Original Article

Dietary patterns and their associations with energy, nutrient intake and socioeconomic factors in rural lactating mothers in Tibet

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Background and Objectives: There is very limited published data on Tibetan dietary patterns and its association with nutrient intakes and socioeconomic factors. The aim of this study was to identify and describe the dietary patterns and the associations with nutrient intakes in rural Tibetan pregnant, lactating mothers. **Methods and Study Design:** Dietary patterns and nutrient intakes were identified via a food frequency questionnaire (FFQ). We identified dietary patterns using principle component analysis (PCA) of intakes of 17 food groups and specific Tibetan foods. Quartile categories of each dietary pattern were used, and non-dietary lifestyle factors and total energy intake were adjusted for the analysis. We identified two dietary patterns: "Varied pattern" and "Staple pattern". **Result:** The "Varied pattern" was characterized by a high intake of vegetables, fruits and soy foods which showed significant positive associations with vitamins. Vitamin C (P_{trend}<0.01) and vitamin E (P_{trend}<0.01) were strongly associated with "Varied pattern" among mothers with children younger or older than 12 months. The "Staple pattern" was characterized by Tibetan staple foods, Tibetan beverages and Tibetan snacks and showed significant negative associations with protein (P_{trend}<0.01) among mothers with children younger than 12 months or older than 12 months. Carbohydrate intakes significantly increased with "Staple pattern" among mother with children younger than 12 months only. **Conclusions:** The results presented here suggested our dietary patterns to great extent characterize the dietary behavior of Tibetan lactating mothers. There is, therefore, potential for dietary patterns to be used as a valid tool in assessing Tibetan diet.

Key Words: dietary patterns, nutrient, rural, lactating, Tibet

INTRODUCTION

Dietary practices of mothers can have a notable effect on the wellbeing of their infants. In fact, the proportion of ingested nutrients appropriated for breast milk biosynthesis may depend on maternal nutrient concentrations from their dietary behaviors.[1] These nutrients may be mobilized to contribute to the nutrient availability for breast milk biosynthesis, and it is likely that the extent of nutrient mobilization depends on maternal dietary intake.[2] Maternal nutrition during pregnancy and lactation plays an important role in the overall health of the infant[1] because inadequate nutrient intakes of infants at birth or during early growth affects the risk of developing coronary heart disease and related disorders.[3]

Despite the increase in the use of principal components analysis (PCA) to identify dietary patterns in epidemiological studies, little consideration has been paid to the associations between these patterns and the actual nutrient intake of Tibetan mothers during their pregnancy or lactating period.[4] Dietary patterns may be a better qualitative dietary choice and give greater insight into overall life style choices; it is therefore important to determine whether these dietary patterns can adequately characterize actual dietary intakes and whether they are useful measurements in nutritional epidemiology.[4]

The aim of the present study was to examine the associations between dietary patterns obtained by PCA and estimated nutrient intakes in a cross-sectional study of rural Tibetan mothers. In this study, we considered the socioeconomic factors and a comprehensive list of micronutrients and macronutrients with regard to dietary patterns.

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METHODS

Study design

Data were derived from a cross-sectional survey that was designed to document the health status of children aged under 24 months and their mothers' dietary and nutrient intakes. The details of the study design and conduct have been described elsewhere.[5] Participants were selected using a simple random sampling method and were interviewed face-to-face by trained professional interviewers between May and August 2008. In total, 386 eligible children aged 0-2 years and their mothers completed the entire survey. Standardized questions were used to collect socio-demographic information, including parental age, parent year of education, parental occupation, and family size, as described in previous studies in Tibet.[6,7] The study protocol was approved by the Ethics Review Committee at College of Medicine, Xi'an Jiaotong University (Approval No. 2007015) and all participants provided their consent.

Assessment of dietary intake

The mothers' nutritional status was determined from the dietary data collected using a validated food-frequency questionnaire (FFQ), which included 92 food items covering cereals, meat, vegetables, fruits, egg products, nuts, fish, beverages, alcoholic beverages, and snacks. Because this survey was conducted in Tibet, we added certain Tibetan foods to the questionnaire, such as Zanba, Tibetan milk tea, and Tibetan salt cream tea. Before being used in the study, the FFQ was revised twice with the assistance of local nutrition staff. After each revision, the FFQ was re-tested to determine whether the items fitted local daily food consumption patterns. In regard to consumption frequency, different numbers of response categories were: almost never; less than 1 time/month; 1-3 times/month; 1 time/week; 2-4 times/week; 5-6 times/week; 1 time/day; 2-3 times/day; and more than 4 times/day. Typical dishes were displayed in the booklet, in addition to average portion sizes. Options for the serving size were 0.5, 1, 1.5, or 2, with the displayed size as a reference (average size) for most of the food items. Participants were asked how often, on average, they consumed each food item during the past 12 months. Therefore, we defined two subsamples for analyzing the data. One was mothers with children younger than 12 months; another was mothers with children aged older than 12 months. Intakes were calculated for energy, protein, fat, carbohydrate, vitamin A, vitamin B-1, vitamin C, vitamin E, calcium, iron, and zinc. Nutrients were calculated according to the 2002 and 2004 China Food Composition Tables.[8,9] More detailed information on the dietary access has been published elsewhere.[5]

Quality control

The interviewers (physicians from the Department of Public Health, School of Medicine, Tibet University) were trained to standardize the administration of the questionnaire and anthropometric measurements. They were trained in the field for at least 1 week prior to commencing the surveys. A pilot survey was performed before the formal survey, with all data from the formal survey for the analysis. Two investigation teams were established, including four members and a supervisor in each team. At least two members were Tibetan and were able to communicate in both Tibetan native language and Chinese. During the survey, a data checking system was employed, which involved all interviewers checking their own data, each interviewer checking data with another interviewer, and data checking by supervisors. Subjects were re-interviewed if answers to key questions with missing values were identified. The accurate age of the child was based on the Permanent Residence Registration and/or Record of Scheming Immunization documents, in which the birth date is recorded. The Tibetan lunar calendar dates were converted to Gregorian calendar dates.

Statistical analysis

We identified dietary patterns by principal components analysis based on 17 food groups (Table 1) for each subsample (mothers with children younger than 12 months; mothers with children aged older than 12 months). The factors were rotated by varimax rotation to maintain the uncorrelated nature of the factor and for greater interpretability. Dietary patterns were determined after considering eigenvalues and interpretability of the factors. Dietary patterns were named by the food groups with the highest loadings on each factor. The factor score of each pattern was calculated for each individual by summing the consumption of food items weighted by their factor loadings. Factor scores were categorized into quartile categories among participants for the purpose of indicating how much the nutrient intake increased or decreased according to each quartile of dietary pattern score. Dietary nutrients intakes were adjusted to a total energy intake by the regression residual method. The trend of the proportions or means of the covariates were examined by using the Cochran-Armitage trend test and general linear regression analysis, respectively, with ordinal values of 0-3 assigned to the quartile categories of each dietary pattern. The correlation between dietary patterns and energy adjusted nutrient intake were calculated by Pearson's correlation. The associations between the means of energy adjusted nutrient intakes and each dietary pattern were examined by using general linear regression analysis, with ordinal values of 0-3 assigned to the quartile categories of each dietary pattern. All reported P values were based on two-sided tests. Statistical analyses were performed with SAS version 9.2 (SAS Institute, Cary, NC).

RESULTS

Basic characteristics of Tibetan mothers in this study are presented in Table 2. Approximately 90% of Tibetan mothers' feeding behavior for their infants was partial breastfeeding. We identified two dietary patterns (Table 3). The first dietary pattern was characterized by high intakes of vegetables, fruits, and soy foods, and was thus named "Varied pattern". The second dietary pattern was characterized by high intakes of Tibetan staple foods, Tibetan beverages and Tibetan snacks. This latter dietary behavior was often observed in Tibetan daily dietary intakes; therefore, this pattern was named "Staple pattern". We conducted sensitivity analyses to examine the robustness of our findings by changing the methods of extracting the factors. The associations between food groups and

Table 1. Definition of the food groups used in the principal component analysis[†]

Food groups	Items (median frequency)
Vegetables	Radishes (3), carrots (3), spinach (4), green bean (1), eggplant (2), tomatoes (4), green pepper (4), white gourd (1), cucumber (3), pumpkin (1), garlic (1), scallions (5), Chinese chives (1), Chinese cabbage (1), cabbage (3), cauliflower (3), lettuce (1),broccoli (3), celery (2), and Lotus root (1)
Soy and soy products	Fresh soybeans (1), soymilk (1), tofu (3), and other soybean products (1)
Potatoes	Potatoes (5) and sweet potatoes (1)
Fruits	Strawberries (1), pears (2), apples (3), oranges (3), bananas (3), and watermelon (2)
Nuts and seeds	Peanuts (3) and sunflower seeds (5)
Beverages	Beer (1) and soft drinks (3)
Meat	Pork (4), beef (4), lamp (3), blood of pork/beef/lamp (1), beef/lamp liver (1), pork intestine (1), sausage (1), chicken (2) and fish (1)
Staple foods	Steamed buns (5), dumplings (3), other flour products (4), rice (7), rice porridge (2), rice noodles (3), noodles (4) and instant noodles (3)
Eggs	Chicken eggs (3)
Dairy products	Milk (2), yogurt (3), and milk power (2)
Snacks	Jelly (4) and red chili jelly (3)
Tibetan staple foods	Zanba (7), Tibetan noodles (5), Tufan (3), Bazamaguo (2), and Turu (2)
Tibetan meats	Yak (5), dried yak (2), and yak products (1)
Tibetan fruits	Qiuluo (1) and Senzhu (1)
Tibetan beverages	Tibetan milk tea (5), Tibetan cream tea (7), Tibetan barley wine (1), rice alcohol (1), and Tibetan white wine (1)
Tibetan snacks	Alcohol peas (1), yue (2), kasan (2), tui (1), Tibetan milk cheese (2), and Tibetan milk cheese products (2)
Green tea	Green tea (7)

[†]Frequency's categories are: 7 (more than once per day), 6 (5-6 times per week), 5 (2-4 times per week), 4 (once per week), 3 (1-3 times per month), 2 (less than once per month), 1 (almost never).

Table 2. Characteristics of rural Tibetan mothers with children

	Mothers with children younger than 12 months (n=145)	Mothers with children older than 12 months (n=241)
Age (years), mean (SD)	29 (5.0)	29 (6.4)
Educational years, mean (SD)	5 (4.3)	5 (4.0)
Maternal occupation (%)[†]	69	73
Family size, mean (SD)	5 (1.8)	6 (2.4)
Height (cm), mean (SD)	159 (4.8)	159 (5.1)
Weight (kg), mean (SD)	54 (6.7)	54 (7.4)
Body mass index (kg/m^2), mean (SD)	21 (2.4)	21 (2.8)
Infants' feeding pattern for 4 months, n (%)		
Almost exclusive breastfeeding	1 (0.7)	2 (0.8)
Partial breastfeeding	129 (89.0)	210 (87.1)
Artificial feeding	15 (10.3)	29 (12.0)

[†]Percentage of farming or animal husbandry only.

two major dietary patterns did not change.

Table 4 showed non-dietary characteristics according to each dietary pattern score in Tibetan mothers. The mothers with higher scores of the varied pattern were characterized by younger age, higher education, and larger family size. In contrast, we did not observe similar associations for the Staple pattern. The Varied pattern was more strongly associated with antioxidant nutrients (energy adjusted) than the Staple pattern. However, the Staple pattern was strongly correlated with iron intake compared with the varied pattern among mothers with children younger than 12 months (Table 5).

Associations between energy adjusted nutrient intakes and dietary pattern scores are shown in Table 6. Higher intakes of energy, protein and fat were associated with higher dietary pattern scores in all types of dietary patterns among mothers with children younger than 12 months. Higher Varied dietary pattern scores were associated with higher intakes of vitamin A, vitamin B-1, vitamin B-2, vitamin C, and vitamin E in Tibetan mothers. In the Staple dietary pattern, we observed notably increased intake of most nutrients with increasing Staple pattern scores. We also noted that intake of vitamin A was negatively associated with the Staple pattern among mothers with children older than 12 months.

DISCUSSION

This study is the first, to our knowledge, to identify and describe dietary patterns and how they relate to nutrient intakes in rural Tibetan mothers. In this study, we identified two dietary patterns explaining 28% of the total variance in daily food intake; the Varied pattern was composed of high consumption of vegetables, fruits, and soy products, but it was similar to the "prudent" pattern de-

Table 3. Factor-loading matrix for major dietary patterns identified by principal component analysis

Food item and group	Mothers with children younger than 12 months (n=145)		Mothers with children older than 12 months (n=241)	
	Varied pattern	Staple pattern	Varied pattern	Staple pattern
Vegetables	0.19†	-0.01	0.73†	-0.12
Soy and soy products	0.20†	-0.14	0.60†	-0.10
Potatoes	-0.06	0.10	0.18†	0.30†
Fruits	0.30†	-0.03	0.76†	0.27†
Nuts and seeds	0.23	0.03	0.51†	0.08
Beverages	0.15	0.08	0.55†	0.31†
Meat	0.20	-0.04	0.66†	-0.32†
Staple foods	0.05	0.28†	0.27†	0.29†
Eggs	0.16†	0.09	0.27†	0.56†
Dairy products	0.07	-0.06	0.04	0.03
Snacks	0.12	0.15†	0.51†	0.12
Tibetan staple foods	-0.10	0.40†	-0.03	0.38†
Tibetan meat	0.09	-0.01	0.15†	-0.28†
Tibetan fruit	-0.04	0.04	0.10	0.08
Tibetan beverage	-0.003	0.16†	0.15†	0.48†
Tibetan snack	-0.11	0.39†	-0.07	0.47†
Green tea	0.03	0.20†	0.08	0.66†
Variance explain (%)	17%	11%	18%	10%

†Absolute values ≥0.15 were bold.

scribed in other studies,[10-12] which is high in vegetables, fruits, legumes, and fish. In the current study, our "Varied pattern" comprised high consumption of green tea, rice, fruits, and meats, which was similar to other studies in China.[13-16] In previous studies conducted in Beijing[13] and Shanghai,[14-16] China, dietary patterns were created by cluster analysis,[13-16] factor analysis,[15] and principal component analysis.[14] Dietary patterns were usually named as fruit-, vegetable- and meat- patterns or fruit and milk, red meat, refined cereals patterns.[13-15] Furthermore, our "Staple pattern," was consistent with a previous study[5] that mainly consisted of staple foods, predominantly Zanba (Tibetan naked barley, Tibet salt cream tea, and Tibetan cream), Tibetan noodles (Tibetan naked barley), Tufan (flour with a special Tibetan cooking method), Bazamaguo (mainly flour, sugar, Tibetan cream), noodles, and Tibetan snacks.

The significant association between dietary patterns and socioeconomic characteristics, behavior factors or lifestyle factors[17,18] confirmed the benefits of healthy food consumption. Sanchez-Villegas et al[19] reported a negative association between age and a Western dietary pattern, whereas Tseng and De Vellis[20] reported a positive association between age and a vegetable–fruit pattern. In a Chinese study conducted in Shanghai, age was negatively associated with a meat diet but not associated with a fruit-based diet. Additionally, we found that more educated people had higher scores with all dietary patterns, and people with high income had higher scores with the meat and fruit diets, associations which have also been observed in other studies.[17,20] In the present study, our results presented a significant positive association with educational years but a negative association with age in the Varied dietary patterns, which were based on vegetables, fruits, and soy products. Young educated mothers had a higher likelihood of preferring a healthy or varied dietary pattern.

Additionally, one of the three studies that investigated dietary patterns among pregnant women presented variations in nutrient intakes.[21-23] In that study, the authors identified two major dietary patterns: the "Western diet" and the "health conscious" pattern.[22] The subjects in the "health conscious" class had lower fat and energy intake compared with those in the "Western diet" pattern. These results were similar to our associations in terms of energy intake in comparing various dietary patterns. Moreover, Tibetan drinks and staple foods, such as Tibetan cream tea and Zanba (which consists of Tibetan naked barley, Tibet cream tea, and Tibetan cream) and so on, provided almost approximately 60% protein intake.[5] We did not observe clear associations between iron, zinc intakes and "Staple pattern" among Tibetan mothers, except for iron intakes among mothers with children younger than 12 months. Zanba as a high frequency consumption food among Tibetan population was a major source of iron (13.9 mg/100 g) and zinc (9.55 mg/100 g), which were higher than general flour.[5] This unique Tibetan dietary behavior might contribute to the positive association between iron, protein intakes and "Staple pattern".

There were some limitations in the present study. First, recall error is a problem inherent in the study of dietary patterns. The total variance explained by dietary patterns was not as high as other studies, which might be due to special Tibetan diet behaviors. Furthermore, there are some limitations related to PCA, including the subjective decisions on how to interpret and name patterns, the choice of variables to include in the matrix, whether to transform or standardize data, the number of components to retain, and the threshold for factor loadings to be used in naming patterns.[24] PCA derived patterns can be used as a standard approach to describe the dietary habits of populations, but the use of these patterns in examining diet-disease relationships may be of limited value. Although PCA aims to maximize the fraction of variance explained by a weight linear combination of original variables, this tool does not necessarily increase the ability to discriminate between subjects with disease. Additionally, this was an observational study and its results were subject to pos-

Table 4. Characteristics according to quartile categories of dietary patterns among rural Tibetan mothers[†]

Dietary pattern and daily intakes	Mothers with children younger than 12 months Quartile category				P_{trend}	Mothers with children older than 12 months Quartile category				P_{trend}
	Q1 (lowest)	Q 2	Q 3	Q4 (Highest)		Q1 (lowest)	Q 2	Q 3	Q4 (Highest)	
Sample size	37	36	36	36		61	60	60	60	
Varied pattern										
Age (years), mean (SD)	30 (5.8)	27 (4.4)	26 (4.9)	27 (3.9)	0.03	29 (7.7)	31 (7.2)	29 (5.4)	27 (4.3)	0.01
Educational years, mean (SD)	3 (4.4)	5 (4.9)	5 (3.3)	6 (3.7)	0.01	4 (3.8)	4 (3.9)	4 (3.8)	6 (4.2)	<0.01
Maternal occupation (%)[‡]	68	58	75	75	0.26	75	73	73	75	0.93
Family size, mean (SD)	5 (1.7)	5 (1.7)	5 (1.7)	6 (2.0)	0.14	5 (1.7)	5 (1.7)	6 (2.0)	6 (2.0)	0.03
Height (cm), mean (SD)	159 (4.8)	158 (4.1)	159 (5.2)	160 (5.3)	0.49	158 (4.8)	158 (5.7)	160 (4.9)	160 (4.8)	0.01
Weight (kg), mean (SD)	54 (5.9)	53 (4.6)	52 (5.7)	56 (9.4)	0.25	53 (5.1)	54 (8.3)	55 (7.2)	53 (8.8)	0.90
Body mass index (kg/m^2), mean (SD)	21 (2.3)	21 (2.0)	21 (2.1)	22 (3.2)	0.42	21 (1.9)	22 (2.9)	21 (2.8)	21 (3.5)	0.24
Staple pattern										
Age (years), mean (SD)	27 (4.1)	29 (5.2)	28 (4.4)	28 (6.1)	0.99	28 (7.4)	30 (6.4)	28 (6.4)	29 (5.4)	0.99
Educational years, mean (SD)	5 (4.6)	5 (3.7)	6 (4.9)	4 (3.6)	0.43	5 (3.9)	5 (4.4)	4 (3.6)	4 (4.2)	0.18
Maternal occupation (%)[‡]	73	69	56	78	0.99	74	76	85	62	0.29
Family size, mean (SD)	6 (2.4)	5 (1.6)	5 (1.7)	5 (1.5)	0.04	6 (3.0)	6 (2.3)	5 (1.8))	6 (2.2)	0.45
Height (cm), mean (SD)	158 (5.7)	160 (5.1)	159 (4.3)	159 (3.9)	0.77	159 (5.0)	160 (5.8)	159 (5.1)	159 (4.6)	0.69
Weight (kg), mean (SD)	53 (7.7)	54 (6.4)	54 (6.0)	55 (6.7)	0.25	55 (7.5)	53 (6.5)	54 (7.3)	53 (8.4)	0.26
Body mass index (kg/m^2), mean (SD)	21 (2.7)	21 (2.1)	21 (2.4)	22 (2.6)	0.29	22 (2.8)	21 (2.3)	21 (2.6)	21 (3.4)	0.36

[†]Trend of continuous variables was determined by general linear regression analysis, and category variable was determined by Cochran-Armitage trend test.
[‡]Percentage of farming or animal husbandry only.

Table 5. Pearson correlation coefficients between dietary pattern scores and nutrient intakes among rural Tibetan mothers[*]

Energy-adjusted nutrients intake	Dietary pattern[‡]			
	Mothers with children younger than 12 months (n=145)		Mothers with children older than 12 months (n=241)	
	Varied	Staple	Varied	Staple
Energy (kJ/day)	0.35	0.81	0.40	0.40
Protein (g/day)	0.19	-0.42	0.18	-0.40
Fat (g/day)	0.18	-0.03	0.24	-0.12
Carbohydrate (g/day)	0.11	0.56	0.01	-0.01
Vitamin A (μg/day)[†]	0.32	-0.08	0.43	-0.15
Vitamin B-1 (mg/day)	0.24	0.75	0.21	0.34
Vitamin B-2 (mg/day)	0.13	-0.10	0.21	0.03
Vitamin C (mg/day)	0.40	-0.12	0.62	0.004
Vitamin E (mg/day)	0.59	-0.11	0.61	-0.01
Calcium (mg/day)	0.15	-0.19	0.10	0.04
Iron (mg/day)	-0.07	0.47	-0.08	-0.004
Zinc (mg/day)	-0.30	-0.07	-0.22	-0.09

[†]Retinol equivalent.
[*]Correlation coefficients ≥|0.15| are significantly different from 0 (p<0.05).

Table 6. Nutrients intakes (mean (SD)) by quartile categories of dietary patterns[†]

Dietary pattern and daily intakes	Mothers with children younger than 12 months				P_{trend}	Mothers with children older than 12 months				P_{trend}
	Quartile category					Quartile category				
	Q1 (lowest)	Q2	Q3	Q4 (Highest)		Q1 (lowest)	Q2	Q3	Q4 (Highest)	
Sample size	37	36	36	36		61	60	60	60	
Varied pattern										
Energy (kJ/day)	1949 (946)	2112 (692)	2165 (957)	2888 (1017)	<0.01	1694 (572)	2133 (1720)	2454 (834)	2976 (985)	<0.01
Protein (g/day)	64 (9)	61 (7)	65 (12)	70 (16)	0.01	62 (7)	62 (12)	61 (9)	67 (23)	0.08
Fat (g/day)	59 (15)	56 (13)	64 (17)	68 (23)	0.01	58 (16)	52 (26)	58 (16)	67 (20)	<0.01
Carbohydrate (g/day)	390 (111)	375 (88)	384 (96)	407 (94)	0.42	431 (353)	354 (188)	386 (102)	384 (159)	0.39
Vitamin A (μg/day)[‡]	469 (703)	282 (217)	405 (482)	745 (700)	0.03	312 (504)	416 (755)	384 (491)	869 (949)	<0.01
Vitamin B-1 (mg/day)	0.9 (0.7)	0.9 (0.3)	0.9 (0.4)	1.3 (0.5)	0.01	0.7 (0.3)	1.0 (1.5)	1.0 (0.5)	1.2 (0.5)	<0.01
Vitamin B-2 (mg/day)	0.8 (0.2)	0.7 (0.1)	0.7 (0.2)	0.8 (0.4)	0.26	0.7 (0.1)	0.7 (0.1)	0.7 (0.2)	0.8 (0.3)	0.07
Vitamin C (mg/day)	79 (43)	63 (29)	83 (41)	134 (93)	<0.01	76 (28)	67 (44)	77 (45)	136 (100)	<0.01
Vitamin E (mg/day)	12 (4)	11 (3)	13 (3)	19 (6)	<0.01	11 (3)	11 (4)	14 (6)	19 (10)	<0.01
Calcium (mg/day)	622 (109)	561 (102)	570 (180)	689 (302)	0.16	572 (103)	574 (137)	560 (147)	603 (235)	0.40
Iron (mg/day)	43 (19)	35 (11)	33 (10)	37 (10)	0.07	45 (39)	37 (23)	37 (14)	34 (17)	0.03
Zinc (mg/day)	22 (6)	20 (5)	16 (5)	17 (5)	<0.01	21 (8)	21 (9)	20 (9)	17 (9)	0.01
Staple pattern										
Energy (kJ/day)	1615 (487)	1889 (489)	2244 (530)	3375 (1124)	<0.01	1848 (903)	1987 (678)	2261 (741)	3161 (1715)	<0.01
Protein (g/day)	70 (12)	66 (8)	65 (11)	58 (13)	<0.01	71 (19)	64 (8)	60 (8)	56 (14)	<0.01
Fat (g/day)	63 (15)	63 (14)	64 (13)	58 (26)	0.28	61 (16)	59 (17)	60 (17)	55 (29)	0.17
Carbohydrate (g/day)	360 (100)	356 (76)	365 (75)	474 (86)	<0.01	405 (158)	370 (109)	389 (351)	392 (199)	0.86
Vitamin A (μg/day)[‡]	570 (657)	553 (688)	395 (374)	379 (553)	0.09	749 (952)	532 (870)	371 (459)	320 (399)	<0.01
Vitamin B-1 (mg/day)	0.7 (0.2)	0.8 (0.3)	1.0 (0.4)	1.5 (0.7)	<0.01	0.8 (0.4)	0.8 (0.4)	0.9 (0.4)	1.5 (1.4)	<0.01
Vitamin B-2 (mg/day)	0.8 (0.2)	0.7 (0.2)	0.8 (0.3)	0.6 (0.2)	0.09	0.7 (0.2)	0.7 (0.2	0.7 (0.2)	0.7 (0.3)	0.81
Vitamin C (mg/day)	96 (41)	90 (71)	102 (69)	70 (62)	0.16	103 (77)	90 (63)	81 (48)	80 (73)	0.04
Vitamin E (mg/day)	15 (6)	14 (6)	13 (5)	13 (4)	0.10	14 (6)	14 (8)	14 (6)	13 (8)	0.31
Calcium (mg/day)	659 (147)	601 (109)	651 (260)	530 (210)	0.02	599 (134)	575 (131)	548 (156)	588 (238)	0.51
Iron (mg/day)	34 (15)	34 (10)	37 (11)	45 (14)	<0.01	40 (23)	36 (12)	37 (37	39 (23)	0.95
Zinc (mg/day)	19 (4)	19 (4)	20 (7)	17 (7)	0.31	19 (7)	20 (6)	21 (10)	20 (11)	0.43

[†]Nutrients were adjusted by energy intake.
[‡]Retinol equivalent.

sible confounding factors.

Although there were some limitations, this study is the first to explore the dietary patterns in rural pregnant lactating mothers in Tibet. Dietary patterns were related to socioeconomic factors and nutrient intake in rural Tibetan women. Furthermore, a varied pattern was related to high intake of vegetables, fruits, and soy products and was significantly associated with macronutrients and micronutrients. Additionally, the micronutrient distribution varied within each dietary pattern.

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AUTHOR DISCLOSURES

The authors declare that they have no competing interests.

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