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Association between dietary patterns and blood lipid profiles among Chinese women

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Abstract
Objective: The present study aimed to identify dietary patterns and explore their associations with blood lipid profiles among Chinese women.
Design: In a cross-sectional study, we identified dietary patterns using principal component analysis of data from three consecutive 24 h dietary recalls. The China Health and Nutrition Survey (CHNS) collected blood samples in the morning after an overnight fast and measured total cholesterol (TC), HDL cholesterol (HDL-C), LDL cholesterol (LDL-C) and TAG.
Setting: Data were from the 2009 wave of the CHNS.
Subjects: We studied 2468 women aged 18–80 years from the CHNS.
Results: We identified three dietary patterns: traditional southern (high intakes of rice, pork and vegetables), snack (high intakes of fruits, eggs and cakes) and Western (high intakes of poultry, fast foods and milk). The traditional southern pattern was inversely associated with HDL-C ($\beta = -0{\cdot}68$; 95 % CI −1·22, −0·14; $P < 0{\cdot}05$). The snack pattern was significantly associated with higher TAG ($\beta = 4{\cdot}14$; 95 % CI 0·44, 7·84; $P < 0{\cdot}05$). The Western pattern was positively associated with TC ($\beta = 2{\cdot}52$; 95 % CI 1·03, 4·02; $P < 0{\cdot}01$) and LDL-C ($\beta = 2{\cdot}26$; 95 % CI 0·86, 3·66; $P < 0{\cdot}01$).
Conclusions: We identified three dietary patterns that are significantly associated with blood lipid profiles. This information is important for developing interventions and policies addressing dyslipidaemia prevention among Chinese women.

Keywords
Dietary patterns
Principal component analysis
Lipid profiles
Women
China

With rapid economic growth and associated lifestyle changes in China, the prevalence of dyslipidaemia has increased dramatically and CVD have emerged as a leading cause of death in Chinese adults[1–3]. A report on the status of nutrition and chronic diseases in China states that the national prevalence of dyslipidaemia in 2012 was 33·5 % among women aged 18 years or older. Dyslipidaemia is an important modifiable risk factor for the development of CVD[4,5]. Effective management of dyslipidaemia is known to reduce the rate of CVD morbidity and mortality[6,7].

As dietary intake is a complex exposure variable, examining and assessing the total diet requires distinct approaches. Traditional dietary analyses have had limitations, because they have focused on the relationship between individual nutrients or foods and diseases[8]. Therefore dietary pattern analysis has emerged as an alternative, holistic approach[9]. Dietary patterns can summarize complex dietary data to render the information more practical and meaningful than data on individual foods or nutrients for investigating diet–disease relationships, given that patterns consider total dietary intake and the collinearity between many foods and nutrients as well as the potentially synergistic effects of foods and nutrients[8–11].

Some approaches have been proposed to determine dietary patterns, such as principal component analysis (PCA), cluster analysis and reduced rank regression[10]. The strength of one approach is the limitation of another. PCA, the most commonly used approach, utilizes correlations that exist between different food groups to identify linear combinations of foods that are frequently consumed together. Moreover, PCA describes the actual dietary patterns of the population, so PCA patterns have public health relevance[12]. Cluster analysis groups the individuals into hierarchical clusters according to the level of dissimilarity between the components of the diets of the individuals[13]. Reduced rank regression is similar to

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PCA but requires existing evidence about factors associated with the disease in combination with exploratory statistics to extract dietary patterns that are likely to be related to a specific disease[14].

Several studies among Western populations have shown the association of dietary patterns and blood lipid profiles, although the results are not consistent[15–18]. Also associations between dietary patterns extracted by factor analysis and biological cardiovascular risk factors, such as serum lipids, have seldom been investigated in Asian populations, especially among women. Moreover, these findings have limited applicability to Chinese women because of culturally specific dietary patterns.

China has experienced a rapid nutrition transition during the last few decades[19]. The increased intake of vegetable oils and animal-source foods has been rapid and appears to be continuing, and coarse grains, legumes, vegetables and other healthful foods have declined in importance and intake levels[20]. The change in dietary habits may impact the blood lipid profiles of Chinese adults. The present study identified the prevailing dietary patterns and examined their associations with blood lipid profiles among Chinese women.

Methods

Study population

We used data collected by the China Health and Nutrition Survey (CHNS), which was designed to examine how the social and economic transformation in China affects the health and nutritional status of the Chinese population[21,22]. The CHNS used a multistage, random-cluster process to draw the sample in nine provinces that vary in demography, geography, economic development and public resources. We used data from the surveys conducted in 2009. Our analysis included 2468 women aged 18–80 years with complete demographic, biomarker and dietary data. All women gave written informed consent for their participation in the survey. The study was approved by the institutional review boards of the University of North Carolina at Chapel Hill and the National Institute for Nutrition and Health, Chinese Center for Disease Control and Prevention.

Measures

Each wave of the CHNS assessed dietary intake using three consecutive 24 h dietary recalls (two weekdays and one weekend day). Interviewers were trained to use standard forms to administer the dietary recalls in household interviews. The participants were asked to report the kinds and amounts of food and beverage items (measured in grams) that they ate both at home and away from home during a 24 h period[23]. We used the average intake of the three recalls for each individual.

The CHNS collected blood samples in the morning after an overnight fast. A national laboratory in Beijing analysed all samples with strict quality control and measured total cholesterol (TC; mg/dl), HDL cholesterol (HDL-C; mg/dl), LDL cholesterol (LDL-C; mg/dl) and TAG (mg/dl). Laboratory analysis methods for the lipid profiles are described in detail elsewhere[24].

A general information questionnaire collected each participant's age, education, living area, cigarette smoking habits, alcohol intake, physical activity and annual household income. Well-trained health workers measured height, weight and waist circumference following a reference protocol recommended by the WHO[25]. BMI was calculated as weight divided by the square of height (kg/m^2).

Statistical analysis

We used PCA to derive food patterns (Table 1) based on the nineteen foods or food groups of the China food composition data (as detailed in the online supplementary material, Supplemental Table 1) and used mean intakes (g/d) as input values in the analysis. We conducted the analysis using the factor procedure in the statistical software package SAS version 9.2. We rotated the factors with an orthogonal transformation (varian rotation function in SAS) to achieve a more simplistic structure with greater interpretability. In considering the number of factors to retain, we evaluated eigenvalues (>1), scree plots and interpretability of the factors to determine which set of factors could most meaningfully describe distinct food patterns. From these analyses we selected the three-factor solution. We retained items in a factor if they had an absolute correlation ≥0·25 with that factor. We calculated factor loadings for each food group across the three factors and a factor score for each participant in each of the three factors, in which intakes of the nineteen food groups were weighted by their factor loadings and summed. We categorized quartiles across the score of each dietary pattern based on the distribution in the whole population and compared the following nutrient intakes according to the quartiles of dietary patterns: total energy intake; percentage of energy from carbohydrate, protein and fat; and intakes of fibre, vitamin C, vitamin A, Ca and Fe. Nutrient intake is highly correlated to energy intake, so ANCOVA was performed to calculate energy-adjusted nutrient intakes.

We used multivariate linear regression analysis to evaluate the effect of dietary pattern scores on blood lipid profiles by adjusting for the potential risk factors of age (18–44, 45–59, 60–80 years), education (low, medium, high), living area (urban/rural), smoking status (yes/no), drinking status (yes/no), physical activity (continuous), annual household income (continuous), BMI (continuous) and total energy intake (continuous). We used SAS version 9.2 to perform all statistical analyses and $P<0·05$ was considered statistically significant.

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Results

Dietary patterns

PCA revealed three dietary patterns: traditional southern, snack and Western. Table 1 shows the factor loadings of each pattern after orthogonal rotation. These three factors explained 26·2 % of the variance in total food intake. The traditional southern pattern (component 1), characterized by high intakes of rice, pork, vegetables and aquatic products and low consumption of wheat and other cereals, represents a typical traditional diet in southern China. The snack pattern (component 2) was highly correlated with intakes of fruits, eggs, cakes and tubers. The third component, the Western pattern, was characterized by high intakes of poultry, fast foods, milk, organ meats and soft drinks.

Association of dietary patterns with sociodemographic characteristics, lifestyle and health-related factors

Table 2 presents the characteristics of Chinese women across quartile categories of the dietary pattern scores. Women with high scores for the Western pattern were younger. Women with high scores for the snack pattern and the Western pattern were more likely to live in urban areas, to be current drinkers and to have better education. Women with high scores for the snack pattern were more likely to be current smokers. For the health-related factors, women in the top quartile of the snack pattern had higher BMI and waist circumference than those in the lowest quartile. In contrast, women in the top quartile of the traditional southern and the Western patterns had lower BMI and waist circumference. In addition, women in the top quartile of the Western pattern had higher LDL-C level and lower TAG level than those in the lowest quartile.

Association of dietary patterns with nutrient intakes

Women with higher scores for the traditional southern pattern had higher total energy intake; higher percentages of energy from protein and fat; and higher intakes of vitamin C (mg/d), vitamin A (μg retinol equivalents/d) and Ca (mg/d; Table 3). Higher scores for the snack pattern were associated with higher total energy intake; higher percentages of energy from protein and fat; higher intakes of fibre (g/d), vitamin C, Ca and Fe (mg/d); and lower percentage of energy from carbohydrates and vitamin A intake. Higher scores for the Western pattern were associated with higher percentages of energy from protein and fat; higher intakes of vitamin A, Ca and Fe; lower total energy intake; and lower percentage of energy from carbohydrate and vitamin C intake.

Association of dietary patterns with lipid profiles

The traditional southern pattern was inversely associated with HDL-C ($\beta = -0·68$; 95 % CI −1·22, −0·14; $P < 0·05$).

Table 1 Factor-loading matrix† for dietary patterns identified by factor analysis among Chinese women (*n* 2468) aged 18–80 years, China Health and Nutrition Survey, 2009

Food	Traditional southern	Snack	Western
Rice	0·81	–	–
Wheat	−0·74	–	–
Other cereals	−0·33	–	–
Tubers	–	0·37	−0·53
Legumes	–	–	–
Fungi and algae	–	–	0·28
Vegetables	0·39	–	−0·31
Fruits	–	0·66	–
Pork	0·47	–	–
Other livestock meat	–	–	0·30
Poultry	–	–	0·46
Organ meats	–	–	0·36
Aquatic products	0·37	0·36	–
Milk	–	0·37	0·37
Eggs	–	0·43	–
Nuts	–	0·30	–
Cakes	–	0·41	–
Fast foods	−0·27	–	0·40
Soft drinks	–	–	0·32
Variance explained (%)	11·1	8·8	6·3

†Absolute factor loadings ≥0·25 are presented for simplicity.

Women in the upper quartile of the traditional southern pattern had a decrease in HDL-C ($\beta = -1·86$; 95 % CI −3·39, −0·33; $P < 0·05$) when we used dietary pattern scores as a categorical variable (quartiles) in the multivariate linear regression models (Table 4). The snack pattern was significantly associated with higher TAG ($\beta = 4·14$; 95 % CI 0·44, 7·84; $P < 0·05$). The Western pattern was positively associated with TC ($\beta = 2·52$; 95 % CI 1·03, 4·02; $P < 0·01$) and LDL-C ($\beta = 2·26$; 95 % CI 0·86, 3·66; $P < 0·01$). Women in the upper quartile of the Western pattern had an increase in TC ($\beta = 6·28$; 95 % CI 2·04, 10·51; $P < 0·01$) and LDL-C ($\beta = 6·06$; 95 % CI 2·11, 10·01; $P < 0·01$).

Discussion

The present study identified three distinct dietary patterns among Chinese women: traditional southern, snack and Western. These patterns are similar to those of Chinese adults reported by other research[26–28]. The traditional southern pattern, characterized by high intakes of rice, pork, vegetables and aquatic products, was inversely associated with HDL-C. The snack pattern, high in fruits, eggs, cakes and tubers, was linked with increased TAG. The Western pattern, high in poultry, fast foods, milk, organ meats and soft drinks, was associated with increased TC and LDL-C. These associations were observed after adjusting for all confounders in Chinese women.

The traditional Chinese diet includes large amounts of cereals and vegetables and small amounts of animal-source foods[29]. Rice and wheat flour are staple foods in the southern and northern regions in China. The people in southern China prefer rice as a staple food with meat and

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Table 2 Participant characteristics† according to quartile (Q) of the three dietary patterns‡ identified among Chinese women (*n* 2468) aged 18–80 years, China Health and Nutrition Survey, 2009

	Traditional southern					Snack					Western				
	Q1		Q4			Q1		Q4			Q1		Q4		
	Mean	SD	Mean	SD	*P*§	Mean	SD	Mean	SD	*P*§	Mean	SD	Mean	SD	*P*§
n	617		617			617		617			617		617		
Age (years)	47·6	12·8	48·8	12·1	0·13	48·8	13·1	48·0	12·6	0·33	49·0	11·8	46·0	13·4	<0·0001
Urban (%)	24·0		23·0		0·21	15·6		39·1		<0·0001	12·2		42·1		<0·0001
Education (high) (%)	22·5		15·7		<0·001	11·5		34·7		<0·0001	9·9		39·9		<0·0001
Current smoker (%)	3·7		1·9		0·02	1·8		5·0		<0·01	5·0		2·1		<0·01
Current drinker (%)	7·5		9·9		0·25	7·0		12·3		<0·001	7·8		15·1		<0·0001
BMI (kg/m^2)	23·8	3·3	23·0	3·3	<0·0001	22·8	3·3	23·3	3·2	0·02	23·5	3·2	23·0	3·4	<0·01
Waist circumference (cm)	82·3	9·4	79·2	9·8	<0·0001	79·0	9·8	80·6	9·6	<0·01	81·5	9·0	79·3	10·2	<0·0001
HDL-C (mg/dl)	57·3	14·9	56·8	12·7	0·53	57·1	13·5	57·3	13·7	0·54	55·9	13·4	57·7	13·2	0·12
LDL-C (mg/dl)	116·4	37·1	113·4	35·2	0·15	113·0	35·3	116·6	35·2	0·12	111·3	34·8	116·1	35·9	<0·01
TAG (mg/dl)	125·9	95·1	126·0	91·7	0·99	124·1	88·4	128·8	113·2	0·49	133·7	94·8	118·4	94·2	<0·01
TC (mg/dl)	186·9	40·3	184·4	37·8	0·29	184·4	38·3	187·1	38·2	0·35	182·3	38·3	186·7	38·0	0·05

HDL-C, HDL cholesterol; LDL-C, LDL cholesterol; TC, total cholesterol.
†Values are presented as mean and standard for continuous variables or as percentage for categorical variables.
‡Traditional southern pattern is characterized by high intakes of rice, pork, vegetables and aquatic products. Snack pattern is highly correlated with intakes of fruits, eggs, cakes and tubers. Western pattern is characterized by high intakes of poultry, fast foods, milk, organ meats and soft drinks.
§We calculated *P* for trend from a linear regression analysis for continuous variables and the Mantel–Haenszel χ^2 distribution for categorical variables.

Table 3 Nutrient intakes according to quartile (Q) of the three dietary patterns† identified among Chinese women (*n* 2468) aged 18–80 years, China Health and Nutrition Survey, 2009

	Traditional southern					Snack					Western				
	Q1		Q4			Q1		Q4			Q1		Q4		
	Mean	SD	Mean	SD	*P*‡	Mean	SD	Mean	SD	*P*‡	Mean	SD	Mean	SD	*P*‡
Energy (kJ/d)§	8678	97	9996	97	<0·0001	8733	102	9024	102	<0·01	9233	101	8752	101	<0·001
Energy (kcal/d)§	2074·1	23·1	2389·1	23·1	<0·0001	2087·3	24·3	2156·9	24·3	<0·01	2206·7	24·1	2091·7	24·2	<0·001
Carbohydrate (% energy)‖	58·6	0·4	51·5	0·5	<0·0001	58·0	0·5	52·1	0·5	<0·0001	61·0	0·4	46·8	0·4	<0·0001
Protein (% energy)‖	12·3	0·1	13·0	0·1	<0·001	11·4	0·1	13·8	0·1	<0·0001	11·7	0·1	14·0	0·1	<0·0001
Fat (% energy)‖	28·3	0·5	32·8	0·5	<0·0001	29·3	0·5	31·9	0·5	<0·001	27·0	0·5	35·8	0·5	<0·0001
Fibre (g/d)‖	14·0	0·3	10·5	0·3	<0·0001	10·5	0·3	14·2	0·3	<0·0001	13·0	0·3	12·6	0·3	0·78
Vitamin C (mg/d)‖	70·0	2·6	107·2	2·7	<0·0001	75·4	2·6	101·4	2·6	<0·0001	106·2	2·6	79·1	2·6	<0·0001
Vitamin A (µg RE/d)‖	443·8	31·9	1098·6	33·0	<0·0001	853·1	33·2	707·4	33·2	0·01	699·6	33·4	842·5	33·4	<0·001
Ca (mg/d)‖	346·1	10·2	458·4	10·6	<0·0001	340·1	10·1	477·3	10·2	<0·0001	385·6	10·3	448·5	10·3	<0·0001
Fe (mg/d)‖	20·9	0·3	21·7	0·3	0·09	19·8	0·3	22·8	0·3	<0·0001	21·1	0·3	22·6	0·3	<0·0001

RE, retinol equivalents.
†Traditional southern pattern is characterized by high intakes of rice, pork, vegetables and aquatic products. Snack pattern is highly correlated with intakes of fruits, eggs, cakes and tubers. Western pattern is characterized by high intakes of poultry, fast foods, milk, organ meats and soft drinks.
‡We calculated *P* for trend from a linear regression analysis.
§Adjusted for age.
‖Adjusted for age and total energy intake.

Table 4 Multivariate linear regression model to evaluate the effect of dietary pattern† scores on lipid profiles‡ among Chinese women (*n* 2468) aged 18–80 years, China Health and Nutrition Survey, 2009

	HDL-C		LDL-C		TAG		TC	
	β	95 % CI	*β*	95 % CI	*β*	95 % CI	*β*	95 % CI
Traditional southern								
β, continuous	−0·68	−1·22, −0·14*	−0·08	−1·45, 1·28	1·70	−1·98, 5·39	−0·04	−1·50, 1·42
Q1	0	–	0	–	0	–	0	–
Q2	−0·51	−2·02, 1·00	−3·03	−6·82, 0·76	7·00	−3·24, 17·24	−1·55	−5·61, 2·51
Q3	−1·26	−2·76, 0·24	−0·58	−4·34, 3·17	9·48	−0·68, 19·64	0·70	−3·32, 4·73
Q4	−1·86	−3·39, −0·33*	−2·09	−5·94, 1·75	5·39	−5·00, 15·78	−1·83	−5·95, 2·29
Snack								
β, continuous	0·25	−0·29, 0·80	0·75	−0·61, 2·12	4·14	0·44, 7·84*	1·11	−0·35, 2·58
Q1	0	–	0	–	0	–	0	–
Q2	0·01	−1·48, 1·50	1·43	−2·31, 5·17	0·02	−10·10, 10·13	1·32	−2·68, 5·33
Q3	0·89	−0·62, 2·40	−1·34	−5·14, 2·45	−0·75	−11·01, 9·51	−1·68	−5·74, 2·38
Q4	0·77	−0·77, 2·31	2·42	−1·45, 6·29	0·44	−10·03, 10·92	1·27	−2·87, 5·42
Western								
β, continuous	0·43	−0·13, 0·99	2·26	0·86, 3·66**	−3·16	−6·94, 0·62	2·52	1·03, 4·02**
Q1	0	–	0	–	0	–	0	–
Q2	2·01	0·52, 3·51**	1·88	−1·86, 5·63	2·31	−7·83, 12·45	4·09	0·07, 8·10*
Q3	0·30	−1·22, 1·83	5·44	1·62, 9·27**	−6·92	−17·28, 3·44	5·07	0·97, 9·17*
Q4	1·10	−0·48, 2·67	6·06	2·11, 10·01**	−9·43	−20·13, 1·26	6·28	2·04, 10·51**

HDL-C, HDL cholesterol; LDL-C, LDL cholesterol; TC, total cholesterol; Q, quartile.

$^{*}P<0.05$, $^{**}P<0.01$.

†Traditional southern pattern is characterized by high intakes of rice, pork, vegetables and aquatic products. Snack pattern is highly correlated with intakes of fruits, eggs, cakes and tubers. Western pattern is characterized by high intakes of poultry, fast foods, milk, organ meats and soft drinks.

‡Adjusted for age (18–44, 45–59, 60–80 years), education (low, medium, high), living area (urban, rural), annual household income per family member (continuous), physical activity (continuous), current smoker (yes, no), alcohol drinker (yes, no), BMI (continuous) and total energy intake (continuous).

vegetable dishes. We therefore labelled the pattern with high intakes of rice, pork and vegetables as traditional southern. In our study, the traditional southern pattern was inversely associated with HDL-C. This is consistent with studies in Korea[30–32] and may be explained by the high consumption of white rice[33–35]. In China most of the rice consumed is white rice, which has a high glycaemic index (GI) and is a predominant contributor to the dietary glycaemic load. Regular consumption of high-GI foods could induce chronic hyperglycaemia and an increased workload for pancreatic β cells as well as insulin resistance through increased NEFA levels and counter-regulatory hormones. These metabolic changes lead to decreased concentrations of HDL-C[34].

The snack pattern in the present study had high loadings mostly for convenience foods, including fruits, eggs, cakes and tubers. Similar dietary patterns have been identified elsewhere[36,37]. Since 2004 snacking has been increasing rapidly as a dietary component in China. However, to date snacking has not been dominated by savoury snacks, sugary beverages and other unhealthy foods as in the West[38]. In China fruit has been one of the most popular snack items[20].

Our study showed that women with a higher snack pattern score were positively associated with high TAG levels. This result is surprising, because fruit is considered a healthy food that is known to reduce blood TAG levels[39]. It is plausible that other components of food items in the dietary pattern may counter the beneficial effects of fruit like added sugars from cakes. Several potential mechanisms have been proposed to explain the effect of added sugars on lipid profiles[40]. Besides, several short-term controlled feeding studies have found that dietary fructose significantly increases postprandial TAG levels; thus, the fructose content in fruits may play a role in the association[39]. TAG level has been reported to be affected by dietary patterns[41–43] characterized by high intake of carbohydrate or foods with a high GI. In our study, the positive associations between the snack pattern and TAG may be attributable to the high GI of the diet. The mechanisms underlying the TAG increase as a result of a high-GI diet are not fully understood. In addition, we found that women with a higher snack pattern score had higher BMI and waist circumference, which indicates that overweight or obesity may be related to higher TAG.

The increase in consumption of animal-source foods in China has been remarkably rapid[44]. Pork remains the most common animal-source food, but intakes of eggs, poultry and dairy products are growing quickly[20]. The eating behaviour shift is leading to what is often called a Western pattern. The Western pattern has emerged with the nutrition transition in China and has been called a meat pattern or a high-fat pattern in other research[11], although the specific foods contributing to each factor vary in level of contribution. One characteristic of the Western pattern is high content of fat, especially the saturated fat that is an important determinant of serum TC concentration[45]. Adair *et al.* found that the percentage of energy from fat in the diet of Chinese women increased from 22 % in 1991 to

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32 % in 2011 and that the change was associated with an 8 % increase in the likelihood of having high LDL-C[46].

In the present study we also found a positive relationship between the Western pattern and increased TC and LDL-C. This is consistent with a study of the Japanese population that found that a Western pattern was associated with higher TC, HDL-C and LDL-C in women[47]. However, this is inconsistent with some American studies. A Western dietary pattern characterized by high intakes of red meats, processed meats and high-fat foods was not associated with plasma TC in the Health Professionals Follow-up Study[17]. Similarly, in the National Health and Nutrition Examination Survey III, a Western dietary pattern characterized by high intakes of processed meats, eggs, red meats and high-fat dairy products was not associated with serum TC[15]. Although these discrepancies are attributed to differences in populations, study designs, food groups and analytic methods, the exact explanations have yet to be clarified.

The present study has several limitations. First, the results do not show the causal or resultant relationship between dietary patterns and lipid profiles owing to the cross-sectional data. Second, the statistical methods we used to define the dietary patterns are somewhat subjective, including the consolidation of food items into food groups, the number of factors to extract and the labelling of the patterns. Third, dietary patterns could be different among studies because of different ethnicities/cultures or objectives. It is difficult to compare these findings with other studies. Fourth, the 24 h dietary recall method cannot generally evaluate usual dietary intake; the three components explained only 26·2 % of the variance in the foods. Despite these limitations, the present study is the first to reveal the relationship between dietary patterns and blood lipid profiles in Chinese women using data from a large survey. In China women are in charge of the diet at home. The present study usefully provides a better understanding of the dietary habits of women, which relates not only to their health but also to that of their family members, especially their children.

Conclusion

In conclusion, we identified three unique dietary patterns among Chinese women: traditional southern, snack and Western. Our findings indicate that the traditional southern pattern, characterized by high intakes of rice, pork, vegetables and aquatic products, was inversely associated with HDL-C. The snack pattern, high in fruits, eggs, cakes and tubers, was linked with increased TAG. The Western pattern, high in poultry, fast foods, milk, organ meats and soft drinks, was associated with increased TC and LDL-C. This information is important for developing interventions and policies addressing dyslipidaemia prevention among women. Further prospective studies are needed to better understand the relationships.

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Supplementary material

To view supplementary material for this article, please visit http://dx.doi.org/10.1017/S136898001600197X

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