



Health Communication Patterns and Adherence to a Micronutrient Home Fortification Program in Rural China

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ABSTRACT

Objectives: Examine the association between ethnic health communication patterns and adherence to a micronutrient home fortification program in rural China among 3 distinct ethnic groups.

Design: Cross-sectional survey conducted in rural western China.

Setting: Enrolled 283 villages across 6 national poverty counties in rural western China.

Participants: A total of 1,358 caregiver–children pairs with Han, Tibetan, or Yi ethnic backgrounds.

Variables Measured: A structured questionnaire was used to collect information on caregiver demographics, program adherence, and health communication about the program.

Analysis: Logistic regression model was used to examine the associations between health communication patterns and adherence to the program.

Results: Adherence rates across all ethnic groups were low, 55.5% (229/413) of Han, 55.0% (186/338) of Tibetan, and 47.2% (178/377) of Yi caregivers adhered to the program. Increased adherence was correlated with how each ethnic group received health information. Han caregivers were most influenced by mass media (odds ratio [OR], 1.87; 95% confidence interval [CI], 1.05–3.31), Tibetan caregivers by family (OR, 4.86; 95% CI, 1.45–16.29), and Yi caregivers by village doctors (OR, 6.63; 95% CI, 3.46–12.73).

Conclusions and Implications: Implementing culturally sensitive health communication strategies will likely improve adherence to home fortification programs among caregivers with distinct ethnic backgrounds.

Key Words: home fortification program, adherence behavior, health communication, ethnic differences, western China (*J Nutr Educ Behav.* 2022;54:36–45.)

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INTRODUCTION

Although the prevalence of stunting and wasting has decreased in the last decade, children aged < 5 years in low- and middle-income countries

(LMICs) continue to suffer from micronutrient deficiencies, particularly iron-deficiency anemia.^{1,2} Early childhood anemia is often associated with insufficient childhood nutrition and may negatively affect health

outcomes throughout an individual's life.^{2,3} In response to this nutrition crisis, the World Health Organization (WHO) recommends that countries with high rates of childhood anemia (> 20%) distribute micronutrient powders (MNPs) to meet the nutritional needs of children.⁴ A number of MNP programs have since been implemented internationally, and multiple studies have found significant declines in childhood anemia because of MNP programs.⁵

Unfortunately, research conducted in LMICs has shown low rates of caregiver adherence to MNP programs.^{6–8} Although there are many possible reasons for low levels of adherence in LMICs, researchers have determined that culturally appropriate and effective health communication strategies influence MNP adherence.^{9–12} International

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studies have shown that for MNP programs to be successful, local characteristics, such as socioeconomic status (SES), cultural norms, and beliefs, must be taken into consideration. Studies in LMICs have found that effective communication methods within the context of one socioeconomic and cultural community may not be as effective in other contexts. For example, one study of MNP programs found that communication from village-level health teams was most effective for increasing adherence in sampled communities of rural Uganda.¹⁰ Another study conducted in rural communities in Peru indicated that different forms of communication about the benefits of MNPs from relatives and neighbors were most effective.¹¹

In rural areas of western China, like other LMICs, research has found high rates of childhood anemia, with > 50% of infants and toddlers suffering from iron-deficiency anemia in western rural communities.^{13,14} To address these high anemia rates, China's government implemented its own MNP distribution program, *Ying Yang Bao* (YYB). The program has been implemented in rural, low SES communities in western China. These communities are composed of diverse ethnic groups, including Han (the largest ethnic group in China, comprising > 90% of the population) and a series of ethnic minority groups, including Tibetan, Yi, Bai, and Hui.^{15,16} This program distributes YYB packets to local township and village doctors who are in charge of delivering the packets and YYB information to local caregivers. Doctors typically distribute YYB packets and provide information about YYB to caregivers during routine infant health checks at the township health centers or village clinics. In villages, if caregivers live far from the local clinic, doctors may make home visits.^{15,17,18} Doctors do not follow a formal YYB communication plan and, instead, use their discretion to decide what YYB information to provide to households. In addition to doctor visits, caregivers may receive information about YYB through mass media.¹⁹ However, there are no formal communication plans to specifically accommodate different cultural contexts.

Although the YYB program receives substantial government support, adherence rates in western China remain low. Studies have found that only 36% to 50% of caregivers regularly feed their children YYB packets.^{19–23} Similar to other LMICs, it may be that YYB programs need to be tailored to local contexts to improve YYB adherence and reduce the overall prevalence of anemia in rural western China.

Given that the culture of an ethnic group is an important factor that shapes the values, lifestyles, and communication patterns of its people,^{24,25} it is likely that culturally appropriate strategies of dispersing information can improve YYB adherence in the ethnically diverse program sites in western China. However, the association between health communication patterns and YYB adherence among different ethnic groups in western China has not been studied. Therefore, the purpose of this study is to explore (1) YYB adherence rates among caregivers who are ethnically Han, Tibetan, and Yi; (2) how health information is communicated among these 3 ethnic groups; and (3) how health communication patterns are associated with YYB adherence among Han, Tibetan, and Yi caregivers.

METHODS

Study Design and Participants

Our research team conducted a cross-sectional study in May 2019 in rural, multiethnic areas of Sichuan Province in western China. In this study, Han, Tibetan, and Yi communities were sampled. The multiethnic population of Sichuan Province and the unique demographic characteristics of each ethnic group make this province ideal for conducting this study.

As detailed in the [Figure](#), a 4-step, multistage, cluster sampling method was used to select the study's sample. To choose the study sample, a computer-generated random number method was implemented at each level. First, to select the sample counties, we identified 32 YYB program counties in Sichuan Province. From these 32 counties, 2 rural Han counties, 2 rural Tibetan counties, and 2

rural Yi counties were selected. Second, we randomly selected 6 sample townships within each sampled county. Townships that housed the county seat (which are typically more urbanized) were excluded. A total of 36 townships were enrolled from 159 townships. Third, 7 or 8 villages (depending on how many villages had populations more than 800) were selected from each sampled township. If there were no villages with populations of 800 or more, 2 small neighboring villages were combined and considered as 1 village-level sampling unit. A total of 283 villages were enrolled from 903 villages. Finally, our team obtained a list of all registered births over the past 24 months from the local officials in each village, and all caregivers with an infant in the target age range (6–24 months) were enrolled in each sample village. A total of 1,515 caregivers were eligible. In total, 139 eligible caregivers failed to enroll in the study for various reasons, which included that their household had migrated to another city or province for work; they were visiting relatives during the time of the survey; their infant was sick, and the caregiver was not able to be interviewed; or they refused the interview. Of the 1,376 caregivers who enrolled in this study, 1,338 caregivers completed all aspects of the questionnaire, for a response rate of 97.2%. After imputing 20 missing values, the final analytical sample included 1,358 participants.

This study received ethical approval from the Sichuan University Medical Ethical Review Board (approval no. K2018103). Before conducting interviews, trained enumerators introduced the study aims, the process, the potential risks and benefits, the privacy measures that were taken, the rights and duties of the individual, and the contact for the study. Enumerators also presented each household with a standardized document that outlined the same information.

Data Collection

Data were collected through survey interviews by trained enumerators using a structured survey questionnaire.

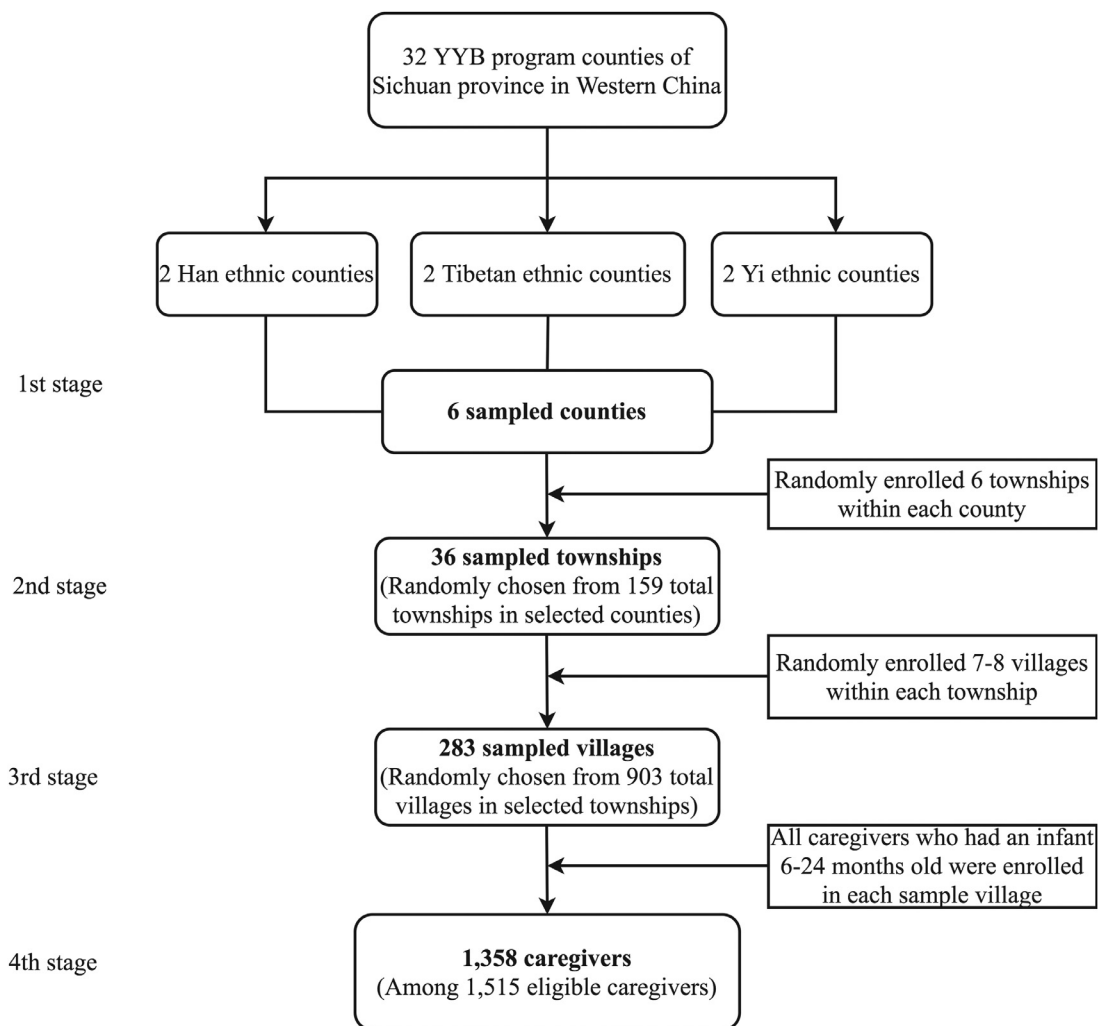


Figure. Flow diagram of the sampling procedure. YYB indicates *Ying Yang Bao* (a micronutrient powder program conducted in China).

This questionnaire was developed using a comprehensive literature review and 2 rounds of Delphi expert consultation. After assessing the questionnaire and revising it for validity, our enumerators pretested the questionnaire in nonsample villages (details regarding the development of the questionnaire are listed in Supplementary Data).

In Tibetan and Yi communities, local doctors often use local dialects while providing caregivers with information about YYB. For our research team to overcome language barriers presented in minority communities, we used locally trained

volunteers to help translate between Mandarin and the local dialect during the survey interviews. The survey collected 3 blocks of data, including YYB adherence, YYB health communication, and demographic characteristics.

The first survey block concerned the outcome of interest in this study, which was caregiver adherence to the YYB program. To assess adherence, each caregiver was asked to report how many packets of YYB they fed their child each week, on average. The WHO and Chinese YYB program offices recommend that children be fed 4–7 packets of YYB per

week.^{4,18,26} Nonadherence to YYB was thus defined as feeding children fewer than 4 YYB packets per week.

The second survey block focused on how YYB health information was communicated to caregivers. The nature by which the respondent household had heard about the YYB program was measured in 2 dimensions: communication channels and messages about YYB. To assess communication channels for YYB information, enumerators asked caregivers to select the typical channels through which they received information about YYB, including family members, relatives and friends, village cadres (local officials), village

doctors, township doctors, and mass media (eg, leaflets, radio, television). To assess the messages about YYB that caregivers received through these channels, our team asked caregivers a series of questions: (1) whether they received any YYB information, (2) whether they were informed about the health benefits of YYB, (3) whether they had been told that YYB was free, and (4) whether they had received information about YYB feeding methods.

The third block concerned the demographic characteristics of caregivers. In this part of the survey, enumerators asked about the caregiver's age, gender, ethnicity, educational level, occupation, and household assets. Ethnicity was self-reported by the caregivers from a list that included Han, Tibetan, and Yi. To assess caregiver educational level, enumerators asked caregivers to choose 1 of 6 response options: no formal education, did not finish primary school, primary school, junior school, high school, and undergraduate or higher level. Because nearly half of the participants in Tibetan and Yi communities had not attended any school, we transformed the responses into a binary variable, in which 0 = no formal education and 1 = any amount of formal education. To produce a measure of household wealth, enumerators asked caregivers a series of questions that collected information about the value of each household's assets. A household asset index was calculated using polychoric principal components analysis^{27,28} on the basis of whether the household owned or had access to a water heater, washing machine, refrigerator, air conditioner, television, computer, motorcycle, and car or truck. Using the index, households were grouped into lower levels of assets (asset index score below the mean) and higher levels of assets (asset index score above the mean).

Statistical Analysis

The empirical strategy included 3 parts. First, descriptive analyses were used to assess the statistical values of the variables that measured the outcomes of interest and the

independent variables. Continuous variables were expressed as mean and SD, and categorical variables as numbers and percentages. The missing values were imputed using regression imputation,^{29,30} using the `mi impute regress` command in Stata for the imputation.^{29,30} Second, we used Chi-square tests of independence to assess differences in adherence to YYB among Han, Tibetan, and Yi ethnic groups and differences in YYB health communication patterns. Finally, to understand how health communication patterns are associated with YYB adherence among Han, Tibetan, and Yi caregivers, we estimated 3 robust logistic regression models for each ethnic group separately. In each regression, the health communication patterns (communication channel and communication message) were predictors, and adherence to YYB was the outcome variable. Each regression model used an adjusted model that controlled for covariates (age, gender, educational level, occupation, and household fixed assets level) to calculate the odds ratio (OR) and the associated 95% confidence interval (CI). In all cases, we used a cluster-corrected estimator to adjust standard errors for clustering at the township level; $P < 0.05$ were considered statistically significant. All statistical analyses were conducted using Stata software (version 14.1, StataCorp, College Station, TX, 2015).

RESULTS

Demographics of the Caregivers by Ethnicity

The demographic characteristics of study participants are reported in Table 1. Among the 1,358 caregivers, the average age was 36 years (SD, 13 years). Most caregivers were female (91.8%). More than half of the caregivers had a formal education (54.2%), and about half were stay-at-home parents (48.2%). Less than half reported a level of household assets above the mean of the household fixed assets index score (47.3%). Demographically, Han, Tibetan, and Yi caregivers differed significantly in educational level, occupation, and household asset value ($P < 0.05$).

Adherence to YYB and Health Communication

The rates of adherence to YYB are shown in Table 2. The results show that 1,128 of 1,358 caregivers (83.1%) had heard about the YYB program. Significantly more Han caregivers (94.3%) knew about YYB than did Tibetan (79.3%) and Yi (76.3%) caregivers (both $P < 0.05$). Among caregivers who had heard about YYB, 52.6% administered YYB to their child as recommended (4–7 packets per week). Adherence to YYB recommendations varied significantly among the 3 ethnic groups ($P < 0.05$). Yi caregivers reported significantly lower rates of adherence (47.2%) than did Han (55.5%) and Tibetan (55.0%) caregivers ($P < 0.05$).

Table 2 presents the communication channels through which caregivers most frequently received YYB information. Among the 1,128 caregivers who had heard about YYB, the most common communication channel was township doctors (81.4%), followed by relatives or friends (19.1%). Among the 3 ethnic groups in the sample, the results showed significant differences in communication channels. Significantly higher percentages of Han caregivers received information from relatives or friends (30.5%), mass media (22.8%), and family members (18.6%) than did Tibetan and Yi caregivers (all $P < 0.05$). In addition, significantly more Han (87.7%) and Tibetan (90.2%) caregivers received YYB information from township doctors as compared with Yi (70.3%) caregivers (both $P < 0.05$). In comparison, significantly higher percentages of Yi caregivers received information from village doctors (12.5%) and village cadres (7.7%) as compared with Han and Tibetan caregivers (both $P < 0.05$).

Table 2 also provides information about the messages about YYB that caregivers received. Caregivers primarily reported receiving messages on the health benefits of YYB (45.4%), followed by the message that YYB is free (28.0%). These percentages are consistent among Han and Tibetan caregivers who received YYB information. However, among Yi caregivers, approximately one third knew no more than the YYB name and had not received any other information about

Table 1. Demographics of Caregivers by Ethnicity in Rural Western China (n = 1,358)

Demographics	Total (N = 1,358)	Han (n = 438)	Tibetan (n = 426)	Yi (n = 494)	P for Difference Among Groups ^a		
	Mean (SD)/N (%)	Mean (SD)/n (%)	Mean (SD)/n (%)	Mean (SD)/n (%)	(2) – (3)	(2) – (4)	(3) – (4)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Age, y	36.0 (12.8)	39.1 (12.8)	37.1 (14.1)	32.5 (10.5)	0.06	<0.001	<0.001
Sex					<0.001	<0.001	0.06
Female	1,246 (91.8)	422 (96.3)	373 (87.6)	451 (91.3)			
Male	112 (8.2)	16 (3.7)	53 (12.4)	43 (8.7)			
Education ^b					<0.001	<0.001	<0.001
Illiterate	622 (45.8)	47 (10.7)	195 (45.8)	380 (76.9)			
Literate	736 (54.2)	391 (89.3)	231 (54.2)	114 (23.1)			
Occupation ^c					<0.001	<0.001	<0.001
Stay-at-home parent	655 (48.2)	346 (79.0)	224 (52.6)	85 (17.2)			
Farmer/ nomadic herder	552 (40.7)	28 (6.4)	145 (34.3)	379 (76.7)			
Other	151 (11.1)	57 (14.6)	57 (13.1)	30 (6.1)			
Household assets level ^d					<0.001	<0.001	<0.001
Lower level	716 (52.7)	83 (18.9)	154 (36.2)	479 (97.0)			
Higher level	642 (47.3)	355 (81.1)	272 (63.8)	15 (3.0)			

SD indicates standard deviation.

^aAnalysis of variance s were conducted with the oneway command and bonferroni option in Stata. Using these statistical tools, the group differences of the sample's continuous variables, such as caregiver age, were analyzed. To examine group differences between categorical variables, such as caregiver sex, education, occupation, and household assets, chi-square tests of independence between Han and Tibetan ethnic groups, Han and Yi ethnic groups, and Tibetan and Yi ethnic groups were conducted, for which $P < 0.05$ were considered statistically significant; ^bTo assess caregiver educational level, caregivers were asked to choose 1 of 6 response options: no formal education, did not finish primary school, primary school, junior school, high school, and undergraduate or higher level. We transformed the responses into a binary variable, in which 0 = no formal education and 1 = any amount of formal education; ^cThe occupation stay-at-home parent refers to caregivers responsible for staying home and caring for the child. The occupation farmer/nomadic herder was found predominantly in Tibetan communities (27.7%), and there are no nomadic herders among Han and Yi caregivers. Other occupations include off-farm part-time jobs and self-employment; ^dA household fixed assets score was developed using polychoric principal component analysis on the basis of whether the household owned or had access to a water heater, washing machine, refrigerator, air conditioner, television, computer, motorcycles, and car or truck. Households were then divided into 2 groups: lower levels of assets (asset index score below the mean) and higher levels of assets (asset index score above the mean).

Table 2. Feeding Practice and Health Communication on YYB Program of Caregivers by Ethnicity in Rural Western China (n = 1,358)

	Total (N = 1,358)	Han (n = 438)	Tibetan (n = 426)	Yi (n = 494)	P for Difference Among Groups ^a		
	N (%)	n (%)	n (%)	n (%)	(2) – (3)	(2) – (4)	(3) – (4)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
YYB Health Communication							
Heard about YYB program (N = 1,358) ^b							
Yes	1,128 (83.1)	413 (94.3)	338 (79.3)	377 (76.3)	<0.001	<0.001	0.27
No	230 (16.9)	25 (5.7)	88 (20.7)	117 (23.7)			
Average no. of YYB packets fed to child/wk (n = 1,128) ^c					0.46	0.02	0.04
<4	535 (47.4)	184 (44.5)	152 (45.0)	199 (52.8)			
4–7 ^d	593 (52.6)	229 (55.5)	186 (55.0)	178 (47.2)			
YYB communication channels (n = 1,128) ^e							
Township doctors					0.26	<0.001	<0.001
Yes	952 (81.4)	362 (87.7)	305 (90.2)	265 (70.3)			
No	218 (18.6)	51 (12.3)	33 (9.8)	112 (29.7)			
Relatives or friends					<0.001	<0.001	0.73
Yes	216 (19.1)	126 (30.5)	41 (12.1)	49 (13.0)			
No	912 (80.9)	287 (69.5)	297 (87.9)	328 (87.0)			
Mass media ^e					<0.001	<0.001	0.79
Yes	130 (11.1)	94 (22.8)	13 (3.8)	16 (4.2)			
No	1,040 (88.9)	319 (77.2)	325 (96.2)	361 (95.8)			
Family members					<0.001	<0.001	0.12
Yes	116 (9.9)	77 (18.6)	20 (5.9)	13 (3.4)			
No	1,054 (90.1)	336 (81.4)	318 (94.1)	364 (96.6)			
Village doctors					0.20	<0.001	<0.001
Yes	51 (4.4)	2 (0.5)	0 (0.0)	47 (12.5)			
No	1,119 (95.6)	411 (99.5)	338 (100.0)	330 (87.5)			
Village cadres					0.12	<0.001	<0.001
Yes	36 (3.1)	1 (0.2)	4 (1.2)	29 (7.7)			
No	1,134 (96.9)	412 (99.8)	334 (98.8)	348 (92.3)			
Messages about YYB (n = 1,128) ^e					0.001	<0.001	<0.001
YYB benefits ^f	512 (45.4)	185 (49.7)	184 (54.4)	123 (32.6)			
YYB is free	316 (28.0)	152 (36.8)	83 (24.6)	81 (21.5)			
Did not receive any YYB information ^f	210 (18.6)	34 (8.2)	49 (14.5)	127 (33.7)			
Methods of feeding YYB ^f	90 (8.0)	22 (5.3)	22 (6.5)	46 (12.2)			

YYB indicates *Ying Yang Bao* (a micronutrient powder program conducted in China).

^aAnalysis of variances were conducted with the oneway command and Bonferroni option in Stata. Using these statistical tools, the group differences of the sample's continuous variables, such as caregiver age, were analyzed. To examine group differences between categorical variables, such as caregiver sex, education, occupation, and household assets, chi-square tests of independence between Han and Tibetan ethnic groups, Han and Yi ethnic groups, and Tibetan and Yi ethnic groups were conducted, for which $P < 0.05$ were considered statistically significant; ^bCaregivers (N = 1,358); ^cCaregivers who heard about the YYB program (n = 1,128); ^dYYB adherence was defined as feeding infants 4 to 7 YYB packets per week; ^eMass media, including leaflets, radios, and televisions; ^fYYB benefits means "I heard that YYB gives health benefits to my child (such as preventing malnutrition and increasing immunity)", did not receive any YYB information means "I just know the YYB name and did not receive any other YYB information", and methods of feeding YYB means "I heard that I need to use warm water to stir YYB and then to mix YYB with the child's favorite food."

YYB (33.7%). Similarly, few Yi caregivers knew about the health benefits of YYB (32.6%), and even fewer knew that YYB was free (21.5%). Among all 3 groups, information on methods of feeding YYB reached only a small percentage of caregivers (Han, 5.3%; Tibetan, 6.5%; and Yi, 12.2%).

The Association Between Health Communication and Adherence to YYB

Table 3 shows the correlations between health communication (communication channels and messages about YYB) and YYB adherence among caregivers, controlling for demographic variables. Among all 3 ethnic groups, receiving information from township doctors was correlated with increased adherence to YYB (Han: odds ratio [OR], 2.18; 95% CI, 1.11–4.29; Tibetan: OR, 7.22; 95% CI, 1.97–26.55; Yi: OR, 2.99; 95% CI, 1.55–5.75). However, apart from township doctors, each ethnic group showed unique correlations between YYB adherence and a specific communication channel. Receiving information via mass media was significantly associated with YYB adherence among

Han caregivers (OR, 1.87; 95% CI, 1.05–3.31). Among Tibetan caregivers, communication with family members was significantly linked to adherence to YYB (OR, 4.86; 95% CI, 1.45–16.29), and village doctors were significantly associated with Yi adherence to YYB (OR, 6.63; 95% CI, 3.46–12.73).

Messages about YYB also showed varying associations to YYB adherence among the 3 ethnic groups. Tibetan caregivers were more likely to adhere to YYB if they obtained information on the health benefits of YYB (OR, 2.00; 95% CI, 1.03–3.90). For Yi caregivers, receiving information on the health benefits of YYB (OR, 2.30; 95% CI, 1.14–4.62) and information about feeding methods (OR, 2.48; 95% CI, 1.22–5.03) were associated with YYB adherence. In contrast, no types of YYB information were significantly associated with YYB adherence among Han caregivers.

DISCUSSION

This study examined the associations between various health communication patterns and YYB adherence among ethnic Han, Tibetan, and Yi caregivers in rural

western China. The results found that rates of adherence to YYB varied significantly among the 3 ethnic groups. Surprisingly, all 3 ethnic groups received YYB information primarily from township doctors, which was shown to be positively associated with adherence rates. Apart from township doctors, this study found significant differences between health communication patterns and adherence to YYB among Han, Tibetan, and Yi caregivers.

Although YYB packets are safe and effective, in practice, the effectiveness of YYB depends on community adherence.³¹ Across the 3 ethnic groups in this study, just more than half of the caregivers adhered to YYB feeding instructions, far below the national average of 70%.¹⁷ Although the difference in adherence between Han and Tibetan caregivers was not significant, the difference between Han and Yi caregivers, as well as between Tibetan and Yi caregivers, was significant. Previous studies of YYB have found that the variance in caregivers' adherence between ethnic groups may be explained by differences in SES (including household assets and education

Table 3. Association Between Health Communication and Adherence to YYB Among Children's Caregivers from Different Ethnicity in Rural Western China (n = 1,128)

	Adherence to YYB					
	Han (n = 413)		Tibetan (n = 338)		Yi (n = 377)	
	Adjusted OR	95% CI	Adjusted OR	95% CI	Adjusted OR	95% CI
	(1)	(2)	(3)	(4)	(5)	(6)
YYB Health Communication						
Communication channel of YYB information						
Township doctors	2.18**	1.11–4.29	7.22**	1.97–26.55	2.99***	1.55–5.75
Mass media	1.87*	1.05–3.31	1.05	0.25–4.34	0.62	0.24–1.61
Family members	1.00	0.53–1.90	4.86*	1.45–16.29	1.37	0.37–5.08
Village doctors	—	—	—	—	6.63***	3.46–12.73
Village cadres	—	—	1.60	0.18–14.12	1.10	0.42–2.87
Relatives or friends	1.03	0.72–1.47	1.06	0.36–3.13	1.38	0.73–2.61
Main communication messages of YYB information						
Did not receive any YYB information	Reference		Reference		Reference	
YYB benefits	1.13	0.53–2.43	2.00*	1.03–3.90	2.30**	1.14–4.62
Methods of feeding YYB	1.40	0.49–4.02	1.28	0.47–3.50	2.48*	1.22–5.03
YYB is free	1.00	0.48–2.09	0.83	0.32–2.17	1.13	0.60–2.11

CI indicates confidence interval; OR, odds ratio; YYB, *Ying Yang Bao*, (a micronutrient powder program conducted in China).

* $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$.

Note: Adherence to YYB was defined as feeding children 4 to 7 YYB sachets/wk by caregivers. Clustering is at the township level. For each regression, we fit the model after controlling for caregiver demographic variables, including age, sex, educational level, occupation, and household fixed assets level. All variables in the dimension of the communication channel of YYB information are dummy variables.

levels),^{19,32,33} language barriers (Mandarin is the primary language used in mass media),^{19,34} and differences in communication channels and messages in regard to YYB information in Han and minority areas.³⁵

Among Han, Tibetan, and Yi groups, the findings indicated that township doctors played an important role in promoting YYB adherence. Township doctors were the most frequently reported communication channel for YYB information. Township doctors were also the only significant determinant of caregiver adherence to YYB common across all 3 ethnic groups. Additional analysis revealed that more than two-thirds of the overall sample received YYB information from township doctors, typically when they brought their children to the township health center for vaccinations or physical examinations. This is a far higher percentage than other YYB counties in China, in which < 20% of caregivers reported receiving YYB packets from township doctors.³⁶

However, aside from township doctors, each ethnic group differed in terms of the most common communication channels through which caregivers received messages associated with YYB adherence. Among Han caregivers, communicating YYB information via mass media (such as leaflets, radio, or television) effectively promoted YYB adherence, which is consistent with previous studies in Han communities of China.^{37,38} This association can be explained by the relatively high educational and household fixed assets levels found among Han caregivers, both in this study sample and nationally.¹⁶ Greater access to mass media (because of higher levels of household assets) may provide increased exposure to information in the case of Han caregivers.^{39,40} Another possible reason that mass media is most accessible to Han communities could be their higher Mandarin literacy rates. Given that most mass media is in Mandarin (which is the native language for many Han households), it seems likely that language plays an essential role in promoting YYB adherence in Han communities. Unlike Han caregivers, the communication methods predominantly used

by minorities are likely influenced by local cultural norms, which contribute to the YYB adherence in minority communities.^{41,42}

An example of such cultural norms was found in the sample of Tibetan caregivers. The results indicated that receiving health information from family members was most likely to increase YYB adherence in Tibetan communities. This may be influenced by the nomadic lifestyle of many Tibetan caregivers (27.7%) in the sample, who spend most of the year herding animals with other family members (and with little access to other channels of communication). In addition, the majority of the sampled caregivers who reported being stay-at-home parents (52.6%) participate in the nomadic lifestyle but are tasked with raising children rather than taking an active role in herding animals.^{43,44} These families are typically isolated during nomadic periods (April to November each year).^{42,43} This isolation means that caregivers communicate almost exclusively with family members during nomadic periods. As such, interpersonal community-based communication strategies that educate family units may be most effective in promoting YYB adherence among Tibetan caregivers.

Similarly, the results show that interpersonal relationships are also important to Yi caregiver adherence to YYB, as Yi caregiver adherence is predominantly influenced by village doctors. In many Yi communities, village doctors are more accessible to Yi caregivers because of their connection to the community (they are usually members of the village), including proximity to Yi households and mastery of the local dialect.⁴⁵ Thus, although it is clear that township doctors play a key role in improving Yi caregiver adherence, village doctors may be even more effective in communicating YYB information because of their accessibility to and familiarity with the individuals in Yi communities. The findings indicate that, in the case of Yi communities, further utilization of village doctors may increase YYB adherence.

In addition to differences in the effectiveness of different communication

channels, the nature of the messages received about YYB also differed among ethnic groups (as well as having different impacts on adherence). Although no messages about YYB were significant for Han caregivers, this study found that adherence rates among the Tibetan and Yi communities increased significantly when caregivers were given information about the health benefits of YYB (eg, preventing anemia, strengthening immunity). These findings are consistent with previous research highlighting the importance of caregiver knowledge and increased adherence rates.¹⁹

Taken together, the findings emphasize the necessity to promote YYB adherence in rural western China, particularly among minority caregivers. The results indicate that interpersonal community-based interventions are most appropriate for minority populations. Specifically, for Tibetan caregivers, future interventions could consider the influence of the family on YYB adherence and provide greater outreach on YYB health benefits to family units. For Yi caregivers, village doctors may be effective in bridging unique cultural and linguistic practices in the Yi community.

This study examined the association between health communication patterns and YYB adherence among Han, Tibetan, and Yi ethnic groups in western China and provides insight into how culturally appropriate health communication strategies can effectively be used to promote YYB adherence in western China as well as in other ethnically diverse LMICs.

This study is also subject to certain limitations. First, because the data on YYB feeding practices were based on caregiver recall, this study could not rule out the possibility of recall bias. To increase accuracy, future studies might use enumerators to count the number of unused packets per month in addition to asking the caregiver to recall the number of YYB packets fed to infants. Second, caregivers were not asked follow-up questions about the YYB messages they had received from each YYB channel they had affirmed using; rather, they were asked about the messages received from YYB communication channels,

generally. Future study is needed to capture more detailed information about the type of information received through each YYB channel. Third, for a more in-depth understanding of how cultural norms influence caregiver adherence among diverse ethnic populations, future research may consider using qualitative and/or mixed-method approaches. Fourth, although measures were taken before the interviews to reduce bias during the survey because of the quality of the translations that was needed between respondent and surveyor in minority areas (all measures are listed in Supplementary Data), it is possible that the use of locally trained volunteers to translate the survey may have resulted in the inconsistent presentation of the survey questions.

IMPLICATIONS FOR RESEARCH AND PRACTICE

The findings of this study underscore the importance of designing culturally tailored health communication strategies to improve adherence to micronutrient intervention programs among caregivers with diverse ethnic backgrounds. The findings indicate that a culturally specific, interpersonal health communication strategy can significantly increase YYB adherence among ethnically diverse rural caregivers. Given that township doctors play a critical role in caregiver adherence to YYB feeding instructions across Han, Tibetan, and Yi groups, training township doctors to communicate YYB information more effectively may broadly increase YYB adherence. This study indicated that minority communities display the lowest rates of adherence, calling for community-based interventions to be implemented to promote better YYB practices in minority populations in rural China.

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SUPPLEMENTARY DATA

Supplementary data related to this article can be found at <https://doi.org/10.1016/j.jneb.2021.07.014>.

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