The relationship between dietary factors and serum lipids in southern Chinese population samples

Xiaoqing Liu*, Zhendong Huang *, Yihe Li*, Xuxu Rao*, Runchao Cen*, Qiling Zhuo*, Gemin Ni*, Peifang Chen*, Barbara H. Dennis† and Jeremiah Stamler‡

**Department of Epidemiology, Guangdong Cardiovascular Institute, Guangzhou 510100, P.R. China; †University of North Carolina, USA; ‡Northwestern University Medical School, USA.*

As part of the PRC-USA collaborative research project on the epidemiology of cardiovascular disease, baseline surveys were conducted in four random urban and rural samples in Guangzhou, Guangdong Province in southern China on 334 men and women aged 35–54 in the fall of 1983–84 with the aim of studying the correlation between dietary intakes and serum lipids. Methods standardized by the US Centers for Disease Control were used for measuring different parameters, and quality control was emphasized to assure comparability between workers and farmers. Three 24-hour recalls were collected from each participant in each survey. Mean values of daily intakes of nutrients per capita for the four groups were as follows: 59–69% kcal carbohydrate; 10–12% kcal protein; 22–26% kcal fat. Dietary total fat, saturated fatty acid (SFA), polyunsaturated fatty acid (PUFA) and cholesterol were higher in the urban than the rural areas. Mean levels of serum total cholesterol (TC), triglycerides (TG), high density lipoprotein cholesterol (HDL-C) and low density lipoprotein cholesterol (LDL-C) were 4.6 mmol/l, 1.1 mmol/l, 1.3 mmol/l and 2.8 mmol/l respectively. The TC, TG and LDL-C and HDL-C were significantly higher in the urban than the rural areas. Analyses of correlation showed that the Keys 'dietary lipid score' was positively associated with TC, LDL-C and HDL-C; specifically, dietary cholesterol was positively associated with serum TC. Saturated fatty acids (SFA) and monounsaturated fatty acids (MUFA) were positively correlated with HDL-C. It seems that the traditional dietary pattern of Guangzhou favours serum lipids being at an optimal level

Introduction

The relationship between dietary factors, serum lipids and coronary heart disease (CHD) has been studied for many years in Western countries. There is a big difference between the Chinese dietary pattern and the Western dietary pattern and the level of serum total cholesterol in China is lower than that of Western countries. There is no unanimous opinion about the relationship between serum lipids and dietary factors in China[1,2]. The main objectives of this report are to reveal and analyse the relationship between diet and serum lipids among the population samples in the southern part of China.

As part of PRC-USA collaborative research on the epidemiology of cardiovascular disease, baseline surveys were conducted in four random urban and rural samples of Guangzhou in the fall of 1983–84.

Participants and methods

Participants

The surveyed participants were men and women, aged 35–54 years, sampled from two populations, urban Guangzhou (Guangzhou Shipyard Company) and rural Guangzhou (Dashi District of Panyu County). Ten per cent of the participants interviewed for eating patterns and measured for serum lipids were selected randomly as subsamples from the populations screened for cardiovascular disease and their risk factors. The number of participants in the subsamples was 334 persons (171 from the urban area, 163 from the rural area), as shown in Table 1.

Survey methods

Dietary assessment involved a standardized 24-hour recall for each of three consecutive days. Physicians were trained to conduct the dietary interview according to a common protocol. Duplicate coding (blind) was performed for all the dietary data before entry into the computer. Energy and nutrient intakes were calculated from the Chinese National Table of Food Composition[3].

Laboratory methods

Blood was taken from each of the participants after they had been on a 12-hour fast for determination of serum lipids. The lipid laboratory methodology was standardized for analyses of total cholesterol (TC), high density lipoprotein cholesterol (HDL-C), and triglycerides (TG) by the Lipid Standardization Program of the US National Heart, Lung, and Blood Institute and the Centers for Disease Control (CDC), Atlanta, Georgia, USA. Low density lipoprotein

Table 1. Number of participants.

Total	Urban	Rural	Total
Male	75	82	157
Female	96	81	177
Total	171	163	334

cholesterol (LDL-C) was calculated[4] according to the formula LDL-C = $\frac{TG}{5}$.

Statistical methods

Means of daily intake of dietary nutrients were computed for each individual. Means and standard deviations of the selected nutrients and serum lipids were calculated by sex and setting (ie urban or rural).

With control for variables including sex, age, body mass index (BMI) and alcohol use, the relationship between dietary factors and serum lipids within each of the four sex/setting groups was studied by multiple regression analyses. A logarithm transformation of TG (LnTG) was used as a dependent variable because of the skewness of the TG distribution.

Results

Mean daily intake of selected nutrients by sex and setting

Mean daily intakes of total energy, protein, total fat (fat), fatty acids, carbohydrate (CHO) and their fractions and Keys score are shown in Table 2. Mean values of daily intakes of nutrients demonstrated a typical dietary pattern for Guangzhou with CHO providing 59–69% total energy, total fat 22–26% and protein 10–12%.

Mean daily intake of total energy in women was significantly higher in rural than in urban population groups. For both men and women the per cent of energy provided by protein, animal protein (Apro), fat, saturated fatty acids (SFA), monounsaturated fatty acids (MUFA) and polyunsaturated fatty acids (PUFA), as well as mean daily intake of cholesterol, were all significantly higher in urban than in rural population groups. The same was true for the dietary Keys score.

Mean serum lipids by sex and setting

Mean levels of serum TC, HDL-C, TG and LDL-C were 4.6 mmol/l, 1.3 mmol/l, 1.1 mmol/l and 2.8 mmol/l, respectively.

Mean serum TC, TG and LDL levels were higher in the urban than in the corresponding rural population groups but there were no consistent urban–rural differences for HDL-C. For mean serum TC, TG and LDL-C levels rural women had the lowest mean value and urban women the highest among the four population groups as shown in Table 3.

Association of dietary factors with serum lipids

Tables 4 and 5 show the regression coefficients of dietary variables for serum lipids in the sex/setting combined population group.

Dietary Keys score and CHOL (as mg/1000 kcal) were directly associated with serum TC. No significant associations were found between %fat or %MUFA and serum TC. Per cent PUFA showed a nonsignificant positive association with serum TC. Per cent CHO and VPRO (variable protein) tended to associate inversely with serum TC. Per cent APro tended to associate positively with serum TC.

The association of dietary variables with LDL-C demonstrated a relationship similar to that with serum TC. Keys Score and %SFA tended to associate positively with serum HDL-C. Only weak inverse associations were found between %fat and %MUFA with LnTG.

Discussion

The mean serum TC levels in this study for all population samples were significantly lower than those reported for

Table 2. Mean daily intake of nutrients by sex and setting.

%Nutrient[a] and total	Male				Female			
	Urban		Rural		Urban		Rural	
	M	SD	M	SD	M	SD	M	SD
Energy (kcal)	2879	433	2898	515	2212	378	2591	475
%Protein	12.4*	1.5	10.7	1.2	12.8*	1.7	10.8	1.1
A pro	5.6*	1.9	4.1	1.5	6.0*	1.8	3.5	1.2
V pro	6.8	1.0	6.6	1.0	6.3*	0.8	7.3	0.6
%Fat	25.8*	4.6	22.4	5.7	27.0*	4.1	19.3	4.2
SFA	8.0*	1.8	7.0	2.2	7.9*	1.5	5.8	1.5
MUFA	11.1*	2.3	9.5	2.9	11.5*	2.0	7.8	2.0
PUFA	5.3*	1.1	4.7	0.8	6.0	1.3	4.5	0.9
CHOL (mg/1000 kcal)	170*	43	77	36	204*	59	68	41
%CHO	58.9	7.1	61.2	9.8	60.0*	4.6	69.5	4.7
Starch	51.1*	6.5	55.1	9.6	49.9*	5.2	62.3	4.9
Sugar	5.2*	2.2	3.9	2.3	6.0*	2.2	4.7	2.8
Other CHO	2.6*	1.0	2.2	1.0	4.0*	1.9	2.5	1.3
Keys score	33.7*	5.5	25.4	6.5	34.4*	5.7	21.4	5.2

[a]% = Percentage of the nutrient (protein etc) relative to total energy intake. Keys score = 1.35 (2S-P)+1.5 *SQRT(CHOL/1000 kcal)[5].

Comparison between urban and rural by t-test, $P<0.05$.

Table 3. Mean serum lipid (mmol/l) by sex and setting.

	Male				Female			
	Urban		Rural		Urban		Rural	
	M	SD	M	SD	M	SD	M	SD
TC	4.7*	0.7*	4.2	0.7	5.0*	0.9	4.1	0.7
HDL-C	1.3	0.3	1.2	0.3	1.3	0.2	1.2	0.2
TG	1.1*	0.6	0.9	0.4	1.1*	0.5	0.9	0.3
LDL-C	2.9*	0.6	2.5	0.6	3.2*	0.7	2.4	0.6

*Comparison between urban and rural, $P<0.05$.

Table 4. Within-group multiple regression coefficients of dietary factors separately on serum TC and LDL-C (Guangzhou n=334).

%Dietary factor[a] and Keys score	TC combined group*		LDL-C combined group*	
	B	R2	B	R2
Keys score	0.67†	0.28	0.56†	0.23
%Fat	0.56	0.27	0.46	0.22
%SFA	1.35	0.27	0.89	0.22
%MUFA	1.15	0.27	0.96	0.22
%PUFA	1.57	0.27	1.88	0.22
CHOL mg/1000 kcal	0.10†	0.29	0.10†	0.24
%CHO	–0.48	0.27	–0.38	0.22
%Starch	–0.51	0.27	–0.42	0.22
%Sugar	–0.01	0.27	0.22	0.21
%Apro	1.47	0.27	1.17	0.22
%Vpro	–5.02†	0.28	–4.08†	0.23

[a]The coefficients are based on the comparative percentages of total dietary factory contributed by each factor.
*Adjusted for age, sex, BMT, alcohol and setting. †$P<0.05$; ** $P<0.01$.

Table 5. Within-group multiple regression coefficients (wgMRCs) of dietary factors separately on HDL-C and LnTG (Guangzhou n=334).

Dietary factor[a] and Keys score	HDL-C combined group*		LnTG combined group*	
	B	R2	B	R2
Keys score	0.19†	0.16	0.004	0.16
%Fat	0.19	0.16	–0.006	0.16
%SFA	0.70†	0.17	–0.018	0.16
%MUFA	0.39	0.16	–0.013	0.16
%PUFA	–0.19	0.15	–0.008	0.16
CHOL mg/1000 kcal	0.01	0.15	0.0001	0.15
%CHO	–0.20	0.16	0.006	0.16
%Starch	–0.18	0.16	0.006	0.16
%Sugar	–0.16	0.15	–0.002	0.15
%Apro	0.56	0.16	–0.010	0.15
%Vpro	–1.70†	0.17	0.024	0.15

[a]The coefficients are based on the comparative percentages of total dietary factory contributed by each factor.
*Adjusted for age, sex, BMT, alcohol and setting. †$P<0.05$; ** $P<0.01$.

Western industrialized populations[6].

Dietary lipids, expressed as the integrated index Keys score, were found to predict group means of serum TC values in some short-term clinical studies in metabolic wards[4,5]. International population studies, such as the Seven Countries study[7], have shown that the dietary saturated fat correlated significantly with mean levels of serum cholesterol (r=0.89).

Although the mean serum TC levels were lower in these population groups than in Western countries, in the present study there were significant correlations between the dietary Keys score and serum TC and LDL-C in multiple regression analyses in the four study populations. The main components of this score, %SFA and CHOL per 1000 kcal also showed significant positive associations with both serum TC and LDL-C.

Mean serum HDL-C levels for men in this study were distinctly higher than those of US men of the same age (1.1 mmol/l)[8], but for women they were lower than those of the US value (1.3–1.4 mmol/l). Dietary Keys score, total fat, saturated and monounsaturated fatty acids were associated positively with serum HDL-C. The opposite was true for %CHO, %starch and %VPRO, which showed an inverse association with serum HDL-C. The correlation between %PUFA and HDL-C was not confirmed in many other studies[9,10]. In this study, %PUFA showed a positive though not significant association with HDL-C.

In conclusion, the present study demonstrated that in southern China the dietary pattern is beneficial for keeping serum lipids at an optimal level. As to the population with a high level of serum TC, dietary factors have the same important effect on the lipids. The present paper proved that is necessary for the southern Chinese population to limit the intake of dietary saturated acids and total cholesterol so as to protect them from the development of this CHD risk factor.

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中國南方居民血清脂類和飲食因素的關係

摘要

根據中美心血管病流行病學合作研究方案，我們於 1983 年和 1984 年秋對中國南方廣東省農村和城市 4 個 35—54 歲不同性別的人群共 334 人進行了基線調查，目的在於尋找營養素攝入與血脂的關係。調查中應用美國疾病控制中心的標準化方法進行多種指標的測量，以保証工人和農民之間資料的可比性，每個對象用 24 小時回憶法收集膳食資料。四個人群每人每日營養素的平均入量如下：碳水化物佔總能量 59—69% 、蛋白質佔 10—12% 、脂肪佔 22—26% 。城市的膳食總脂肪、飽和脂肪酸、多不飽和脂肪酸和膽固醇的攝入量均高於農村。城市和農村血清平均總膽固醇、甘油三酯、高密度脂蛋白和低密度脂蛋白分別爲 4.6 mmol/l、1.1 mmol/l、1.3 mmol/l 和 2.8 mmol/l。城市的血清總膽固醇、甘油三酯和低密度脂蛋白水平均顯著高於農村，相關分析顯示「膳食脂肪指數」與血清膽固醇、低密度脂蛋白和高密度脂蛋白呈正相關，膳食膽固醇與血清膽固醇呈正相關，飽和及單不飽和脂肪酸與高密度脂蛋白呈正相關。

作者得出結論：廣洲的膳食模式有利於血脂保持在合適的水平。