and normed fit index were 0.977, 0.930, 0.994 and 0.990 respectively (all >0.90). As a robust index of confirmatory factor analysis, the root mean square error of approximation was 0.069 and the root mean residual was 0.019. These indices showed the model fit as good, and the construct validity of the single-factor model was acceptable. The indices are shown in *Table 4*.

Internal consistency reliability

Cronbach's alpha for the overall questionnaire showed excellent internal consistency with a value of 0.943. The Cronbach alpha coefficient did not increase significantly even after removal of the item. Corrected item-total correlation values (between 0.820 and 0.901) were all greater than 0.70. These values indicated a good correlation between items and a good reliability level (Majbar et al, 2020). The result of the Cronbach alpha test can be seen in *Table 5*.

Test-retest reliability

The intraclass correlation coefficients for each item ranged from 0.870–0.974, indicating good test reliability, as shown in *Table 6*.

Discussion

The perceived insufficient milk questionnaire was designed to measure mothers' perception of breastmilk adequacy in terms of quality and quantity to satisfy their infants. The present study aimed to perform translation, cultural adaptation and verification of the perceived insufficient milk questionnaire. This is the first study to translate this questionnaire into Mandarin. The findings validated the perceived insufficient milk questionnaire's psychometric properties in Chinese.

From the item and scale content validity indices, it can be concluded that the content validity of each item and the translated questionnaire was excellent, indicating that the Chinese perceived insufficient milk questionnaire is representative of the entire domain of the target

construct. Exploratory and confirmatory factor analysis were used to evaluate the construct validity. Exploratory factor analysis is a statistical technique that explores the underlying structure of an instrument. Only one factor with an eigenvalue greater than 1 was extracted using exploratory factor analysis. The factor loading and cumulative percentage variance explained by this factor indicated that information was extracted effectively. Confirmatory factor analysis is a statistical procedure that tests a set of measured variables. All estimates were within the acceptable range, indicating that the single-factor structure was appropriate for evaluating mothers' perception of insufficient milk.

The Cronbach alpha value for the overall perceived insufficient milk questionnaire was 0.943, consistent with previous studies in Turkish. The internal consistency of the Turkish version was good, with a Cronbach alpha coefficient of 0.81 (Gökçeoğlu and Küçükoğlu, 2018). Other studies reported that the Cronbach's alpha coefficients of the original and the Japanese versions were 0.70 and 0.82 respectively (Otsuka et al, 2008; McCarter-Spaulding and Kearney, 2011). The differences in the Cronbach's coefficient values may be because of the larger sample size used in the present study than in previous studies. The perceived insufficient milk questionnaire is considered reliable based on the Cronbach's alpha coefficients.

Within the first 4 weeks postpartum, mothers may perceive that they have an insufficient milk supply leading to a high rate of breastfeeding cessation (Gatti, 2008). The perceived insufficient milk questionnaire helps assess mothers' perception of insufficient milk during the early postpartum period (Gatti, 2008). The present study examined the test-retest reliability of the questionnaire before discharge and 1 week post-discharge. The two time points were periods of high incidence of perceived insufficient milk. As a result, all intraclass correlation coefficients for the questionnaire were good, and almost all indices were ≥0.90. Therefore, the test-retest reliability of the Chinese version was good. The test-retest reliability of the Turkish version of the questionnaire during the early postpartum period was previously evaluated (Gökçeoğlu and Küçükoğlu, 2018). The first test was 2.84 weeks postpartum and retested within a 2-week interval. The Ttest-retest correlation value in this case was 0.81 (Gökçeoğlu and Küçükoğlu, 2018). The present study and previous studies have shown the questionnaire to be stable and reliable during the early postpartum period, as there is good correlation and agreement between the test and retest.

Strenths and limitations

To ensure translation quality, forward and backward translation was used in the present study, which is

Table 4. Goodness of fit indices in confirmatory factor analysis

Factor analyses	Criteria	Confirmatory factor analysis
X²/degrees of freedom	<3	2.611
Goodness-of-fit index	>0.90	0.977
Adjusted goodness-of-fit index	>0.90	0.930
Comparative fit index	>0.90	0.994
Normed fit index	>0.90	0.990
Root mean residual	<0.05	0.019
Root mean square error of approximation	<0.08	0.069

Table 5. Result of Cronbach alpha test

Items	Corrected item-total correlation	Cronbach alpha if item deleted	Cronbach alpha
T2	0.901	0.921	0.943
T3	0.845	0.931	
T4	0.821	0.935	
T5	0.820	0.935	
T6	0.852	0.930	

Table 6. Test–retest reliability

Items	Intraclass correlation coefficient (95% confidence interval)	F test value	*P* value
2	0.931(0.882–0.960)	28.012	<0.001
3	0.902 (0.834–0.943)	19.315	<0.001
4	0.961 (0.933–0.978)	50.238	<0.001
5	0.969 (0.947–0.982)	63.939	<0.001
6	0.965 (0.939–0.980)	55.395	<0.001

a strength of its method. Additionally, compared to previous studies (Otsuka et al, 2008; McCarter-Spaulding and Kearney, 2011), the psychometric properties of the perceived insufficient milk questionnaire were comprehensively verified with a larger sample size. Sample size can influence the precision and replicability of the results (Thompson, 2004). The Chinese version of the perceived insufficient milk questionnaire is the first questionnaire that focuses on a mother's perception of insufficient milk in China and could be used in other parts of China.

However, this study was conducted in a single hospital, and although it included both urban and rural participants, verification of the Chinese version is needed in different settings because of cultural diversity in China.

Key points

- Almost all mothers can produce adequate breastmilk, while perceived breastmilk insufficiency is widely reported.
- Perceived insufficient milk is one of the most commonly reported reasons for early cessation of breastfeeding.
- It is crucial for healthcare providers to identify mothers who perceive their milk supply to be inadequate and put in place effective strategies to address perceived insufficient milk.
- The Chinese version of the perceived insufficient milk questionnaire provides a consistent and accurate assessment with acceptable validity and reliability.
- Future studies are needed to verify the Chinese version of the questionnaire on a larger scale.

Conclusions

The study's findings show an acceptable validity and reliability for the Chinese version of the perceived insufficient milk questionnaire. It is appropriate for healthcare providers to use the questionnaire to assess mothers' perception of breastmilk amount or nutritional quality. With the aid of the questionnaire, healthcare providers can further understand the reasons for a mothers' perception of insufficient milk supply. On this basis, healthcare providers can provide timely interventions to reduce early cessation of breastfeeding as a result of potentially inaccurate perceptions of milk supply. Future studies are needed to verify the Chinese version of the questionnaire on a larger scale. **BJM**

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CPD reflective questions

- How can healthcare professionals' practice be enhanced to increase identification of perceived insufficient milk among mothers?
- How can mothers be helped to correctly understand their milk supply?
- What are the implications of using the Chinese version of the perceived insufficient milk questionnaire in future research?

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