



## Complementary feeding patterns among ethnic groups in rural western China\*

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**Abstract:** Objective: This study investigated complementary feeding practices among four ethnic groups (Han, Uygur, Tibetan, and Zhuang) based on a cross-sectional survey in rural western China. Methods: In 2005, a stratified multi-stage cluster random sampling method was used to recruit 9712 children (7411 Han, 1032 Uygur, 678 Tibetan, and 591 Zhuang) between 6 and 35 months of age and their mothers from 45 counties in 10 provinces (autonomous regions, municipalities) in western China. Results: The rates of early introduction (before 6 months) of complementary foods in four ethnic groups (Han, Uygur, Tibetan, and Zhuang) were 71.30%, 95.95%, 82.40%, and 72.30%, respectively. The Infant and Child Feeding Index (ICFI) for Uygur and Tibetan children was lower than that for Han children at all age groups. Uygur children were more likely to have unqualified ICFI compared with Han children in a multivariate logistic regression (odds ratio (OR)=5.138, 95% confidence interval (CI): 4.340–6.084). A higher level of maternal education, greater family wealth, and the availability of complementary feeding educational materials decreased the likelihood of an unqualified ICFI. The nutritional status of children (Han, Tibetan, and Zhuang) with qualified ICFI was better than that for children with unqualified ICFI. Conclusions: Appropriate interventions are required to improve complementary feeding practices in rural western China.

**Key words:** Complementary feeding; Infant and Child Feeding Index (ICFI); Ethnic group; Western China  
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### 1 Introduction

The United Nations Children's Fund (UNICEF) and the World Health Organization (WHO) recommend that children should be exclusively breast fed during the first 6 months of life (Pan American Health Organization, 2003). After 6 months, a child requires

adequate complementary foods for normal growth. This transition is called complementary feeding, and inappropriate complementary feeding practices may lead to malnutrition and frequent illnesses. It is an important stage in the child's growth (Schwartz et al., 2011; Young and Krebs, 2013). A baby should receive nutritionally adequate and safe complementary foods after 6 months of exclusive breastfeeding and that breastfeeding should continue up to 2 years of age or even beyond based on WHO guidelines (WHO, 2001). However, living conditions for a large number of ethnic minorities in western China are difficult, with the level of economic development and health care being quite poor. Also, these groups enjoy their own culture of food and traditional medicine.

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Few studies have concentrated on the food supplement practices of infants and young children in rural western China (Dang et al., 2005; Xu et al., 2006). Studies are needed to document the complementary feeding practices among different ethnic groups in western China and to investigate the factors influencing these practices. This information can provide evidence to determine whether specific interventions are needed for children among diverse ethnic groups. The UNICEF and the Chinese Ministry of Health (MOH) conducted a Rural Primary Health Care Project from 2001 to 2005 in 45 counties in 10 western provinces. Using program data from 2005, the objective of this paper is to document the complementary feeding practices of infants and young children from four ethnic groups (Han, Uygur, Tibetan, and Zhuang) and to explore the factors that affect complementary feeding.

## 2 Materials and methods

### 2.1 Participants and design

This study was completed in 2005. We chose our sample from a total of 14 112 mother and child pairs from four major ethnic groups (Han, Uygur, Tibetan, and Zhuang) using a stratified multistage cluster random sampling method. All the mothers gave their informed consent before being interviewed by skilled interviewers, trained to the same rigorous standard. All feeding practices and family background and demographic information were recorded in a survey questionnaire. Infants less than 6 months and children over 3 years old were excluded; 9712 mother and child pairs were included for analysis in this study. The Ethics Committee of the Xi'an Jiaotong University College of Medicine (Xi'an, China) approved the study.

### 2.2 Feeding information and definition

Complementary foods included porridge, egg, fresh milk, milk powder, formula (rice flour, powdered rice-cereal), bean products, fish, meat (beef, mutton, and pork), fruits, and vegetables.

The early introduction of complementary foods (early complementary feeding) was defined as adding complementary foods before 6 months of age.

Infant and Child Feeding Index (ICFI) was developed based on the followings: the initial definition

proposed by Ruel and Menon (2002); an ICFI scoring system developed by Lai et al. (2005) according to the Nutrition and Health Survey of the Chinese People; and WHO feeding recommendations. ICFI compiled information that was then separated into three age groups: 6–8 months, 9–11 months, and 12–35 months (Qu et al., 2017). To account for the recommendation of the Lai JQ's ICFI scoring system, qualified ICFI refers to a score that exceeds 60% of total ICFI score ( $>13.8$ ), and unqualified ICFI refers to a score that less than or equal to 60% of total ICFI score ( $\leq 13.8$ ).

### 2.3 Assessment of child nutritional status

The Z-scores of height for age (HAZ), weight for age (WAZ), and weight for height (WHZ) were used to assess children's nutritional status. The HAZ, WAZ, and WHZ were calculated based on the WHO guidelines (WHO, 2006).

### 2.4 Statistical analysis

A total of 7411 Han, 1032 Uygur, 678 Tibetan, and 591 Zhuang children between 6 and 35 months were enrolled. A database was set up using EpiData Version 3.02 (the EpiData Association, Odense, Denmark), and data entry was duplicated. Principal component analysis was used to establish a wealth index to identify the family economic status of the participants. The wealth index was based on household assets, facilities, and income, and was classified into three groups: poor, moderate, and rich.

Frequency was used for the categorical variable descriptions. The mean and standard deviation were used for continuous variable descriptions. Chi-squared tests were performed for comparison of sociodemographic characteristics, early introduction of complementary foods, and introduction of egg and meat. The Bonferroni method was used for post hoc comparison of baseline characteristics. Covariance analysis was used to compare the ICFI and any association between children's status and ICFI among ethnic groups. Differences in unqualified ICFI between the four ethnic groups were analyzed using multivariate logistic regression, which adjusted county rank, child's gender, and child's age in Model 1, Model 2, and Model 3, respectively.

All analyses were performed with SAS 9.3 (SAS Institute Inc., Cary, NC, USA). The level of significance was established at  $P < 0.05$ .

### 3 Results

#### 3.1 Sociodemographic characteristics of participants

There were significant differences between the four groups across all baseline characteristics (all  $P < 0.001$ ; Table 1).

#### 3.2 Comparisons of the early introduction of complementary foods and the frequencies of introduction of egg and meat among ethnic groups

There were major differences between the groups in the rate of early complementary feeding. Complementary foods were introduced to 71.30% of Han, 73.30% of Zhuang, 82.40% of Tibetan, and 95.95% of Uygur children before 6 months of age. After 6 months of age, 79.00% of Han, 59.40% of Uygur, 60.86% of Tibetan, and 73.51% of Zhuang children were fed a sufficient ( $\geq 2$  week<sup>-1</sup>) amount of egg; and 62.05% of Han, 71.26% of Uygur, 69.53% of Tibetan, and 81.55% of Zhuang children were fed a sufficient amount of meat (beef, mutton, and pork).

The differences between ethnic groups in the addition of sufficient egg and meat were significant (Table 2).

#### 3.3 Comparison of ICFI among ethnic groups

The lowest ICFI was found in Tibetan children in the 6–8 months age range and in Uygur children in the 9–11 and 12–35 months age ranges. The Uygur children’s ICFI was lowest from 6 to 35 months. The Zhuang and the Han children’s ICFIs were higher than those of the Tibetan as well as the Uygur children in the 6–35 months age range. In total, 78.12% of Uygur children were unqualified for the ICFI, which is the highest rate. Unqualified ICFI rates were lower in Han and Zhuang than in Uygur and Tibetan children, as shown in Table 3. In Fig. 1, the ICFI trends for children in all the ethnic groups increased rapidly in the 6–9 months age range and remained steady after 12 months. The ICFI trend for Uygur children was the lowest in the 9–33 months age range and for Han children was the highest for children older than 12 months.

**Table 1 Sociodemographic characteristics of Han, Uygur, Tibetan, and Zhuang ethnic groups in rural western China, 2005**

Descriptor	Percent (%)					P value*
	Han (n=7411)	Uygur (n=1032)	Tibetan (n=678)	Zhuang (n=591)	Total (n=9712)	
Sample	76.31	10.63	6.98	6.08	100.00	
Male	58.86	51.74	53.10	58.54	57.68	<0.001 <sup>abe</sup>
Age (month)						
6–11	26.29	25.48	23.45	33.33	26.44	<0.001 <sup>cef</sup>
12–23	41.36	43.60	42.33	47.38	42.03	
24–35	32.34	30.91	34.22	19.29	31.53	
Child’s birth order						
1	61.59	48.16	57.96	68.47	60.33	<0.001 <sup>abcdef</sup>
$\geq 2$	38.41	51.84	42.04	31.53	39.67	
Maternal education (year)						
0	7.28	3.78	29.27	4.07	8.21	<0.001 <sup>abcdf</sup>
1–9	83.59	93.31	65.85	91.01	83.88	
>9	9.13	2.91	4.88	4.92	7.91	
Maternal age at child’s birth (year)						
<20	4.26	21.90	12.63	3.57	6.72	
20–29	76.19	65.21	75.19	75.72	74.90	<0.001 <sup>abdef</sup>
$\geq 30$	19.55	12.89	12.18	20.71	18.38	
Main source of household income						
Farming or animal husbandry only	40.94	76.07	52.95	54.99	46.37	<0.001 <sup>abcdef</sup>
Farming or animal husbandry and others	59.06	23.93	47.05	45.01	53.63	

\* Bonferroni method was used for post hoc comparison of baseline characteristics,  $\alpha = 0.05/6 = 0.0083$ . <sup>a</sup>  $P < 0.0083$ , Han vs. Uygur; <sup>b</sup>  $P < 0.0083$ , Han vs. Tibetan; <sup>c</sup>  $P < 0.0083$ , Han vs. Zhuang; <sup>d</sup>  $P < 0.0083$ , Uygur vs. Tibetan; <sup>e</sup>  $P < 0.0083$ , Uygur vs. Zhuang; <sup>f</sup>  $P < 0.0083$ , Tibetan vs. Zhuang

**Table 2 Comparisons of the rates of early introduction of complementary foods and egg and meat introduction among ethnic groups in rural western China, 2005**

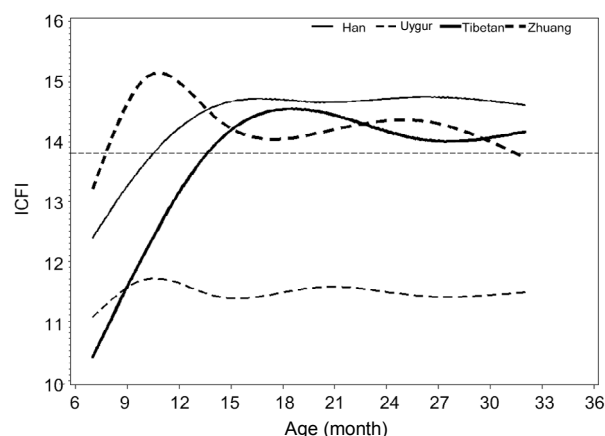
Group	Rate of early (before 6 months) introduction of complementary foods (%)	Rate of introduction of complementary foods after 6 months (%)			
		Egg		Meat*	
		Insufficient (<2 week <sup>-1</sup> )	Sufficient (≥2 week <sup>-1</sup> )	Insufficient (<2 week <sup>-1</sup> )	Sufficient (≥2 week <sup>-1</sup> )
Han (n=7411)	71.30	21.00	79.00	37.95	62.05
Uygur (n=1032)	95.95	40.60	59.40	28.74	71.26
Tibetan (n=678)	82.40	39.14	60.86	30.47	69.53
Zhuang (n=591)	73.30	26.49	73.51	18.45	81.55
<i>P</i> value	<0.001	<0.001		<0.001	

\* Meat includes beef, mutton, and pork

**Table 3 Comparison of the ICFI among ethnic groups in rural western China, 2005**

Group	ICFI*				Unqualified ICFI (%)
	6–8 months	9–11 months	12–35 months	6–35 months	
Han (n=7411)	12.39±3.88	13.63±3.38	14.64±3.20	14.20±3.42	37.08
Uygur (n=1032)	11.06±2.38	11.69±2.51	11.46±2.72	11.42±2.65	78.12
Tibetan (n=678)	10.40±3.68	12.13±3.41	14.18±3.44	13.48±3.69	48.18
Zhuang (n=591)	13.21±3.23	15.05±3.21	14.22±3.11	14.21±3.18	38.13
<i>P</i> value	<0.001	<0.001	<0.001	<0.001	<0.001

\* Analysis of covariance was used; child age was adjusted; data are expressed as mean±standard deviation

**Fig. 1 Comparison of ICFI trend at different ages among ethnic groups in rural western China, 2005**

### 3.4 Result of unqualified ICFI in logistic regression

County rank, child's gender, and child's age were adjusted in Model 1, Model 2, and Model 3, respectively. After adjusting for the related factors in Model 1, unqualified ICFI was more likely in Uygur (odds ratio (OR)=5.672, 95% confidence interval (CI): 4.862–6.667) and Tibetan (OR=1.479, 95% CI: 1.251–1.750) than Han children. No significant difference in unqualified ICFI was found between the Han and Zhuang children. After adjusting for the related factors in Model 2, the Uygur children had

higher odds of an unqualified ICFI compared to the Han (OR=5.407, 95% CI: 4.577–6.387). There was no significant difference between the Han and Tibetan children in unqualified ICFI (OR=1.148, 95% CI: 0.958–1.375). Additionally, there was no significant difference between the Han and Zhuang children in unqualified ICFI (OR=0.890, 95% CI: 0.734–1.079). We also found that when the mothers' education increased, the odds of an unqualified ICFI decreased in Model 2. Children with a mother of primary school education had a lower unqualified ICFI compared with children whose mothers were illiterate (OR=0.526, 95% CI: 0.439–0.629).

In addition, children with a mother of junior high school education had a lower unqualified ICFI compared with children whose mothers were illiterate (OR=0.347, 95% CI: 0.289–0.417). Finally, children whose mothers had a senior high school education and above had a lower unqualified ICFI compared with children whose mothers were illiterate (OR=0.259, 95% CI: 0.203–0.329).

With the increase in the family wealth index, the odds of an unqualified ICFI decreased in Model 2. Children who had a moderate family wealth index had a lower unqualified ICFI compared with children who had a poor family wealth index (OR=0.720, 95% CI: 0.610–0.851). Children who had a rich family wealth

index had a lower unqualified ICFI compared to children who had a poor family wealth index (OR=0.642, 95% CI: 0.550–0.749).

After adjusting for the related factors in Model 3, the unqualified ICFI comparison among different ethnic groups was consistent with Model 2 (Uygur vs. Han, OR=5.138, 95% CI: 4.340–6.084; Tibetan vs. Han, OR=1.126, 95% CI: 0.938–1.353; Zhuang vs. Han, OR=0.975, 95% CI: 0.802–1.185). The unqualified ICFI comparison between mothers with different education levels was consistent with Model 2 (primary school vs. no education, OR=0.517, 95% CI: 0.431–0.621; junior high school vs. no education, OR=0.353, 95% CI: 0.293–0.425; senior high school and above vs. no education, OR=0.274, 95% CI: 0.214–0.394), and the unqualified ICFI comparison among different family wealth index levels was consistent with Model 2 (moderate vs. poor, OR=0.749, 95% CI: 0.632–0.887; rich vs. poor, OR=0.693, 95%

CI: 0.592–0.811). Children whose mothers received complementary feeding educational materials had a lower unqualified ICFI compared to children whose mothers did not receive these materials (OR=0.362, 95% CI: 0.317–0.413) as shown in Table 4.

### 3.5 Association between ICFI and nutritional status of children among ethnic groups

The WAZ and HAZ of Han children with qualified ICFI were higher than those with unqualified ICFI ( $P=0.002$ ,  $P<0.001$ , respectively). The WHZ of Tibetan children with qualified ICFI was higher than those with unqualified ICFI ( $P=0.042$ ). The WAZ and HAZ of Zhuang children with qualified ICFI were higher than those with unqualified ICFI ( $P=0.001$ ,  $P=0.003$ , respectively; Table 5). There was no statistical difference in HAZ, WAZ, or WHZ between children with qualified ICFI and unqualified ICFI in Uygur groups.

**Table 4 Predictor of complementary feeding in rural western China, 2005**

Variable	Model 1*		Model 2*		Model 3*	
	OR (95% CI)	P value	OR (95% CI)	P value	OR (95% CI)	P value
Ethnic groups						
Han						
Uygur	5.672 (4.862–6.667)	<0.001	5.407 (4.577–6.387)	<0.001	5.138 (4.340–6.084)	<0.001
Tibetan	1.479 (1.251–1.750)	<0.001	1.148 (0.958–1.375)	0.136	1.126 (0.938–1.353)	0.203
Zhuang	0.985 (0.817–1.188)	0.875	0.890 (0.734–1.079)	0.237	0.975 (0.802–1.185)	0.797
Mother's education						
No education						
Primary school			0.526 (0.439–0.629)	<0.001	0.517 (0.431–0.621)	<0.001
Junior high school			0.347 (0.289–0.417)	<0.001	0.353 (0.293–0.425)	<0.001
Senior high school and above			0.259 (0.203–0.329)	<0.001	0.274 (0.214–0.394)	<0.001
Wealth index						
Poor						
Moderate			0.720 (0.610–0.851)	<0.001	0.749 (0.632–0.887)	0.001
Rich			0.642 (0.550–0.749)	<0.001	0.693 (0.592–0.811)	<0.001
Receiving complementary feeding educational materials						
No						
Yes					0.362 (0.317–0.413)	<0.001

\* County rank, child's gender, and child's age were adjusted in Model 1, Model 2, and Model 3, respectively, in logistic regression

**Table 5 Association between ICFI and nutritional status of children among ethnic groups**

Population	ICFI	WAZ	HAZ	WHZ
Han	≤13.8	-0.409	-0.729	-0.021
	>13.8	-0.399	-0.711	-0.033
<i>P</i> value		0.002	<0.001	0.772
Uygur	≤13.8	-0.835	-1.166	-0.261
	>13.8	-0.818	-1.092	-0.341
<i>P</i> value		0.924	0.261	0.224
Tibetan	≤13.8	-0.353	-1.035	0.300
	>13.8	-0.326	-1.319	0.511
<i>P</i> value		0.090	0.686	0.042
Zhuang	≤13.8	-1.179	-1.542	-0.435
	>13.8	-0.829	-1.186	-0.293
<i>P</i> value		0.001	0.003	0.206

HAZ: Z-score of height for age; WAZ: Z-score of weight for age; WHZ: Z-score of weight for height

## 4 Discussion

This study analyzed the different complementary feeding patterns among four ethnic groups and explored the factors that affect complementary feeding in rural western China. Complementary foods were introduced to more than 70% of children from all of the ethnic groups before the age of 6 months, including 95.95% of Uygur children. Between the ages of 6 and 35 months, Uygur and Tibetan children had lower ICFI than Han children. The adjusted related factors in an unqualified ICFI logistic regression model revealed that Uygur children were more likely to have unqualified ICFI than Han children (OR=5.138, 95% CI: 4.340–6.084). Mother's education, the family wealth index, and the availability of complementary feeding educational materials were important factors affecting ICFI.

### 4.1 Comparisons of complementary feeding time and main protein introduction among ethnic groups

Adding complementary foods too early was common in all the ethnic groups. Nutritionally adequate and safe complementary foods are necessary for a child after 6 months of exclusive breastfeeding, based on WHO guidelines (WHO, 2001). We found that 71.30% of Han, 73.30% of Zhuang, 95.95% of Uygur, and 82.40% of Tibetan infants were fed complementary foods before they were 6 months old.

A related study in Xinjiang Uygur Autonomous Region in rural western China in 2006, which included Uygur, Han, Kazakh, Xibe, and Hui groups, found that only 5.8% of Han, 1.1% of Uygur, and 21.3% of other minority children were exclusively breastfed for 6 months (Xu et al., 2006).

Egg and meat, which are high quality protein foods (Olaya et al., 2013; Iannotti et al., 2014), were the main sources of protein in rural western China. A related study showed that sufficient and timely feeding of animal protein can reduce infant malnutrition (Dube et al., 2010; Hipgrave et al., 2014; Pantoja-Mendoza et al., 2014). The Rural Primary Health Care Project found that 22.8% of infants under 3 years old suffered from malnutrition in rural China (Qu et al., 2013) and that inadequate complementary foods, especially insufficient protein sources, were associated with these high levels of malnutrition.

### 4.2 Comparison of ICFI among ethnic groups and the association between ICFI and the nutritional status of children

Lai et al. (2005) using data from the Nutrition and Health Survey of the Chinese People, found significant differences among different regions and children of different ages in China. A study of the general situation of feeding in ethnic minority areas (Ma et al., 2010) found that complementary feeding habits were different between the Han and Tibetan groups. Malnutrition was more common in minority areas. In our study, the Uygur children's ICFI was the lowest among four ethnic groups. The Zhuang and Han children's ICFIs were higher than those of the Uygur and Tibetan children. A percentage of 78.12% of the Uygur children had an unqualified ICFI, which is the highest rate among the four groups. The ICFI trend for the Han children was the highest after 12 months of age. Minority ethnic groups in western China have always lived in remote areas, and relied on a single food source. Different ethnic groups have different food cultures for feeding their children (Xu et al., 2007; Wu et al., 2014). Mothers from minority ethnic groups were more likely to receive knowledge of infant feeding from their mothers and their families than from health institutions.

We found that ICFI was associated with the nutritional status of Han, Tibetan, and Zhuang children. In particular, the nutritional status of Han and Zhuang

children with qualified ICFI was better than for those with unqualified ICFI. Other studies in several other countries have come to the same conclusion. In Burkina Faso, for example, Sawadogo et al. (2006) also found that ICFI was significantly and positively related to HAZ in children aged 6–23 months.

#### 4.3 Analysis of the factors affecting ICFI

The level of maternal education, family wealth index, and availability of complementary feeding information were important factors associated with the ICFI in the logistic regression analysis. Children who have mothers with higher levels of education have lower odds of unqualified ICFI as do children from families with a higher family wealth index. Children whose mothers received complementary feeding educational materials were less likely to have an unqualified ICFI (0.362 times) than those whose mothers did not receive these materials. The results of Zhang et al. (2009) were consistent with our findings. A lack of health resources, a sparsely populated region, and lack of access to convenient transportation reduced the number of mothers who received complementary feeding educational materials in rural western China.

## 5 Conclusions

A strength of our study is the large number of subjects. However, several limitations should be taken into account when interpreting our results. First, recall bias: all information about feeding practices was based on mothers' recall. Second, some confounding factors were not accounted for, for example, the occupation of mothers. Third, this is a cross-sectional study, and causation can therefore not be determined.

Complementary feeding practices were best in the Han. Early complementary feeding was a common problem among all ethnic groups, leading to low rates of exclusive breastfeeding. Maternal education level, family wealth index, and availability of complementary feeding educational materials were important factors affecting complementary feeding practices. Appropriate interventions are required to improve the quality of complementary feeding in rural western China.

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## Compliance with ethics guidelines

Peng-fei QU, Ya ZHANG, Jia-mei LI, Ruo ZHANG, Jiao-mei YANG, Fang-liang LEI, Shan-shan LI, Dan-meng LIU, Shao-nong DANG, and Hong YAN declare that they have no conflict of interest.

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008 (5). Informed consent was obtained from all participants for being included in the study. Additional informed consent was obtained from all participants for whom identifying information is included in this article.

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## 中文概要

**题目:** 中国西部农村地区婴幼儿辅食喂养状况民族差异的调查

**目的:** 比较中国西部农村地区四个民族(汉、维、藏和壮)的婴幼儿的辅食喂养状况, 探讨影响婴幼儿辅食喂养的影响因素。

**创新点:** 在中国西部 10 省区开展大规模人群流行病学调查, 对比分析西部农村地区四个主要民族(汉、维、藏和壮)的婴幼儿的辅食添加的时间、类别、频率及质量, 探讨其差异的可能原因, 以及研究影响西部农村地区辅食喂养的可控因素, 为西部农村地区不同民族改善婴幼儿辅食喂养状况提供干预措施。

**方法:** 采用人口比例抽样法, 在 2005 年调查西部 10 省区 45 县 9172 个 6~35 个月的婴幼儿的辅食添加状况(7411 汉、1032 维、678 藏和 591 壮), 构建了适合西部地区的婴幼儿喂养指数(ICFI), 综合评价婴幼儿辅食喂养质量。

**结论:** 汉族和壮族婴幼儿的喂养质量好于维族和藏族。母亲教育水平、家庭经济水平和喂养宣传是影响婴幼儿辅食喂养质量的重要因素, 合理的干预措施是促进西部地区婴幼儿辅食添加质量的关键。

**关键词:** 辅食喂养; 婴幼儿喂养指数; 多民族; 中国西部地区