# Comparison of demography, diet, lifestyle, and serum lipid levels between the Guangxi Bai Ku Yao and Han populations

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**Abstract Bai Ku Yao is an isolated subgroup of the Yao minority in China. Little is known about dyslipidemia in this population. The aim of this study was to compare the effects of demography, diet, and lifestyle on serum lipid levels between the Bai Ku Yao and Han populations. A total of 1,170 subjects of Bai Ku Yao and 1,173 subjects of Han Chinese aged 15–89 years were surveyed by a stratified randomized cluster sampling. The levels of total cholesterol, high density lipoprotein cholesterol, low density lipoprotein cholesterol, apolipoprotein A-I (apoA-I), and apoB were significantly lower in Bai Ku Yao than in Han. Physical activity level and total dietary fiber intake were higher, whereas body mass index (BMI), waist circumference, total energy intake, and total fat intake were lower in Bai Ku Yao than in Han. Hyperlipidemia was positively correlated with BMI, waist circumference, and total energy and total fat intakes and negatively associated with physical activity level and total dietary fiber intake in both populations, but it was positively associated with age and alcohol consumption only in Han. The differences in the lipid profiles between the two ethnic groups were associated with different dietary habits, lifestyle choices, and levels of physical activities.**—Ruixing, Y., F. Qiming, Y. Dezhai, L. Shuquan, L. Weixiong, P. Shangling, W. Hai, Y. Yongzhong, H. Feng, and Q. Shuming. **Comparison of demography, diet, lifestyle, and serum lipid levels between the Guangxi Bai Ku Yao and Han populations. *J. Lipid Res.* 2007.** 48: **2673–2681.**

**Supplementary key words** lipids • apolipoproteins • risk factors

Dyslipidemia is a condition in which there is an abnormal lipid or lipoprotein concentration. It is well known that dyslipidemia is determined by genetic, demographic, and lifestyle factors (1, 2). High levels of plasma total cholesterol (TC) (3, 4), triglycerides (TGs) (5, 6), low density lipoprotein cholesterol (LDL-C) (7, 8), and apolipoprotein B (apoB) (9, 10) and low levels of high density lipoprotein cholesterol (HDL-C) (11, 12) are correlated with the progression of atherosclerosis and a higher incidence of coronary artery disease (CHD) (13). To prevent the development of these diseases, a great deal of research has been focused on determining the relationship between these lipid phenotypes and dietary intake and lifestyle in different ethnic groups (14–16).

There are fifty-six ethnic groups in China. Han is the largest group. Although several regional studies have examined serum lipid levels in Chinese populations (17–19), little is known about the differences in lipids between Han and other minority groups in rural areas. Bai Ku Yao (white trouser Yao), an isolated subgroup of the Yao minority in China, is named because all of the men wear white knee-length knickerbockers. The population size is ~30,000. The special customs and culture of Bai Ku Yao, including their clothing, intraethnic marriages, ballads, funerals, bronze drums, alcohol intake, and spinning-top activities are still completely conserved to the present day. Little is known about the association between dietary intake and lifestyle and the serum lipid levels in this population. Therefore, the present study was undertaken to compare the effects of demographic characteristics, dietary patterns, and other lifestyle factors on the serum lipid levels between the Bai Ku Yao and Han populations from the same region.

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Abbreviations: apoA-I, apolipoprotein A-I; BMI, body mass index; CHD, coronary artery disease; HDL-C, high density lipoprotein cholesterol; LDL-C, low density lipoprotein cholesterol; TC, total cholesterol; TG, triglyceride.

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## MATERIALS AND METHODS

### Subjects

A total of 1,170 subjects of Bai Ku Yao who reside in Lihu and Baxu villages in Nandan County, Guangxi Zhuang Autonomous Region, China, were surveyed by a stratified randomized cluster sampling (20). The ages of the subjects ranged from 15 to 85 years, with an average age of 37.52 ± 16.71 years. There were 588 males (50.26%) and 582 females (49.74%). All subjects were peasants. The subjects accounted for 3.90% of the total Bai Ku Yao population. At the same time, a total of 1,173 people of Han Chinese who reside in the same villages were also surveyed by the same method. The mean age of the subjects was 38.29 ± 16.84 years (range, 15–89 years). There were 589 men (50.21%) and 584 women (49.79%). All of them were also peasants. All study subjects were essentially healthy and had no evidence of any chronic illness, including hepatic, renal, or thyroid disease. Participants with a history of heart attack or myocardial infarction, stroke, congestive heart failure, diabetes, or fasting blood glucose ⩾ 7.0 mmol/l determined by glucose meter were also rejected. The participants were not taking medications known to affect serum lipid levels (lipid-lowering drugs such as statins or fibrates, β-blockers, diuretics, or hormones). The present study was approved by the Ethics Committee of the First Affiliated Hospital, Guangxi Medical University. Informed consent was obtained from all subjects after they received a full explanation of the study.

### Epidemiological survey

The survey was carried out using internationally standardized methods and following a common protocol. Information on demographics (age, gender, and residential area), socioeconomic status (educational level, marital status, and annual household income), cigarette smoking, alcohol consumption, and physical activity was collected with standardized questionnaires. The 24 h dietary recall method was used to determine the dietary intake of each subject (21). Detailed descriptions of all foods, beverages, and supplements consumed during the 24 h period before the interview, including the quantity, cooking method, and brand names, were recorded by a chief physician. The interviewer used food models and pictures depicting portion sizes and followed a standardized protocol to determine the weight of the food consumed. The intakes of macronutrients from the ingredients were determined using the 2002 Chinese Food Composition Table (22). Although a 24 h dietary recall may be inaccurate when diets are highly variable, the Bai Ku Yao diet is consistent throughout the year and among individuals because of the Bai Ku Yao's reliance on a limited number of locally available food items.

Overall physical activity was ascertained with the use of a modified version of the Harvard Alumni Physical Activity Questionnaire (23), which included questions about the number of hours per day (mean of a regular weekday and a regular weekend day) spent sleeping and in sedentary, light, moderate, and vigorous activities; the interviewer ensured that the total time added up to 24 h. The alcohol information included questions about the number of liangs (∼50 g) of rice wine, wine, beer, or liquor consumed during the preceding 12 months. At the physical examination, several anthropometric parameters, such as height, weight, and waist circumference, were measured. Sitting blood pressure was measured three times with the use of a mercury sphygmomanometer after a rest of at least 15 min, and the average of the three measurements was used for the level of blood pressure. Systolic blood pressure was determined by the first Korotkoff sound, and diastolic blood pressure was determined by the fifth Korotkoff sound. Body weight, to the nearest 50 g, was measured using a portable balance scale. Subjects were weighed without shoes and in a minimum of clothing. Height was measured, to the nearest 0.5 cm, using a portable steel measuring device. From these two measurements, body mass index (BMI; kg/m$^2$) was calculated. Waist circumference was measured with a nonstretchable measuring tape, at the level of the smallest area of the waist, to the nearest 0.1 cm.

### Measurements of lipid and apolipoprotein levels

Venous blood samples were drawn from an antecubital vein in all subjects after an overnight fast. The blood was transferred into glass tubes and allowed to clot at room temperature. Immediately after clotting, serum was separated by centrifugation for 15 min at 3,000 rpm. The levels of TC, TG, HDL-C, and LDL-C in samples were determined enzymatically using the commercially available kits Tcho-1 and TG-LH (Randox Laboratories, Ltd., Ardmore, Antrim, UK) and Cholestest N HDL and Cholestest LDL (Daiichi Pure Chemicals Co., Ltd., Tokyo, Japan), respectively. Serum apoA-I and apoB levels were measured by an immunoturbidimetric assay (Randox Laboratories, Ltd.) (24, 25). All determinations were performed with an autoanalyzer (type 7170A; Hitachi, Ltd., Tokyo, Japan) in the Clinical Science Experiment Center of the First Affiliated Hospital, Guangxi Medical University.

### Diagnostic criteria

The normal values of serum TC, TG, HDL-C, LDL-C, apoA-I, and apoB and the ratio of apoA-I to apoB in our Clinical Science Experiment Center were 3.10–5.17, 0.56–1.70, 0.91–1.81, 2.70–3.20 mmol/l, 1.00–1.78, 0.63–1.14 g/l, and 1.00–2.50, respectively. The individuals with TC > 5.17 mmol/l and/or TG > 1.70 mmol/l were defined as hyperlipidemic (24, 25). Hypertension was diagnosed according to the 1999 World Health Organization-International Society of Hypertension Guidelines for the management of hypertension (26, 27). Uncontrolled hypertension was defined as a systolic pressure of 140 mmHg or greater and a diastolic pressure of 90 mmHg or greater. The subjects with only systolic pressure ⩾ 140 mmHg but diastolic pressure < 90 mmHg were diagnosed as having isolated systolic hypertension. The diagnostic criteria of overweight and obesity were according to the Coorperative Meta-Analysis Group of China Obesity Task Force. Normal weight, overweight, and obesity were defined as BMI of <24, 24–28, and >28 kg/m$^2$, respectively (28).

### Statistical analysis

The data were organized and analyzed using Excel XP (Microsoft, Seattle, WA) and SPSS for Windows version 10.0 (SPSS, Inc., Chicago, IL). Means and SD as well as frequency distributions of participant characteristics were calculated. The differences of two parameters between Bai Ku Yao and Han were tested by Student's unpaired $t$-test. One-way ANOVA was performed to assess the differences of three and more parameters. Significant differences were then subjected to multiple comparison using the Newman-Keuls test. The percentage difference was tested by the Chi-square test. To evaluate the association of hyperlipidemia and ethnic group (Bai Ku Yao = 0; Han = 1), sex (female = 0; male = 1), age (<20 = 1; 20–29 = 2; 30–39 = 3; 40–49 = 4; 50–59 = 5; 60–69 = 6; ⩾70 = 7), educational level (years), physical activity (hours per week), BMI (⩽24 kg/m$^2$ = 0; >24 kg/m$^2$ = 1), waist circumference (cm), blood pressure (normotensive = 0; hypertensive = 1), alcohol consumption (nondrinkers = 0; <25 g alcohol/day = 1; 25–49 g/day = 2; 50–99 g/day = 3; ⩾100 g/day = 4), cigarette smoking (nonsmokers = 0; <10 cigarettes/day = 1; 10–19 cigarettes/day = 2; 20–39 cigarettes/day = 3; ⩾40 cigarettes/day = 4), and the intakes of total energy (kJ/day), total fat (g/day), dietary cholesterol (mg/day), total dietary fiber (g/day), or salt (g/day), unconditional logistic regression analysis was also performed in a combined population of Bai Ku Yao and Han, Bai Ku Yao, and Han. The backward multiple logistic regression method was used to select the risk factors significantly associated with hyperlipidemia. Total intake of each nutrient was summed over all foods consumed. Matlab5.0 software was used to process these procedures by the multiplication of matrix method (29). $P < 0.05$ was considered statistically significant.

## RESULTS

### Comparison of demographic, diet, and other lifestyle characteristics between Bai Ku Yao and Han

The demographic, dietary, and other lifestyle characteristics between Bai Ku Yao and Han are shown in **Table 1**. The level of physical activity and the intakes of carbohydrate, vegetable protein, and total dietary fiber in Bai Ku Yao were higher than those in Han ($P < 0.001$ for all), whereas the educational level, height, weight, BMI, waist circumference, blood pressure levels including systolic, diastolic, and pulse pressure, hypertension, and the intakes of total energy, total fat, total protein, dietary cholesterol, and salt in Han were higher than those in Bai Ku Yao ($P < 0.05$–0.001). In addition, there were also differences in staple food, subsidiary food, and drink between the two ethnic groups. For the great majority of Bai Ku Yao people, corn (gruel or tortillas) was the staple food and rice, soy, buckwheat, sweet potato, and pumpkin products were the subsidiary foods all year. Approximately 90% of the beverages were corn wine and rum that they brew themselves. The alcohol content is ~15% (v/v). The Bai Ku Yao subjects are also accustomed to drink hempseed soup. Rice was the staple food and corn, broomcorn, potato, and taro products were the subsidiary foods in Han Chinese. Approximately 90% of the beverage was rice wine. The content of alcohol is ~30% (v/v). The age structure of the Bai Ku Yao and Han populations is shown in **Fig. 1** and **Table 2**. There were no significant differences in the age structure, the percentage of alcohol consumption and cigarette smoking, or the ratio of male to female between the two ethnic groups ($P > 0.05$).

### Comparison of serum lipid levels between Bai Ku Yao and Han

As shown in Table 2, the levels of serum TC, HDL-C, LDL-C, apoA-I, and apoB were lower in Bai Ku Yao than in Han (4.16 ± 0.89 vs. 4.66 ± 1.01 mmol/l, $P < 0.001$; 1.47 ± 0.42 vs. 1.90 ± 0.50 mmol/l, $P < 0.001$; 2.45 ± 0.71 vs. 2.54 ± 0.74 mmol/l, $P < 0.01$; 1.23 ± 0.32 vs. 1.40 ± 0.25 g/l, $P < 0.001$; and 0.81 ± 0.22 vs. 0.88 ± 0.22 g/l, $P < 0.001$, respectively). There were no significant differences in TG levels or the ratio of apoA-I to apoB between the two ethnic groups ($P > 0.05$).

### Effects of demographic and lifestyle characteristics on lipid levels between Bai Ku Yao and Han

The effects of sex, BMI, hypertension, alcohol consumption, cigarette smoking, and age on serum lipid levels

TABLE 1. Comparison of demographic, diet and other lifestyle characteristics between Bai Ku Yao and Han

| Characteristics | Bai Ku Yao (n = 1,170) | Han (n = 1,173) | *t* (Chi-square) | *P* |
|---|---|---|---|---|
| Age (years) | 37.52 ± 16.71 | 38.29 ± 16.84 | 1.120 | 0.263 |
| Male/female | 588/582 | 589/584 | 0.000 | 1.000 |
| Education level (years) | 4.40 ± 3.65 | 6.46 ± 3.74 | 13.492 | 0.000 |
| Physical activity (h/week) | 48.76 ± 14.45 | 46.36 ± 13.52 | 4.151 | 0.000 |
| Height (cm) | 152.66 ± 7.15 | 154.96 ± 8.06 | 7.297 | 0.000 |
| Weight (kg) | 50.52 ± 7.06 | 53.30 ± 8.81 | 8.430 | 0.000 |
| BMI (kg/m$^2$) | 21.65 ± 2.39 | 22.15 ± 2.94 | 4.574 | 0.000 |
| BMI > 24 kg/m$^2$ [n (%)] | 178 (15.21) | 246 (20.97) | 13.104 | 0.000 |
| Waist circumference (cm) | 70.94 ± 7.60 | 73.10 ± 9.23 | 6.183 | 0.000 |
| Systolic blood pressure (mmHg) | 115.69 ± 16.34 | 119.98 ± 16.47 | 6.336 | 0.000 |
| Diastolic blood pressure (mmHg) | 74.11 ± 9.35 | 75.86 ± 10.40 | 4.278 | 0.000 |
| Pulse pressure (mmHg) | 41.57 ± 11.98 | 44.16 ± 11.20 | 5.403 | 0.000 |
| Hypertensive prevalence [n (%)] | 127 (10.85) | 193 (16.45) | 15.571 | 0.000 |
| Alcohol consumption [n (%)] | 396 (33.85) | 454 (38.70) | 5.980 | 0.014 |
| Cigarette smoking [n (%)] | 294 (25.13) | 347 (29.58) | 5.847 | 0.016 |
| Total energy (kJ/day) | 8,853.39 ± 368.72 | 8,990.45 ± 388.26 | 8.761 | 0.000 |
| Fat (% of energy) | 9.7 ± 2.6 | 12.5 ± 3.9 | 20.441 | 0.000 |
| Carbohydrate (% of energy) | 77.9 ± 8.3 | 72.3 ± 7.6 | 17.033 | 0.000 |
| Protein (% of energy) | 8.6 ± 2.5 | 10.3 ± 3.8 | 12.789 | 0.000 |
| Alcohol (% of energy) | 3.8 ± 1.6 | 4.9 ± 2.1 | 14.259 | 0.000 |
| Carbohydrate (g/day) | 411.99 ± 17.21 | 388.30 ± 15.26 | 35.255 | 0.000 |
| Protein (g/day) | 45.48 ± 5.73 | 55.32 ± 7.78 | 34.850 | 0.000 |
| Animal (%) | 26.8 ± 3.2 | 34.6 ± 4.3 | 49.799 | 0.000 |
| Vegetable (%) | 73.2 ± 7.2 | 65.4 ± 6.7 | 27.146 | 0.000 |
| Total fat (g/day) | 22.80 ± 3.74 | 29.84 ± 4.15 | 43.129 | 0.000 |
| Saturated (g/day) | 5.71 ± 2.19 | 9.23 ± 3.25 | 30.735 | 0.000 |
| Monounsaturated (g/day) | 7.24 ± 2.86 | 9.72 ± 5.56 | 13.571 | 0.000 |
| Polyunsaturated (g/day) | 9.85 ± 3.88 | 10.89 ± 4.74 | 5.810 | 0.000 |
| Dietary cholesterol (mg/day) | 179.43 ± 102.78 | 198.76 ± 108.49 | 4.427 | 0.000 |
| Total dietary fiber (g/day) | 9.38 ± 3.08 | 7.76 ± 2.68 | 13.582 | 0.000 |
| Sodium intake (g/day) | 7.17 ± 2.36 | 7.77 ± 2.56 | 5.898 | 0.000 |

BMI, body mass index.

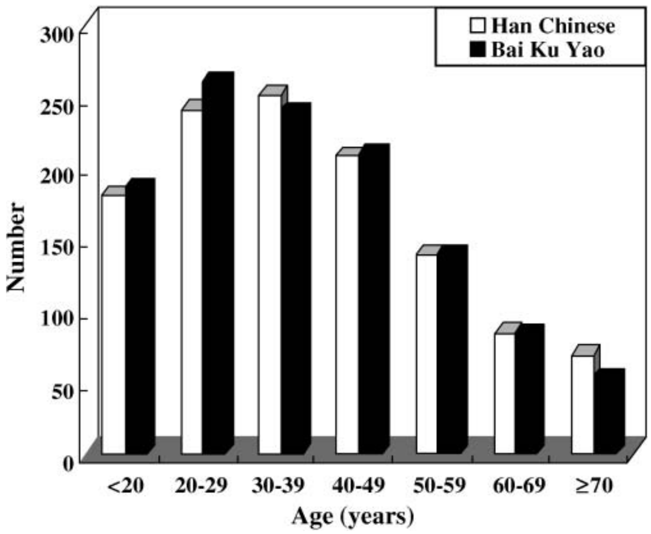


**Fig. 1.** The age structure of the Bai Ku Yao and Han populations.

between Bai Ku Yao and Han are shown in **Tables 2–4**. The levels of TG in both ethnic groups were higher in males than in females, but the levels of TC, LDL-C, and apoB in Bai Ku Yao and HDL-C and apoA-I in Han were lower in males than in females ($P < 0.05$–$0.001$). The ratio of apoA-I to apoB in both ethnic groups was lower in subjects with BMI $> 24$ kg/m$^2$ than in subjects with BMI $\leq 24$ kg/m$^2$, but the levels of TC, TG, LDL-C, and apoB in both ethnic groups were higher in subjects with BMI $> 24$ kg/m$^2$ than in subjects with BMI $\leq 24$ kg/m$^2$ ($P < 0.05$–$0.001$).

The levels of TC, TG, HDL-C, LDL-C, apoA-I, and apoB in both ethnic groups were higher in hypertensives than in normotensives ($P < 0.05$–$0.001$). The levels of TC, TG, HDL-C, apoA-I, and apoB in both ethnic groups were higher in drinkers than in nondrinkers ($P < 0.05$–$0.001$). The levels of TC, TG, HDL-C, and apoA-I and the ratio of apoA-I to apoB in Bai Ku Yao and the level of TG in Han were higher in smokers than in nonsmokers ($P < 0.05$–$0.001$). The levels of TC, TG, HDL-C, and apoA-I and the ratio of apoA-I to apoB in Bai Ku Yao and the levels of TC, TG, HDL-C, apoA-I, and apoB in Han were influenced by the amount of alcohol consumed ($P < 0.05$–$0.001$). The levels of TG, HDL-C, and apoA-I and the ratio of apoA-I to apoB in Bai Ku Yao and the levels of TG, HDL-C, and apoB in Han were also associated with the number of cigarettes smoked ($P < 0.05$–$0.001$). However, alcohol consumption and cigarette smoking did not affect the levels of LDL-C in either ethnic group. As shown in Table 2, there were significant differences in TC, HDL-C, LDL-C, apoA-I, and apoB levels for the seven age subgroups in both ethnic groups.

### Risk factors of hyperlipidemia between Bai Ku Yao and Han

**Table 5** gives the results of unconditional multiple logistic regression analysis between Bai Ku Yao and Han. Hyperlipidemia was positively correlated with BMI, waist circumference, and total energy and total fat intakes and negatively associated with physical activity and total dietary fiber intake in Bai Ku Yao ($P < 0.05$–$0.001$) but it was positively associated with age, alcohol consumption, BMI, waist circumference, and total energy and total fat intakes and inversely correlated with the levels of physical activities and total dietary fiber intake in Han ($P < 0.05$–$0.001$). There was no significant correlation between hyperlipidemia and sex, educational level, dietary cholesterol, salt intake, cigarette smoking, or hypertension in either ethnic group ($P > 0.05$).

### Lipid levels between Lihu and Baxu villages of Bai Ku Yao

As shown in **Table 6**, the levels of TG were higher but the levels of TC, HDL-C, LDL-C, apoA-I, and apoB were lower in Lihu than in Baxu of Bai Ku Yao ($P < 0.001$ for all). There was no significant difference in the ratio of apoA-I to apoB between the two villages ($P > 0.05$).

## DISCUSSION

The present study shows that the levels of serum TC, HDL-C, LDL-C, apoA-I, and apoB in Bai Ku Yao were lower than those in Han. These findings are similar to those of our previous studies in Hei Yi Zhuang (24, 25), another special ethnic subgroup of Zhuang in China. Variation in serum lipid profiles is affected by multiple genetic and environmental factors (1, 2). Although Bai Ku Yao and Han reside in the same region, there were differences in their diet that might account for the observed differences in serum lipid profiles. Corn, which has abundant dietary fiber and high-quality protein (30), was their staple food all year. Dietary fiber can decrease serum cholesterol levels in healthy and hyperlipidemic subjects (31, 32). Plant protein can promote the transportation and excretion of free cholesterol (30, 33). Corn oil is enriched with polyunsaturated fatty acids and monounsaturated fatty acids (34), and it is mostly used for cooking by Bai Ku Yao. A great deal of research has indicated that suitable intakes of polyunsaturated fatty acids and monounsaturated fatty acids can decrease serum cholesterol and LDL-C levels (34–36).

The intake of soy is high in the Bai Ku Yao population. Dietary soy protein has well-documented beneficial effects on serum lipid concentrations. Several meta-analyses involving 10–38 randomized controlled trials showed that soy protein with isoflavones intact was associated with significant decreases in serum TC by 3.77–9.30%, LDL-C by 5.25–12.90%, and TG by 7.27–10.50% and significant increases in serum HDL-C by 2.40–3.03%. Furthermore, the reductions in TC and LDL-C were greater in men than in women and the changes in serum TC and LDL-C concentrations were directly related to the initial serum TC concentration (37–39).

Buckwheat product is also a subsidiary food of Bai Ku Yao. Kayashita, Shimaoka, and Nakajoh (40) found that buckwheat protein product has a potent hypocholesterolemic activity in rats. This activity is far stronger than that of soy protein isolate (41, 42). Their further studies suggested that the cholesterol-lowering effect of

TABLE 2. Effects of demographic, dietary, and lifestyle characteristics on the lipid levels between Bai Ku Yao and Han

| Characteristics | n | TC | TG | HDL-C | LDL-C | ApoA-I | ApoB | ApoA-I/ApoB |
|---|---|---|---|---|---|---|---|---|
| | | *mmol/l* | | | | *g/l* | | |
| Bai Ku Yao | 1,170 | 4.16 ± 0.89 | 1.25 ± 0.97 | 1.57 ± 0.42 | 2.45 ± 0.71 | 1.23 ± 0.32 | 0.81 ± 0.22 | 1.64 ± 0.71 |
| Male | 588 | 4.10 ± 0.99 | 1.36 ± 1.18 | 1.56 ± 0.46 | 2.37 ± 0.78 | 1.24 ± 0.37 | 0.77 ± 0.23 | 1.76 ± 0.88 |
| Female | 582 | 4.23 ± 0.78$^{a}$ | 1.14 ± 0.66$^{b}$ | 1.59 ± 0.37 | 2.53 ± 0.62$^{b}$ | 1.22 ± 0.26 | 0.85 ± 0.20$^{b}$ | 1.52 ± 0.46$^{b}$ |
| BMI ≤ 24 (kg/m$^2$) | 992 | 4.08 ± 0.85 | 1.20 ± 0.85 | 1.56 ± 0.42 | 2.39 ± 0.68 | 1.21 ± 0.32 | 0.79 ± 0.22 | 1.66 ± 0.72 |
| BMI > 24 (kg/m$^2$) | 178 | 4.62 ± 0.98$^{b}$ | 1.56 ± 1.40$^{b}$ | 1.64 ± 0.39$^{a}$ | 2.81 ± 0.76$^{b}$ | 1.32 ± 0.31$^{b}$ | 0.91 ± 0.21$^{b}$ | 1.54 ± 0.66$^{a}$ |
| Normotensive | 1,043 | 4.12 ± 0.88 | 1.22 ± 0.91 | 1.56 ± 0.41 | 2.42 ± 0.70 | 1.21 ± 0.31 | 0.80 ± 0.22 | 1.63 ± 0.68 |
| Hypertensive | 127 | 4.51 ± 0.88$^{b}$ | 1.47 ± 1.32$^{a}$ | 1.72 ± 0.46$^{b}$ | 2.67 ± 0.76$^{b}$ | 1.38 ± 0.36$^{b}$ | 0.89 ± 0.23$^{b}$ | 1.73 ± 0.93 |
| Nondrinker | 774 | 4.07 ± 0.79 | 1.13 ± 0.61 | 1.49 ± 0.37 | 2.44 ± 0.62 | 1.15 ± 0.26 | 0.80 ± 0.21 | 1.53 ± 0.53 |
| Drinker | 396 | 4.34 ± 1.03$^{b}$ | 1.49 ± 1.40$^{b}$ | 1.73 ± 0.46$^{b}$ | 2.48 ± 0.85 | 1.39 ± 0.37$^{b}$ | 0.83 ± 0.23$^{a}$ | 1.85 ± 0.94$^{b}$ |
| Nonsmoker | 876 | 4.13 ± 0.83 | 1.21 ± 0.86 | 1.54 ± 0.40 | 2.45 ± 0.64 | 1.20 ± 0.30 | 0.80 ± 0.22 | 1.60 ± 0.67 |
| Smoker | 294 | 4.27 ± 1.06$^{a}$ | 1.38 ± 1.23$^{c}$ | 1.68 ± 0.46$^{b}$ | 2.46 ± 0.88 | 1.34 ± 0.37$^{b}$ | 0.82 ± 0.23 | 1.77 ± 0.82$^{b}$ |
| Age < 20 years | 185 | 3.66 ± 0.61 | 1.26 ± 0.51 | 1.30 ± 0.29 | 2.12 ± 0.46 | 1.00 ± 0.19 | 0.69 ± 0.17 | 1.55 ± 0.54 |
| 20–29 | 261 | 3.98 ± 0.93 | 1.18 ± 0.69 | 1.43 ± 0.38 | 2.36 ± 0.73 | 1.12 ± 0.27 | 0.78 ± 0.21 | 1.52 ± 0.61 |
| 30–39 | 239 | 4.21 ± 0.81 | 1.31 ± 1.34 | 1.61 ± 0.37 | 2.46 ± 0.65 | 1.27 ± 0.30 | 0.82 ± 0.21 | 1.67 ± 0.67 |
| 40–49 | 210 | 4.46 ± 0.93 | 1.30 ± 1.05 | 1.76 ± 0.40 | 2.64 ± 0.78 | 1.38 ± 0.33 | 0.86 ± 0.23 | 1.76 ± 0.90 |
| 50–59 | 139 | 4.38 ± 0.90 | 1.18 ± 0.89 | 1.73 ± 0.44 | 2.60 ± 0.74 | 1.35 ± 0.33 | 0.87 ± 0.25 | 1.73 ± 0.89 |
| 60–69 | 83 | 4.39 ± 0.88 | 1.15 ± 0.65 | 1.69 ± 0.48 | 2.64 ± 0.70 | 1.35 ± 0.39 | 0.86 ± 0.21 | 1.67 ± 0.65 |
| ⩾70 | 53 | 4.50 ± 0.76 | 1.50 ± 1.47 | 1.70 ± 0.39 | 2.65 ± 0.68 | 1.32 ± 0.29 | 0.87 ± 0.19 | 1.60 ± 0.58 |
| *F* for seven age subgroups | – | 21.107 | 1.321 | 36.094 | 13.481 | 42.139 | 16.581 | 3.093 |
| *P* for seven age subgroups | – | 0.000 | 0.244 | 0.000 | 0.000 | 0.000 | 0.000 | 0.005 |
| Han | 1,173 | 4.66 ± 1.01$^{d}$ | 1.31 ± 1.38 | 1.90 ± 0.50$^{d}$ | 2.54 ± 0.74$^{e}$ | 1.40 ± 0.25$^{d}$ | 0.88 ± 0.22$^{d}$ | 1.67 ± 0.50 |
| Male | 589 | 4.62 ± 1.07$^{d}$ | 1.42 ± 1.74 | 1.86 ± 0.53$^{d}$ | 2.50 ± 0.76$^{e}$ | 1.38 ± 0.25$^{d}$ | 0.88 ± 0.22$^{d}$ | 1.66 ± 0.55$^{f}$ |
| Female | 584 | 4.69 ± 0.96$^{d}$ | 1.20 ± 0.86$^{c}$ | 1.93 ± 0.47$^{a,d}$ | 2.58 ± 0.73 | 1.42 ± 0.24$^{c,d}$ | 0.89 ± 0.22$^{e}$ | 1.67 ± 0.46$^{d}$ |
| BMI ⩽ 24 (kg/m$^2$) | 927 | 4.54 ± 0.95$^{d}$ | 1.18 ± 0.95 | 1.91 ± 0.51$^{d}$ | 2.46 ± 0.72$^{f}$ | 1.39 ± 0.25$^{d}$ | 0.86 ± 0.21$^{d}$ | 1.70 ± 0.49 |
| BMI > 24 (kg/m$^2$) | 246 | 5.11 ± 1.12$^{b,d}$ | 1.80 ± 2.32$^{b}$ | 1.86 ± 0.49$^{d}$ | 2.83 ± 0.76$^{b}$ | 1.43 ± 0.23$^{a,d}$ | 0.99 ± 0.22$^{b,d}$ | 1.52 ± 0.52$^{b}$ |
| Normotensive | 980 | 4.58 ± 0.95$^{d}$ | 1.24 ± 1.12 | 1.88 ± 0.49$^{d}$ | 2.50 ± 0.72$^{f}$ | 1.38 ± 0.24$^{d}$ | 0.87 ± 0.21$^{d}$ | 1.66 ± 0.46 |
| Hypertensive | 193 | 5.06 ± 1.22$^{b,d}$ | 1.66 ± 2.24$^{c}$ | 2.00 ± 0.56$^{c,d}$ | 2.72 ± 0.84$^{b}$ | 1.48 ± 0.27$^{c,d}$ | 0.95 ± 0.24$^{a,b}$ | 1.68 ± 0.69 |
| Nondrinker | 719 | 4.55 ± 1.01$^{d}$ | 1.20 ± 0.89 | 1.80 ± 0.46$^{d}$ | 2.55 ± 0.77$^{b}$ | 1.35 ± 0.25$^{d}$ | 0.86 ± 0.23$^{d}$ | 1.65 ± 0.48$^{d}$ |
| Drinker | 454 | 4.82 ± 0.99$^{b,d}$ | 1.50 ± 1.90$^{c}$ | 2.05 ± 0.53$^{b,d}$ | 2.51 ± 0.70 | 1.47 ± 0.22$^{b,d}$ | 0.92 ± 0.21$^{b,d}$ | 1.69 ± 0.54$^{e}$ |
| Nonsmoker | 826 | 4.63 ± 0.98$^{d}$ | 1.24 ± 1.10 | 1.89 ± 0.49$^{d}$ | 2.54 ± 0.72$^{e}$ | 1.39 ± 0.25$^{d}$ | 0.88 ± 0.22$^{d}$ | 1.66 ± 0.43$^{f}$ |
| Smoker | 347 | 4.73 ± 1.09$^{d}$ | 1.49 ± 1.88$^{a}$ | 1.92 ± 0.54$^{d}$ | 2.52 ± 0.80 | 1.42 ± 0.24$^{d}$ | 0.90 ± 0.22$^{d}$ | 1.69 ± 0.64 |
| Age < 20 years | 180 | 3.90 ± 0.81$^{e}$ | 1.17 ± 0.72 | 1.50 ± 0.39$^{d}$ | 2.16 ± 0.61 | 1.12 ± 0.21$^{d}$ | 0.68 ± 0.16 | 1.73 ± 0.44$^{d}$ |
| 20–29 | 241 | 4.58 ± 0.92$^{d}$ | 1.14 ± 0.78 | 1.93 ± 0.48$^{d}$ | 2.47 ± 0.72 | 1.40 ± 0.17$^{d}$ | 0.89 ± 0.19$^{d}$ | 1.63 ± 0.39$^{f}$ |
| 30–39 | 251 | 4.66 ± 0.88$^{d}$ | 1.43 ± 1.58 | 1.93 ± 0.49$^{d}$ | 2.51 ± 0.66 | 1.44 ± 0.23$^{d}$ | 0.89 ± 0.19$^{d}$ | 1.69 ± 0.55 |
| 40–49 | 208 | 5.02 ± 1.15$^{d}$ | 1.56 ± 2.29 | 2.02 ± 0.47$^{d}$ | 2.71 ± 0.81 | 1.49 ± 0.23$^{d}$ | 0.95 ± 0.23$^{d}$ | 1.65 ± 0.46 |
| 50–59 | 139 | 5.00 ± 0.98$^{d}$ | 1.24 ± 0.90 | 2.01 ± 0.55$^{d}$ | 2.80 ± 0.84$^{f}$ | 1.47 ± 0.24$^{d}$ | 0.96 ± 0.22$^{b}$ | 1.62 ± 0.53 |
| 60–69 | 85 | 4.88 ± 0.80$^{d}$ | 1.34 ± 1.17 | 2.00 ± 0.44$^{d}$ | 2.66 ± 0.63 | 1.49 ± 0.25$^{e}$ | 0.91 ± 0.20 | 1.76 ± 0.77 |
| ⩾70 | 69 | 4.82 ± 1.07 | 1.20 ± 0.62 | 2.02 ± 0.49$^{d}$ | 2.67 ± 0.71 | 1.46 ± 0.23$^{e}$ | 0.96 ± 0.20$^{f}$ | 1.59 ± 0.45 |
| *F* for seven age subgroups | — | 28.519 | 2.460 | 26.624 | 14.640 | 60.985 | 41.501 | 1.771 |
| *P* for seven age subgroups | — | 0.000 | 0.023 | 0.000 | 0.000 | 0.000 | 0.000 | 0.102 |

ApoA-I, apolipoprotein A-I; HDL-C, high density lipoprotein cholesterol; LDL-C, low density lipoprotein cholesterol; TC, total cholesterol; TG, triglyceride.

[a] $P < 0.05$, [b] $P < 0.001$, [c] $P < 0.01$, compared with men, BMI ≤ 24 kg/m$^2$, normotensive, no drinking, or nonsmoker of the same ethnic group.

[d] $P < 0.001$, [e] $P < 0.01$, [f] $P < 0.05$, compared with the same subgroup of Bai Ku Yao.

buckwheat protein product is mediated by greater bile acid synthesis and fecal excretion of both neutral and acidic steroids and that the lower digestibility of buckwheat protein product is at least partially responsible for the effect (42–44).

The people of Bai Ku Yao are accustomed to drink hempseed soup. There are >29 fat-soluble constituents in hempseed, among which saturated and unsaturated fatty acid methyl esters account for 12.36% and 86.96%, respectively (45, 46). The main components of the fatty acids in hemp fruit oil are palmitic acid (8.43%), γ-linolenic acid (1.28%), linoleic acid (58.66%), linolenic acid (14.01%), oleic acid (10.14%), stearic acid (3.77%), and arachidonic acid (1.00%) (47). A number of experimental and clinical studies have demonstrated that the beneficial effects of hempseed or hempseed oil on lipid profiles include decreasing serum TC, TG, and LDL-C levels (48–52), inhibiting lipid peroxidation (50), reducing the atherogenic index (50), and increasing serum HDL-C levels (50, 51).

For nearly 50 years, it has been widely accepted that high-fat diets, particularly those that contain large quantities of saturated fatty acids, increase blood cholesterol concentrations and predispose individuals to cardiovascular disease (53). In the present study, we found that the intake of animal fat was less in Bai Ku Yao than in Han. The body weight, BMI, and waist circumference were also significantly lower in Bai Ku Yao than in Han.

Epidemiological studies have provided abundant evidence that lipid levels are closely related to age and sex (54–56). The results of our study are in agreement with those of previous studies. In the current study, however, we showed that the levels of TC, LDL-C, and apoB in Bai Ku Yao were lower in males than in females. These changes of serum lipid levels may be partly attributable to the beneficial effects of physical labor in men. Physical labor and





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TABLE 3. Effects of alcohol consumption on the lipid levels between Bai Ku Yao and Han

| Alcohol Consumption | n | TC | TG | HDL-C | LDL-C | ApoA-I | ApoB | ApoA-I/ApoB |
|---|---|---|---|---|---|---|---|---|
| | | *mmol/l* | | | | *g/l* | | |
| Bai Ku Yao | | | | | | | | |
| Nondrinker | 774 | 4.07 ± 0.79 | 1.13 ± 0.61 | 1.49 ± 0.37 | 2.44 ± 0.62 | 1.15 ± 0.26 | 0.80 ± 0.21 | 1.53 ± 0.53 |
| <25 g/day | 266 | 4.30 ± 0.88[a] | 1.43 ± 1.43[a] | 1.68 ± 0.42[a] | 2.49 ± 0.70 | 1.34 ± 0.33[a] | 0.84 ± 0.22 | 1.73 ± 0.80[a] |
| 25–49 g/day | 40 | 4.39 ± 1.61 | 1.49 ± 1.09 | 1.80 ± 0.55[a] | 2.48 ± 1.34 | 1.45 ± 0.43[a,b] | 0.80 ± 0.28 | 2.08 ± 1.16[a] |
| 50–99 g/day | 69 | 4.47 ± 1.23[a] | 1.81 ± 1.56[a,c] | 1.81 ± 0.50[a,b] | 2.47 ± 1.04 | 1.50 ± 0.42[a,c] | 0.82 ± 0.26 | 2.05 ± 1.07[a,c] |
| ⩾100 g/day | 21 | 4.33 ± 0.80 | 1.14 ± 0.42[d] | 1.98 ± 0.52[a,c] | 2.46 ± 0.76 | 1.57 ± 0.41[a,c] | 0.78 ± 0.24 | 2.33 ± 1.40[a,c] |
| *F* | — | 6.468 | 12.458 | 26.655 | 0.294 | 48.725 | 2.158 | 21.678 |
| *P* | — | 0.000 | 0.000 | 0.000 | 0.882 | 0.000 | 0.072 | 0.000 |
| Han | | | | | | | | |
| Nondrinker | 719 | 4.55 ± 1.01 | 1.20 ± 0.89 | 1.80 ± 0.46 | 2.55 ± 0.77 | 1.35 ± 0.25 | 0.86 ± 0.23 | 1.65 ± 0.48 |
| <25 g/day | 289 | 4.79 ± 0.92[a] | 1.33 ± 1.38 | 2.03 ± 0.47[a] | 2.55 ± 0.70 | 1.46 ± 0.21[a] | 0.93 ± 0.20[a] | 1.66 ± 0.52 |
| 25–49 g/day | 74 | 4.72 ± 0.85 | 1.37 ± 1.01 | 2.07 ± 0.52[a] | 2.39 ± 0.64 | 1.50 ± 0.22[a] | 0.89 ± 0.20 | 1.78 ± 0.54 |
| 50–99 g/day | 73 | 5.13 ± 1.34[a,c,e] | 2.14 ± 3.51[a,c,f] | 2.10 ± 0.70[a] | 2.57 ± 0.76 | 1.49 ± 0.25[a] | 0.95 ± 0.22[a] | 1.66 ± 0.49 |
| ⩾100 g/day | 18 | 4.58 ± 0.72 | 2.08 ± 2.11[e,g] | 2.06 ± 0.70 | 2.13 ± 0.62 | 1.46 ± 0.20 | 0.83 ± 0.21 | 1.94 ± 0.84 |
| *F* | — | 7.376 | 9.513 | 17.825 | 2.182 | 19.434 | 6.774 | 2.365 |
| *P* | — | 0.000 | 0.000 | 0.000 | 0.069 | 0.000 | 0.000 | 0.051 |

[a] $P < 0.01$, compared with nondrinker of the same ethnic group.
[b] $P < 0.05$, compared with <25 g/day of the same ethnic group.
[c] $P < 0.01$, compared with <25 g/day of the same ethnic group.
[d] $P < 0.05$, compared with 50–99 g/day of the same ethnic group.
[e] $P < 0.05$, compared with 25–49 g/day of the same ethnic group.
[f] $P < 0.01$, compared with 25–49 g/day of the same ethnic group.
[g] $P < 0.05$, compared with nondrinker of the same ethnic group.

activity are each significantly stronger among men than among women, especially in Bai Ku Yao.

An association between obesity and dyslipidemia has been shown in both men and women and in diverse race/ethnic groups (57–59). The results of the current study are in agreement with those of previous studies. Dyslipidemia in the obesity may partly result from insulin resistance (60, 61). Insulin resistance can increase plasma free fatty acid levels and stimulate the synthesis and release of VLDL. At the same time, insulin resistance can also suppress lipoprotein lipase activity and increase plasma VLDL levels.

Although light to moderate alcohol consumption has been shown to protect against the development of CHD and mortality (62), the dose-response relation between alcohol consumption and risk of CHD is J- or U-shaped (63), suggesting that the risk of CHD is greatest when alcohol consumption is high (64). The protective effects of regular, light to moderate alcohol consumption on CHD have been attributed to high serum HDL-C and apoA-I levels (62), the suppressed coagulation capacity of platelets, or the suspected role of antioxidant substances contained in alcoholic beverages (65). The harm-

TABLE 4. Effects of cigarette smoking on the lipid levels between Bai Ku Yao and Han

| Cigarette Smoking | n | TC | TG | HDL-C | LDL-C | ApoA-I | ApoB | ApoA-I/ApoB |
|---|---|---|---|---|---|---|---|---|
| | | *mmol/l* | | | | *g/l* | | |
| Bai Ku Yao | | | | | | | | |
| Nonsmoker | 876 | 4.13 ± 0.83 | 1.21 ± 0.86 | 1.54 ± 0.40 | 2.45 ± 0.64 | 1.20 ± 0.30 | 0.80 ± 0.22 | 1.60 ± 0.67 |
| <10 cigarettes/day | 74 | 4.31 ± 1.47 | 1.26 ± 1.05 | 1.68 ± 0.50[a] | 2.49 ± 1.21 | 1.33 ± 0.43[b] | 0.82 ± 0.25 | 1.69 ± 0.56 |
| 10–19 cigarettes/day | 63 | 4.17 ± 0.91 | 1.62 ± 1.76[b] | 1.60 ± 0.46 | 2.35 ± 0.69 | 1.29 ± 0.34[a] | 0.81 ± 0.21 | 1.74 ± 0.83 |
| 20–39 cigarettes/day | 139 | 4.27 ± 0.85 | 1.30 ± 0.96[c] | 1.72 ± 0.46[b] | 2.46 ± 0.75 | 1.36 ± 0.35[b] | 0.82 ± 0.22 | 1.83 ± 0.91[b] |
| ⩾40 cigarettes/day | 18 | 4.48 ± 0.98 | 1.72 ± 1.41 | 1.65 ± 0.40 | 2.60 ± 0.85 | 1.32 ± 0.33 | 0.87 ± 0.26 | 1.73 ± 1.02 |
| *F* | — | 1.994 | 4.044 | 7.578 | 0.571 | 11.318 | 0.608 | 3.742 |
| *P* | — | 0.093 | 0.003 | 0.000 | 0.684 | 0.000 | 0.657 | 0.005 |
| Han | | | | | | | | |
| Nonsmoker | 826 | 4.63 ± 0.98 | 1.24 ± 1.10 | 1.89 ± 0.49 | 2.54 ± 0.72 | 1.39 ± 0.25 | 0.88 ± 0.22 | 1.66 ± 0.43 |
| <10 cigarettes/day | 31 | 4.57 ± 0.96 | 1.16 ± 0.79 | 1.85 ± 0.52 | 2.54 ± 0.74 | 1.39 ± 0.26 | 0.85 ± 0.21 | 1.72 ± 0.55 |
| 10–19 cigarettes/day | 126 | 4.73 ± 1.18 | 1.50 ± 2.67 | 2.02 ± 0.53[b] | 2.42 ± 0.69 | 1.43 ± 0.21 | 0.88 ± 0.20 | 1.73 ± 0.62 |
| 20–39 cigarettes/day | 170 | 4.71 ± 1.00 | 1.44 ± 1.13 | 1.89 ± 0.55 | 2.56 ± 0.86 | 1.42 ± 0.25 | 0.91 ± 0.23 | 1.67 ± 0.69 |
| ⩾40 cigarettes/day | 20 | 5.14 ± 1.37 | 2.28 ± 2.07[b,c,d,e] | 1.70 ± 0.48 | 2.86 ± 0.85 | 1.39 ± 0.30 | 1.01 ± 0.28[a] | 1.47 ± 0.45 |
| *F* | — | 1.610 | 4.153 | 2.725 | 1.750 | 1.072 | 2.609 | 1.469 |
| *P* | — | 0.169 | 0.002 | 0.028 | 0.137 | 0.369 | 0.034 | 0.209 |

[a] $P < 0.05$, compared with nonsmoker of the same ethnic group.
[b] $P < 0.01$, compared with nonsmoker of the same ethnic group.
[c] $P < 0.05$, compared with 10–19 cigarettes/day of the same ethnic group.
[d] $P < 0.05$, compared with <10 cigarettes/day of the same ethnic group.
[e] $P < 0.05$, compared with 20–39 cigarettes/day of the same ethnic group.

TABLE 5. Relationship between hyperlipidemia and the demographic, dietary and other lifestyle factors in Bai Ku Yao and Han

| Populations | Risk Factors | Regression Coefficient | SEM | Wald | *P* | Odds Ratio |
|---|---|---|---|---|---|---|
| Han plus Bai Ku Yao | Ethnic group | 0.386 | 0.096 | 16.221 | 0.000 | 1.471 |
| | Sex | −0.125 | 0.121 | 1.062 | 0.303 | 0.883 |
| | Age | 0.093 | 0.032 | 8.223 | 0.004 | 1.098 |
| | Education level | −0.164 | 0.133 | 1.459 | 0.216 | 0.863 |
| | Physical activity | −0.221 | 0.105 | 9.265 | 0.003 | 1.212 |
| | Cigarette smoking | 0.087 | 0.050 | 3.037 | 0.081 | 1.091 |
| | Alcohol consumption | 0.141 | 0.055 | 6.699 | 0.010 | 1.152 |
| | BMI | 0.915 | 0.115 | 62.937 | 0.000 | 2.498 |
| | Waist circumference | 0.835 | 0.134 | 41.558 | 0.000 | 2.323 |
| | Hypertension | 0.259 | 0.185 | 1.964 | 0.161 | 1.296 |
| | Total energy | 0.575 | 0.143 | 10.366 | 0.001 | 1.324 |
| | Total fat | 0.551 | 0.135 | 17.997 | 0.000 | 1.676 |
| | Dietary cholesterol | 0.113 | 0.056 | 0.005 | 0.882 | 1.013 |
| | Total dietary fiber | −0.443 | 0.131 | 12.158 | 0.000 | 1.574 |
| | Salt intake | 0.266 | 0.241 | 1.336 | 0.252 | 1.245 |
| Han | Sex | −0.264 | 0.168 | 2.471 | 0.116 | 0.768 |
| | Age | 0.136 | 0.043 | 10.131 | 0.001 | 1.146 |
| | Education level | −0.156 | 0.152 | 2.122 | 0.102 | 0.764 |
| | Physical activity | −0.232 | 0.078 | 4.562 | 0.035 | 1.274 |
| | Cigarette smoking | 0.100 | 0.067 | 2.246 | 0.134 | 1.106 |
| | Alcohol consumption | 0.145 | 0.072 | 4.020 | 0.045 | 1.156 |
| | BMI | 0.988 | 0.153 | 41.469 | 0.000 | 2.687 |
| | Waist circumference | 0.763 | 0.248 | 14.674 | 0.000 | 2.233 |
| | Hypertension | 0.182 | 0.250 | 0.529 | 0.467 | 1.199 |
| | Total energy | 0.552 | 0.215 | 7.823 | 0.007 | 1.824 |
| | Total fat | 0.477 | 0.189 | 8.996 | 0.003 | 1.679 |
| | Dietary cholesterol | 0.049 | 0.055 | 0.118 | 0.703 | 1.025 |
| | Total dietary fiber | −0.424 | 0.245 | 4.972 | 0.036 | 1.616 |
| | Salt intake | 0.282 | 0.226 | 2.543 | 0.075 | 1.494 |
| Bai Ku Yao | Sex | −0.048 | 0.178 | 0.071 | 0.789 | 0.953 |
| | Age | 0.040 | 0.051 | 0.597 | 0.440 | 1.040 |
| | Education level | 0.011 | 0.212 | 0.012 | 0.833 | 1.034 |
| | Physical activity | −0.198 | 0.093 | 6.753 | 0.016 | 1.301 |
| | Cigarette smoking | 0.107 | 0.078 | 1.882 | 0.170 | 1.113 |
| | Alcohol consumption | 0.144 | 0.086 | 2.839 | 0.092 | 1.155 |
| | BMI | 0.844 | 0.179 | 22.284 | 0.000 | 2.326 |
| | Waist circumference | 0.876 | 0.177 | 27.563 | 0.000 | 2.396 |
| | Hypertension | 0.299 | 0.285 | 1.097 | 0.295 | 1.348 |
| | Total energy | 0.631 | 0.184 | 12.536 | 0.000 | 1.975 |
| | Total fat | 0.573 | 0.201 | 9.433 | 0.003 | 1.877 |
| | Dietary cholesterol | 0.039 | 0.026 | 0.236 | 0.553 | 1.026 |
| | Total dietary fiber | −0.625 | 0.202 | 10.369 | 0.001 | 1.973 |
| | Salt intake | 0.186 | 0.287 | 1.383 | 0.098 | 1.158 |

Individuals with TC > 5.17 mmol/l and/or TG > 1.70 mmol/l were defined as hyperlipidemic. The number of subjects with TC > 5.17 mmol/l, TG > 1.70 mmol/l, or both TC > 5.17 mmol/l and TG > 1.70 mmol/l was 109, 140, and 36 in Bai Ku Yao and 224, 91, and 83 in Han; respectively. Thus, 285 Bai Ku Yao and 398 Han subjects were classified as hyperlipidemic.

ful effects of heavy alcohol consumption on the lipid profiles may be attributable to an increase in plasma TG (64, 66). In the present study, we showed that alcohol consumption has disadvantageous effects on the lipid profiles in both populations. These findings may be related to the high daily alcohol consumption in these populations. The effect of different kinds of wine on the lipid profiles is not well known. In this study, 90% of the wine drunk by Bai Ku Yao was corn wine and rum, in which the alcohol content is lower. On the contrary, a great deal of the wine drunk by Han is rice wine, in which the alcohol content is higher.

Cigarette smoking is a well-established cardiovascular risk factor, and in our study, smoking appeared to have an unfavorable effect on the lipid profiles in both ethnic groups. Smoking may influence serum lipid levels by in-

TABLE 6. Comparison of serum lipid levels between Lihu and Baxu villages of Bai Ku Yao

| Villages | n | TC | TG | HDL-C | LDL-C | ApoA-I | ApoB | ApoA-I/ApoB |
|---|---|---|---|---|---|---|---|---|
| | | *mmol/l* | | | | *g/l* | | |
| Lihu | 602 | 4.05 ± 0.82 | 1.35 ± 0.91 | 1.49 ± 0.38 | 2.34 ± 0.65 | 1.17 ± 0.31 | 0.78 ± 0.23 | 1.63 ± 0.78 |
| Baxu | 568 | 4.28 ± 0.94 | 1.14 ± 1.00 | 1.66 ± 0.45 | 2.57 ± 0.75 | 1.30 ± 0.31 | 0.83 ± 0.21 | 1.65 ± 0.63 |
| *t* | — | 4.393 | 3.712 | 6.869 | 5.600 | 7.143 | 4.119 | 0.469 |
| *P* | — | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.639 |

creasing insulin resistance and lipid intolerance, decreasing lipoprotein lipase activity, increasing hepatic lipase, and decreasing lecithin:cholesterol acyltransferase activity (67). Smoking was also associated in a dose-dependent manner with reduced plasma HDL-C levels (68).

In the present study, we also showed that the levels of TG were higher but the levels of TC, HDL-C, LDL-C, apoA-I, and apoB were lower in the subjects of Bai Ku Yao in Lihu than in Baxu. The reason for this discrepancy is not yet known. The customs and cultures of both villages are similar, but the distance between the two villages is ~50 km. It is not clear whether geographical factors might be involved in the discrepancy of lipid levels between the two villages.

In conclusion, the present study reveals that the levels of serum TC, HDL-C, LDL-C, apoA-I, and apoB were lower in Bai Ku Yao than in Han Chinese. Hyperlipidemia was positively correlated with BMI, waist circumference, and total energy and total fat intakes and negatively associated with physical activity level and total dietary fiber intake in both ethnic groups, but it was positively associated with age and alcohol consumption only in Han. The differences in the lipid profiles between the two ethnic groups might result from different dietary habits, lifestyle choices, and/or levels of physical activities.

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