Short Communication

Validity and reproducibility of a food frequency questionnaire designed for residents in north China

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The objective of this study was to evaluate the validity of a Xi'an food frequency questionnaire (FFQ) designed for application in an international case-control colorectal cancer study. The FFQ was administered to 125 participants twice over 1-year interval. Four 24-hour dietary recalls (24-HDRs) were conducted with the same participants in each season of the year. Comparative validation was assessed by comparing the nutrient intakes derived from the 24-HDRs and the FFQ-2, and reproducibility was estimated by comparing the nutrient intakes from two FFQs. In the validation study, the mean deattenuated correlation coefficients for nutrients between the 24-HDRs and the FFQ-2 ranged from 0.35 to 0.84 in the males. The female results were slightly lower than the male's. The mean percentage of classification into the same quartile was 38% for the males and 35% for the females. In the reproducibility study, the mean crude correlation coefficients between the two FFQs were from 0.41 to 0.68 in the males and from 0.36 to 0.66 in the females. The newly developed Xi'an FFQ appears to be reasonably valid and reliable for most nutrients but would benefit from the addition of nutritional supplements and seasonings for assessing dietary intake in older persons in Xi'an, China.

Key Words: food frequency questionnaire, dietary assessment, reproducibility, 24-hour recalls

INTRODUCTION

An international collaborative case-control study, the Sino-US Genome Epidemiologic Study, has been planned since June 2006 both in China and the US. The main objectives of this study were to investigate and compare the role of novel nutritional and genetic factors and their interactions in the etiology of colorectal cancer among Chinese in Xi'an, China, Chinese-Americans in the Greater San Francisco Bay Area, California, and residents in the Greater Dayton Area, Ohio, populations chosen because of their different incidence and exposure rates. By March 2008, this study had planned to recruit around 2000 cases of incident colorectal cancer, aged 30-79 years, and equal number of age-, sex- and geographic-frequency matched controls randomly selected from the general populations in the three study centers.

In order to implement the dietary assessment of colorectal cancer patients and others who are living in Xi'an and participating in this international case-control study, a semi-quantities food frequency questionnaire (FFQ) was modified from the Shanghai FFQ.[1] This paper reports the results on relative validity and reproducibility of measurement of nutrient intake about this revised FFQ that used in Xi'an.

MATERIALS AND METHODS

Subjects and study design

The present study was performed from August 2004 to July 2005 in two districts of Xi'an City, Shaanxi province, China. Three hundreds and seven individuals (152 males and 155 females), aged 50-79 years old, were randomly selected from the Municipal Resident Registry Office. Participants had to be free of diseases influencing food consumption, such as cardiovascular disease. Finally, 150 (48.9%) eligible subjects were enrolled for the first FFQ in this study, with 31(10.1%) ineligible due to medical conditions and 126 (41.0%) unwilling to participate, and 125 participants completed all the surveys. The participants were asked to complete four 24-hour dietary recalls scheduled 3 months apart from September 2004 to June 2005 and two dietary FFQs, in August 2004 (FFQ-1) and July 2005 (FFQ-2) respectively. A face-to-face interview was conducted by trained researchers either at the participants' homes or at community health centers. We have the quality control measures in the entire study in an effort to guarantee that all participants meet the inclusion and exclusion criteria, and ensure researchers to reasonable remove the outlier participants from the data analysis.

Dietary assessment methods

The food frequency questionnaire

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The semi-quantitative FFQ was adapted from the Shanghai FFQ, which was developed for a population-based case-control cancer study conducted during 1990-1993 in Shanghai, China.[1] The Shanghai FFQ is specifically designed for Shanghai residents living in the southeast, whereas our FFQ was tailored to reflect dietary habits of Xi'an located in the northwest. The dietary habits between southeast and northwest China are very different, e.g., rice as the staple food in southeast but flour in northwest. Therefore, we removed some food items from the Shanghai FFQ and added some local foods to the new FFQ.

The updated food list was based on knowledge of the regional food supply, new products in the market, and the Shanghai FFQ with 81 food items. The food list was sent out to 100 older individuals in the study area and they were asked to choose food items used more then or at least once every three months. Considering that more and more people use nutritional supplements nowadays and nearly every dish contains cooking oil and seasonings in Xi'an, we added them in the Xi'an FFQ. And then, we calculated the food items that were used reasonably often by an appreciable number of individuals. The final instrument included 121 items, grouped into eleven categories: meats, seafood, eggs, and milk products; beans and bean products; staple foods; sweet foods; vegetables; fruits; nuts and seeds; non-alcoholic beverages; preserved or pickled foods; vitamins or mineral supplements; and seasonings.

Six nutrition professors, dietitians and nurses, who were familiar with the dietary patterns of the target population, confirmed face and content validity of the final food list and reviewed the drafts of the questionnaires. Early versions of the questionnaire was tested for ease of administration and comprehension in 50 older individuals, and revised.

The new FFQ requires each participant to answer the food intake frequency and the quantity of each food item representing by a Chinese food weight unit *liang* (equivalent to 50 grams) for most investigated food items. Food intake frequency was ranked in nine categories ranging from "never or less than once per month" to "two or more times per day". Beverage consumption was categorized in the similar way as food, but maximal frequency was "four or more times per day." In addition, there were sections with questions on vitamin and mineral supplement use. If the participants had taken any of them at least once a week, the frequency and dose of supplementation (mg or IU's per day, per week) was questioned. The quantity of seasoning items was asked for using monthly or yearly per family, e.g., vinegar, pepper sauce, soy sauce.

The 24-hour dietary recall

The present study used a 24-HDR developed by the US Department of Agriculture as the reference method.[2] All four 24-HDRs were obtained from unannounced in-person interviews conducted in the evening, after dinner (around 19:00). During the interview, participants were asked to recall and describe all the foods they ate for breakfast, lunch, and dinner, and any other foods consumed between regular meals in the preceding 24 hours, including seasonings, vitamin and mineral supplements. A food-size booklet containing measuring guides for commonly used kitchen utensils (bowls, plates, cups, spoons, and wine glasses) of different portion sizes of foods were provided to participants for estimation of the portion sizes. Standard measuring spoons were used in assessing portion sizes of seasonings for every dish.

Statistical methods

We calculated daily nutrient intakes for the individual nutrient using China Food Composition 2004 produced by Chinese Center for Disease Control (CCDC).[3] The intake of nutrients from seasonings was computed by dividing the total amount of seasonings by number of persons living together in the participant' family and 30 or 365 days. Nutrients analyzed in the present study included: protein, carbohydrates, fats, minerals, and vitamins. We considered all the nutrient intakes as the continuous variables. Outliers were defined as energy intake less than 1,000 kcal/day or great than 5,000 kcal/day,[4] therefore we have 120 participants left in the analysis. We

Table 1. Dietary intake of nutrients (Median±SD) from FFQ-1, FFQ-2 and the average of four 24-HDRs in male and female

Nutrients	FFQ -1†		FFQ-2†		24-HDR‡	
	Males	Females	Males	Females	Males	Females
Energy (kcal)	2743 ± 940	2522 ± 779	2297 ± 689	2087 ± 728	2333 ± 696	1824 ± 456
Protein (g)	106 ± 37	92 ± 35	85 ± 27	68 ± 27	94 ± 42	68 ± 28
Fat (g)	100 ± 36	106 ± 39	96 ± 28	81 ± 39	82 ± 27	73 ± 22
Carbohydrate (g)	438 ± 156	362 ± 113	323 ± 120	288 ± 100	331 ± 120	273 ± 73
Dietary fiber (g)	44 ± 17	41 ± 15	30 ± 12	29 ± 12	35 ± 33	25 ± 11
Carotene (mg)	3.6 ± 1.8	4.0 ± 2.1	2.2 ± 1.2	2.1 ± 1.8	2.0 ± 1.7	1.7 ± 1.3
Thiamin (mg)	1.0 ± 0.4	0.9 ± 0.3	0.8 ± 0.3	0.6 ± 0.3	0.9 ± 0.4	0.8 ± 0.3
Riboflavin (mg)	1.0 ± 0.4	0.9 ± 0.7	0.8 ± 0.4	0.7 ± 0.9	0.8 ± 0.4	0.6 ± 0.4
Niacin (mg)	10.3 ± 4.4	9.1 ± 4.4	9.0 ± 3.6	6.5 ± 3.4	8.6 ± 3.5	7.6 ± 2.3
Vitamin A (RE)	785 ± 541	877 ± 730	533 ± 455	549 ± 711	587 ± 2717	489 ± 1058
Vitamin C (mg)	130 ± 87	149 ± 102	96 ± 160	112 ± 145	93 ± 85	73 ± 104
Vitamin E (mg)	42 ± 85	52 ± 196	41 ± 71	43 ± 47	26 ± 55	19 ± 46

† food frequency questionnaire
‡ 24-hour dietary recall

calculated the medians and standard deviations of the nutrients from the FFQs and the 24-HDRs questionnaires. Pearson correlation analysis was used to examine the correlation between the 24-HDRs, FFQ-1and FFQ-2. Because within-person variation in four 24-HDRs may attenuate the correlation coefficient between FFQ and the 24-HDRs, we used a formula ($Pc = Po \{[(\sigma_w^2 / \sigma_b^2)/n] +1\}^{1/2}$) to deattenuate the correlation coefficient.[5] A residual method was used for energy adjustment analysis.[6] To assess the agreement between the 24-HDRs, FFQ-1 and FFQ-2, the nutrient intakes were classified into quartiles and the percentages of agreement, adjacent agreement and complete disagreement were calculated.

In the present study, Statistical Analysis Software (SAS) version 9.1 was used for statistical analysis. *p* value less than 0.05 (two tailed) was considered as a statistically significant difference.

RESULTS

The mean age of the 120 participants was 65 years old (SD 7.9, range 50–80). There were also no significant differences between participants with (n=125) or without (n=25) complete dietary data with regard to age (61 v 61 years), sex (62% v 66% female;38% v 48% male), race (100% v 93.6% Han), or education (64.0% v 68.0% with no or incomplete Junior High School education).

Table 1 presents the absolute median values for nutrient intake with standard deviations (SDs) for FFQ-1, FFQ-2 and the average of the four 24-HDRs. All the nutrient intakes assessed by FFQ-2 were lower than those assessed by FFQ-1. The mean correlation coefficients with seasonings and supplements and without seasonings and supplements between the 24-HDRs and the FFQ-2 were described in Table 2. The deattenuated Pearson correlation coefficients between the 24-HDRs and the FFQ-2 ranged from 0.35 (total fiber) to 0.84 (energy) in the males and from 0.24 (thiamine) to 0.62 (riboflavin) in the females. The mean crude Pearson correlation coefficients between the two FFQs was 0.53 which varied from 0.41 (vitamin C) to 0.68 (nicotinic acid) in the males and was 0.54 for females and ranged between 0.36 (fiber) and 0.66 (fat). After adjusted for energy intake, most of the correlation coefficients were attenuated. The subjects were classified into quartiles by nutrient intake as estimated by the FFQs and the 24-HDRs (Table3). The proportion of the male subjects that were classified into the same and the adjacent quartiles by both the 24-HDRs and the FFQ-2 ranged from 68% (fat) to 90% (vitamin A or thiamin), with an average of 79%. On the average, approximately 72%, ranging between 56% (vitamin E) and 81% (niacin), of the female subjects fell into the same or adjacent quartiles. For FFQ-1 and FFQ-2, the mean agreement percentage between them was 36% for male subjects and ranged between 28% (vitamin A and carbohydrate) and 49% (fat), similarly, the mean agreement percentage was 36% for female subjects and ranged from 26% for fiber to 48% for vitamin E.

DISCUSSION

The results of our study suggest that the new FFQ is reasonably comprehensive, reproducible and can capture the major nutrient intake relatively accurate among middle-

Table 2. Pearson's correlation between the average of four 24-HDRs, FFQ-1 and FFQ-2 in male and female

Nutrients	FFQ-2† vs. 24-HDRs‡						FFQ-1† vs. FFQ-2†			
	Crude correlation§		Crude correlation ¶		Deattentuated correlation††		Crude correlation		Energy adjusted correlation	
	M	F	M	F	M	F	M	F	M	F
Energy (kcal)	0.69***	0.34**	0.71***	0.35**	0.84	0.41	0.56***	0.59***	-	-
Protein (g)	0.45**	0.26	0.52***	0.29*	0.65	0.35	0.65***	0.59***	0.33	0.36
Fat (g)	0.44**	0.31**	0.50***	0.36**	0.60	0.42	0.52***	0.66***	0.49	0.44
Carbohydrate (g)	0.49***	0.38***	0.56***	0.45***	0.67	0.54	0.54***	0.45***	0.50	0.33
Dietary fiber (g)	0.25	0.30**	0.26	0.31**	0.35	0.39	0.55**	0.36**	0.48	0.18
Carotene (mg)	0.40**	0.27*	0.45**	0.31**	0.60	0.36	0.48***	0.45***	0.41	0.40
Thiamin (mg)	0.42**	0.20	0.46**	0.20	0.53	0.24	0.61***	0.60***	0.38	0.36
Riboflavin (mg)	0.36**	0.40***	0.41**	0.50***	0.52	0.62	0.44***	0.55***	0.26	0.40
Niacin (mg)	0.52***	0.32**	0.65***	0.38***	0.74	0.48	0.68***	0.60***	0.40	0.40
Vitamin A (RE)	0.28*	0.30**	0.31*	0.35**	0.37	0.46	0.44**	0.43***	0.43	0.34
Vitamin C (mg)	0.42**	0.38***	0.49***	0.45***	0.58	0.48	0.41**	0.54***	0.43	0.40
Vitamin E (mg)	0.49***	0.26*	0.60***	0.31**	0.66	0.36	0.46**	0.63***	0.46	0.51
Mean (SD)	0.43 (0.14)	0.31 (0.06)	0.49 (0.13)	0.36 (0.08)	0.59 (0.14)	0.43 (0.10)	0.53 (0.09)	0.54 (0.09)	0.42 (0.07)	0.37 (0.08)

† food frequency questionnaire
‡ 24-hour dietary recall
§ Crude correlation coefficients without seasonings and nutritional supplements
¶ Crude correlation coefficients with seasonings and nutritional supplements
†† Corrected for within-person variation with seasonings and nutritional supplements

Table 3. The agreement of nutrient intakes between FFQ-1, FFQ-2 and the average of four 24-HDR in male and female

Nutrients	FFQ-2† vs. 24-HDR‡						FFQ-1† vs. FFQ-2†					
	Same quartile		Adjacent quartile		Distant quartile		Same quartile		Adjacent quartile		Distant quartile	
	M	F	M	F	M	F	M	F	M	F	M	F
Energy (kcal)	45	38	45	38	0	10	43	36	36	44	6	4
Protein (g)	30	37	55	27	2	5	36	37	47	41	2	1
Fat (g)	34	33	34	40	6	8	49	44	32	41	2	5
Carbohydrate	38	37	45	41	2	5	28	27	40	47	6	3
Dietary fiber (g)	38	27	40	48	6	7	34	26	34	40	2	8
Carotene (mg)	34	27	47	34	6	8	36	30	28	40	9	8
Thiamin (mg)	34	36	34	33	6	16	40	29	40	45	2	3
Riboflavin (mg)	43	44	43	36	4	4	34	36	38	42	2	3
Niacin (mg)	45	34	38	47	2	5	38	38	47	38	2	1
Vitamin A (RE)	34	41	34	38	6	7	28	37	47	40	4	7
Vitamin C (mg)	43	38	34	38	11	10	34	38	36	47	9	3
Vitamin E (mg)	32	30	45	26	4	15	36	48	47	29	4	4
Mean	38	35	41	37	5	8	36	36	39	41	4	4
Agreement and Adjacent by sex	Male = 38 + 41 = 79 Female = 35 + 37 =72						Male = 36 + 39 = 75 Female = 36 + 41 =77					

† food-frequency questionnaire
‡ 24-hour dietary recall

aged and elderly persons in Xi'an. In addition, we think that the sample size in both the validation and the reproducibility studies were reasonable[4] and the follow-up rate (85%) in this study is relatively high considering the assessment at one year.

The absolute nutrient intakes estimated by the two FFQs and the 24-HDRs in this study were acceptable according to Chinese Recommended Dietary Allowances (RDAs)[7] and these results are consistent with previous observations.[8,9] In our reproducibility study, adjustment for energy intake roughly down-regulated the correlation coefficients suggesting that variation in these nutrients was associated with the energy variation, this effect was also observed in other studies.[10,11] Regardless of the adjustment for energy intake, our crude correlation coefficients for 1-year reproducibility ranged from 0.36 to 0.68 and are comparable to other reproducibility studies.[12-14]

In our validation study, the crude correlations were generally lower than the deattenuated correlations but higher than the energy-adjustment correlations. After deattenuation, our correlation coefficients ranged from 0.35 to 0.84, which are consistent with the previous studies. [7,15] Dietary fiber was the only nutrient that the correlation coefficients in both male (0.35) and female (0.39) were less than 0.4, which may lead to the attenuation of the risk estimation between nutritional intake and chronic disease risk in an epidemiological study.[16] The lower correlations for fiber may reflect difficulty in subjects estimating fiber intake using the FFQ or other reference methods, and, also, lower correlations for fiber may be due to a high within-person variation of fiber intake.[17] Since agreement assessment method demonstrates more advantages than the correlation method when we assess the instruments' capacity for ranking the subjects by their nutrient intake,[18] we estimated the agreement in quartile between the 24-HDR and the FFQ-2. The degree of agreement in the same quartile between these two methods in our study are consistent with the previous studies suggesting that usually the classification into the same quartile by two different methods ranges from 30% to 40%.[19,20] In addition, correlation coefficients for dietary fiber were smaller than most of the other nutrients, but clearly the joint classification displayed a better result.

The assessment of dietary intake in China is difficult because residents tend to mix multiple elements in one food or dish, which makes the accurate dietary estimation almost impossible. The few poor correlations (e.g., fiber) we found between instruments may be at least partly due to this reason. Some validation studies involving multiple nutrients were performed in Southern China.[21-24] Among these studies, some used 24-HDR as a reference method: one study in females showing similar correlations as our female study results;[22] another study administrated in miners reporting a slightly lower and wider range of correlation coefficients (-0.40-0.72) compared to our male study.[21] However, our study is different from these previous studies in that we included seasonings and nutritional supplements in the total nutrients calculation. The addition of nutritional supplements may provide a chance to improve the assessment of some nutrients, such as fat, vitamins A and C, which are verified to be correlated with some chronic diseases, including colorectal cancer. This view is supported by Messerer's study that when dietary supplements was included, correlation coefficients increased 13% between micronutrient estimates of FFQ and 24-HDRs, corresponding value for correct classification into highest quintiles was increased by 14%.[25] Additionally, seasonings were added to the Xi'an FFQ, since omitting these in FFQ might affect the absolute values and correlations between FFQ and other open questionnaires.[26] As a result, the addition of seasonings and nutritional supplements in the present validation study im-

proved the correlations coefficients, the mean crude correlation coefficient increased 14% in male and 16% in female between estimates of FFQ and 24-HDRs.

Whether FFQ results are accurate enough to study diet and disease is a hot topic in epidemiological studies recently.[27] FFQ, like most other self-report dietary assessment methods may be biased by several factors, such as the omitting of a food item in the FFQ that is commonly eaten by a subject, or the misinterpretation of food items listed in the FFQ.[4] The actual source of the measurement properties, such as the measurement or subject bias in our FFQ is not yet known. However, for many cancers, including colorectal cancer, the effect of diet is hypothesized to occur many years before diagnosis; thus the ability to recall diet in the remote past is of considerable interest. Food frequency questionnaires can be used to focus questions on a remote period of time ideally.[4] Additionally, the correlation values in the present study were more than 0.4 with 0.59 in males and 0.43 in females respectively, therefore the effect of error will be relatively small.[16]

In conclusion, this FFQ is relatively reliable and reproducible with reference to the nutrient intakes. Using this Xi'an FFQ, we are able to rank subjects into categories according to their nutrient intakes. This FFQ is very useful to examine the association between dietary factors and health problems in Xi'an residents and, ideally, this tool could be validated and applied in other Northern Chinese populations.

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AUTHOR DISCLOSURES

All authors declare that there isn't any conflict of interest in this manuscript

REFERENCES

1. Shu XO, Zheng W, Potischman N, Brinton LA, Hatch MC, Gao YT, Fraumeni JF. A population-based case-control study of dietary factors and endometrial cancer in Shanghai, People's Republic of China. Am J Epidemiol. 1993;137: 155-65.
2. Burk MC, Pao EM. Methodology for Large-Scale Surveys of Household and Individual Diets. Home Economics Research Report No. 40. Washington, DC: Agricultural Research Service, U.S. Department of Agriculture; 1976.
3. Yang YX, Wang GY, Pan XC. China Food Composition (2). Peking: Peking University Medical Press; 2004.
4. Willett W, Lenart E. Reproducibility and validity of food frequency questionnaire. In: Willett W, editors. Nutritional Epidemiology. New York: Oxford University Press; 1998.
5. Rosner B, Willett WC. Interval estimates for correlation coefficients corrected for within-person variation: implications for study design and hypothesis testing. Am J Epidemiol. 1988;127:377-86.
6. Willett W, Stampfer MJ. Total energy intake: implications for epidemiologic analyses. Am J Epidemiol. 1986;124: 17-27.
7. Block G, Hartman AM. Issues in reproducibility and validity of dietary studies. Am J Clin Nutr. 1989;50:1133-8; discussion 1231-5.
8. Rodriguez MM, Mendez H, Torun B, Schroeder D, Stein AD. Validation of a semi-quantitative food-frequency questionnaire for use among adults in Guatemala. Public Health Nutr. 2002;5:691-9.
9. Ogawa K, Tsubono Y, Nishino Y, Watanabe Y, Ohkubo T, Watanabe T et al. Validation of a food-frequency questionnaire for cohort studies in rural Japan. Public Health Nutr. 2003;6:147-57.
10. Jackson M, Walker S, Cade J, Forrester T, Cruickshank JK, Wilks R. Reproducibility and validity of a quantitative food-frequency questionnaire among Jamaicans of African origin. Public Health Nutr. 2001;4:971-80.
11. Plummer M, Kaaks R. Commentary: An OPEN assessment of dietary measurement errors. Int J Epidemiol. 2003;32: 1062-3.
12. Johansson I, Hallmans G, Wikman A, Biessy C, Riboli E, Kaaks R. Validation and calibration of food-frequency questionnaire measurements in the Northern Sweden Health and Disease cohort. Public Health Nutr. 2002;5: 487-96.
13. Linda EK, Sonia SA, Vladimir V. Development and evaluation of cultural food frequency questionnaires for South Asians, Chinese, and Europeans in North America. Perspectives in Practice. 2003;103:1178-84.
14. Sasaki S, Ishihara J, Tsugane S. Reproducibility of a self-administered food frequency questionnaire used in the 5-year follow-up survey of the JPHC Study Cohort I to assess food and nutrient intake. J Epidemiol. 2003;13: S115–S124.
15. Rohrmann S, Klein G. Validation of a short questionnaire to qualitatively assess the intake of total fat, saturated, monounsaturated, polyunsaturated fatty acids, and cholesterol. J Hum Nutr Diet. 2003;16:111-7.
16. Day N, McKeown N, Wong M, Welch A, Bingham S. Epidemiological assessment of diet: a comparison of a 7-day diary with a food frequency questionnaire using urinary markers of nitrogen, potassium and sodium. Int J Epidemiol. 2001;30:309-17.
17. Nelson M, Black AE, Morris JA, Cole TJ. Between- and within-subject variation in nutrient intake from infancy to old age: estimating the number of days required to rank dietary intakes with desired precision. Am J Clin Nutr. 1989;50:155-67.
18. Garrow JS. Validation of methods for estimating habitual diet: proposed guidelines. Eur J Clin Nutr. 1995;49:231-2.
19. Andersen LF, Solvoll K, Johansson LR, Salminen I, Aro A, Drevon CA. Evaluation of a food frequency questionnaire with weighed records, fatty acids, and alpha-tocopherol in adipose tissue and serum. Am J Epidemiol. 1999;150:75-87.
20. Ahn Y, Kwon E, Shim JE, Park MK, Joo Y, Kimm K, Park C, Kim DH. Validation and reproducibility of food frequency questionnaire for Korean genome epidemiologic study. Eur J Clin Nutr. 2007;61:1435-41.
21. Forman MR, Zhang J, Nebeling L, Yao SX, Slesinski MJ, Qiao YL et al. Relative validity of a food frequency questionnaire among tin miners in China: 1992/93 and 1995/96 diet validation studies. Public Health Nutr. 1999;2:301-15.
22. Shu XO, Yang G, Jin F, Liu D, Kushi L, Wen W, Gao YT, Zheng W. Validity and reproducibility of the food frequency questionnaire used in the Shanghai Women's Health Study. Eur J Clin Nutr. 2004;58:17-23.
23. Xu L, M JD, D'Este C. Reliability and validity of a food-frequency questionnaire for Chinese postmenopausal women. Public Health Nutr. 2004;7:91-8.
24. Li YP, He YN, Zhai FY, Yang XG, Hu XQ, Zhao WH, Ma GS. Comparison of assessment of food intakes by using 3

dietary survey methods. Zhonghua Yu Fang Yi Xue Za Zhi. 2006;40:273-80.
25. Messerer M, Johansson SE, Wolk A. The validity of questionnaire-based micronutrient intake estimates is increased by including dietary supplement use in Swedish men. J Nutr. 2004;134:1800-5.
26. Ahn Y, Kwon E, Shim JE, Park MK, Joo Y, Kimm K, Park C, Kim DH. Validation and reproducibility of food frequency questionnaire for Korean genome epidemiologic study. Eur J Clin Nutr. 2007;61:1435-41.
27. Bingham SA, Luben R, Welch A, Wareham N, Khaw KT, Day N. Are imprecise methods obscuring a relation between fat and breast cancer? Lancet. 2003;362(9379):212-4.

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中国北方居民食物频率问卷的信度和效度研究

本研究目的为评价西安食物频率调查问卷（Xi'an FFQ）的信度与效度，该问卷是为一项国际直结肠癌的病例对照研究设计的。 在本研究调查的一年当中，年初和年末各用 FFQ 调查一次西安老年族群的膳食水平，最终参与者为 125 位；同时，在此一年中每三个月用 24 小时膳食回顾问卷（24-HDRs）进行一次 24 小时膳食调查。通过对比 24-HDRs 与第二次 FFQ 测得的营养素结果获得该问卷的相对效度；对比两次的 FFQ 测得的营养素结果获得该问卷的信度。在效度研究中，男性营养素的去衰减相关系数的均数介于 0.35-0.84 之间，女性结果稍低于男性；两者歸在同一四分位数上所占的百分比，男性均数为 38%，女性为 35%。在信度研究中，男性原始相关系数的均数介于 0.41-0.68 之间，女性介于 0.36-0.66 之间。该西安食物频率问卷对于大多数营养素而言具有合理的信度和效度，其中加入营养補充剂及调味品的資料，对提高信度和效度有益。

關鍵字：食物频率问卷、膳食调查、信度、24 小时膳食回顾