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Epidemiological analysis of dyslipidemia in adults of three ethnicities in Xinjiang, China

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ABSTRACT. This study investigated the prevalence and distribution of dyslipidemia in adults of Uygur, Kazak, and Han ethnicity in Xinjiang, China. A questionnaire including general data, physical examination (blood pressure, body height, and body weight) and blood lipid [total cholesterol (TC), triglyceride (TG), low-density lipoprotein cholesterol (LDL-C), and high-density lipoprotein cholesterol (HDL-C)] was administered to 11,506 adults in Xinjiang, China from 2009 to 2010 using a stratified sampling method. The overall prevalence rates of dyslipidemia in Uygur, Kazak, and Han adults were 42.4, 31.6, and 30.2%, respectively; they were 42.4, 31.8, and 28.2% after age standardization ($P < 0.01$). After standardization, the overall prevalence rates in Uygur, Kazak, and Han men were 52.6, 35.4, and 33.2%, respectively, which were significantly higher than that in women of the corresponding ethnicities ($P < 0.01$). In Uygur, Kazak, and Han adults, there were significant differences with respect to the standardized prevalence rates of high TG (9.3, 9.3, and 17.3%), high TC (5.2, 6.9, and 6%), low HDL-C (33.6, 20.8, and 11.1%), and high LDL-C (2.4, 2.9, and 2%) ($P < 0.05$). The prevalence rates of dyslipidemia in Uygur, Kazak, and Han adults in Xinjiang are higher than the average levels

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in China, with significant differences in ethnicity, age, and gender. Han adults exhibited the highest prevalence rate of high TG. Meanwhile, Uygur adults had the highest prevalence rate of low HDL-C. Kazak adults had high prevalence rates of high TC, low HDL-C, and high LDL-C.

Key words: Dyslipidemia; Prevalence rate; Kazakh; Uygur; Han

INTRODUCTION

Lipid metabolism disorder, also called dyslipidemia, is an important risk factor for cardiovascular and cerebrovascular atherosclerotic disease (Manuel et al., 2006; McPherson et al., 2006) and is closely related to hypertension (Halperin et al., 2006; Lewington et al., 2007), diabetes (Mooradian, 2009), overweight, and obesity (Chehrei et al., 2007). The prevalence rate of dyslipidemia in China is 18.6%, making it one of the main diseases affecting human health (Takahashi et al., 2013). Blood lipid levels and dyslipidemia prevalence rates differ by ethnicity (Merkin et al., 2009; Ford et al., 2010). The majority of residents in Xinjiang, China are Uygur, Kazak, or Han, which have different customs and traditional diets. Whether the high carbohydrate, high fat, and low vegetable intake of the Uygur and Kazak ethnicities causes increased blood lipid levels and whether their blood lipid levels are higher than those of Han ethnicity remain unknown. Therefore, in this study, the prevalence and distribution of dyslipidemia in adults of Uygur, Kazak, and Han ethnicity in Xinjiang, China were investigated by epidemiological analysis.

MATERIAL AND METHODS

Subjects

A total of 11,506 residents (>6 months) of Jiashi County of Kashi City, Nongbashi, Xinyuan County of Yining City, Shawan County of Tacheng City, and Manasi County of Changji City in Xinjiang, China who were ≥18 years old were enrolled in this study from 2009 to 2010 on the basis of stratified sampling according to village population size. This study was conducted in accordance with the Declaration of Helsinki and with approval from the Ethics Committee of Medical College of Shihezi University. Written informed consent was obtained from all participants. Long-term emigrants and fluid population were excluded. There were 3625, 4148, and 3733 subjects of Uygur, Kazak, and Han ethnicity, respectively.

Questionnaire

A unified questionnaire was administered through face-to-face interviews conducted by trained and qualified medical personnel. The questionnaire contents were as follows: 1) general data including age, gender, smoking history, drinking history, dietary habit, and disease history; 2) physical examination (unified method) including blood pressure, body height, and body weight; and 3) laboratory measurements. Fasting venous blood was collected, and blood biochemical indicators were detected using an OLYMPUS 2007 automatic biochemical

analyzer, including total cholesterol (TC), triglyceride (TG), low-density lipoprotein cholesterol (LDL-C), and high-density lipoprotein cholesterol (HDL-C). Blood collection, storage, and operational processes were strictly controlled.

Diagnostic standards

Dyslipidemia

According to the prevention standard proposed of dyslipidemia in China in 2007 (Joint Committee for Developing Chinese Guidelines on Prevention and Treatment of Dyslipidemia in Adults, 2007), TC ≥ 6.22 mM, TG ≥ 2.26 mM, LDL-C ≥ 4.14 mM, and HDL-C < 1.04 mM were indicative of hypercholesterolemia, hypertriglyceridemia, high LDL-C, and low HDL-C, respectively. An abnormality in any one of the parameters above was defined as dyslipidemia.

Overweight and obesity

Overweight and obesity were defined according to the Working Group on Obesity in China, 2004. Body mass index (BMI) was calculated as body weight (kg) / body height^2 (m^2). BMI ≥ 24 kg/m^2 and BMI ≥ 28 kg/m^2 indicated overweight and obesity, respectively.

Statistical analysis

The EpiData 3.02 software was used for double data input and logic check. Statistical analysis was performed using SPSS version 17.0. Measurement data are reported as means ± SD and analyzed using *t*-tests. All P values were two-sided. Numerical data are reported as percentages and analyzed using the χ^2 test and trend test. Multiple comparisons were adjusted by Bonferroni correction. Age was standardized according to the nationwide census data from 2000.

RESULTS

General data

Among 3625 Uyghur adults, there were 1773 men (48.9%) and 1852 women (51.1%) with an average age of 42.89 ± 15.95 years. Among 4148 Kazakh adults, there were 1649 men (39.8%) and 2499 (60.2%) with an average age of 44.14 ± 13.27 years. Among 3733 Han adults, there were 1563 (41.9%) and 2170 (58.1%) with an average age of 49.66 ± 12.24 years. The average age, gender, and all blood lipid parameters differed significantly among ethnicities (Table 1).

Overall prevalence rate of dyslipidemia

General comparison

As shown in Table 2, 1537, 1311, and 1127 residents of Uygur, Kazakh, and Han ethnicity had dyslipidemia, respectively, with overall prevalence rates of 42.4%, 31.6%, and

30.2%, respectively. After age standardization, the overall prevalence rates from high to low were 42.4% (Uygur), 31.8% (Kazak), and 28.2% (Han), showing significant differences among them (χ^2 = 179.87, P = 0.000). Multiple comparisons after Bonferroni correction revealed that the differences among the 3 groups were considered to be statistically significant (P < 0.001).

Table 1. General data in adults with Uygur, Kazak, and Han nationality.

Index	Uygur	Kazak	Han	χ^2/F	P
	N = 3625	N = 4148	N = 3733		
Gender (female/male)	1852/1773	2499/1649	2170/1563	70.82	0.000
Age	42.89 ± 15.95	44.14 ± 13.27	49.66 ± 12.24	252.07	0.000
TG (mM)	1.31 ± 1.03	1.24 ± 0.99	1.62 ± 1.34	123.39	0.000
TC (mM)	4.44 ± 1.20	4.55 ± 1.31	4.60 ± 1.10	15.77	0.000
HDL-C (mM)	1.16 ± 0.32	1.41 ± 0.62	1.61 ± 0.68	581.63	0.000
LDL-C (mM)	2.44 ± 0.81	2.40 ± 0.87	2.23 ± 0.93	58.63	0.000

Table 2. Comparisons of overall prevalence rate of dyslipidemia in three nationalities with different gender and age (%).

Age (years)	Uygur			Kazak			Han			Male		Female	
	Male	Female	Total	Male	Female	Total	Male	Female	Total	χ^2	P	χ^2	P
18-	53.7	31.1	42.2	35.8	33.3	34.3	25.4	26.2	25.8	32.76	0.000	2.04	0.361
30-	56.4	29.3	42.6	35.7	25.8	29.5	35.7	18.8	25.2	40.68	0.000	12.24	0.002
40-	53.3	30.4	40.8	35.4	27.0	30.1	42.3	23.9	31.1	23.97	0.000	5.54	0.063
50-	49.0	35.9	42.1	38.3	29.3	33.0	37.6	29.7	33.0	9.77	0.008	4.40	0.111
≥60	45.1	44.5	44.9	31.1	33.7	32.4	28.2	32.6	30.4	26.43	0.000	12.03	0.002
Total	51.8	33.4	42.4	35.6	29.0	31.6	35.4	26.4	30.2	125.85	0.000	24.05	0.000
Standardized total*	52.6	33.1	42.4	35.4	29.8	31.8	33.2	25.2	28.2	159.19	0.000	30.36	0.000

*Comparison of standardized total prevalence rate: Uygur *vs* Kazak (χ^2 = 93.579, P = 0.000); Uygur *vs* Han (χ^2 =163.646, P = 0.000); Kazakh *vs* Han (χ^2 =12.384, P = 0.000).

Age comparison

The overall prevalence rate of dyslipidemia among Uygur women, Han women, and Han (men + women) increased with increasing age (χ^2_{trend} = 14.97, P = 0.000; χ^2_{trend} = 19.89, P = 0.000; χ^2_{trend} = 5.99, P = 0.014; respectively). The overall prevalence rate in Uygur men decreased with increasing age (χ^2_{trend} = 8.18, P = 0.004). Among Kazak adults, the prevalence rate initially decreased and subsequently increased with age. The prevalence rate in men peaked at 50-59 years of age, decreasing significantly thereafter; meanwhile, that in women initially decreased and subsequently increased. The prevalence rate in Uygur adults reached a minimum at 40-59 years of age, gradually increasing thereafter. In contrast, the prevalence rate in Han men peaked at 40-59 years of age, gradually decreasing thereafter (Table 2).

Gender comparison

After standardization, the overall prevalence rates of dyslipidemia in Uygur, Kazak, and Han men were 52.6%, 35.4%, and 33.2%, respectively, with significant differences among them (χ^2 = 159.19, P = 0.000). The differences among different age groups were also sig-

nificant. The prevalence rates in Uygur, Kazak, and Han women were 33.1, 29.8, and 25.2%, respectively, with significant differences among them (χ^2 = 30.36, P = 0.000) (Table 2).

Blood lipid parameters

TG abnormality

The standardized prevalence rates of TG abnormality in Uygur, Kazak, and Han adults were 9.3, 9.3, and 17.3%, respectively. Multiple comparisons after Bonferroni correction showed that the prevalence rate in Han adults was the highest and significantly different from those of both Uygur and Kazak adults (P < 0.001). The prevalence rates in Uygur and Han adults increased with increasing age (χ^2_{trend} = 11.36, P = 0.001; χ^2_{trend} = 8.73, P = 0.001; respectively), whereas that in Kazak adults initially decreased and subsequently increased, peaking at 50-59 years of age. The prevalence rate in Uygur adults peaked at 40-49 years of age and was significantly higher than that in Kazak adults of the same age (P < 0.05). In Han adults, the prevalence rate increased with increasing age, decreasing at 40-49 years of age. The prevalence rate in Han adults in all age cohorts was higher than that in Kazak and Uygur adults (P < 0.05) (Table 3).

Table 3. Prevalence rates of TG abnormality in three nationalities with different gender and age (%).

Age (years)	Uygur			Kazak			Han			χ^2	P
	N1	N2	Prevalence rate (%)	N1	N2	Prevalence rate (%)	N1	N2	Prevalence rate (%)		
18-	894	53	5.9	633	57	9.0	178	27	15.2	18.43	0.000
30-	784	79	10.1	962	85	8.8	636	113	17.8	32.46	0.000
40-	768	86	11.2	1021	84	8.2	1066	164	15.4	26.12	0.000
50-	537	58	10.8	1005	125	12.4	963	185	19.2	26.25	0.000
≥60	642	70	10.9	527	49	9.3	890	191	21.5	50.87	0.000
Total	3625	346	9.5	4148	400	9.6	3733	680	18.2		
Standardized total			9.3			9.3			17.3	155.65	0.000

N1 = number of residents surveyed; N2 = number of residents with dyslipidemia.

TC abnormality

The standardized prevalence rates of TC abnormality in Uygur, Kazak, and Han adults were 5.2, 6.9, and 6%, respectively. Multiple comparisons after Bonferroni correction showed that there was a significant difference between Uygur and Kazak adults (P = 0.001). The prevalence rates among the 3 ethnicities increased gradually with increasing age (χ^2_{trend} = 59.36, P = 0.000; χ^2_{trend} = 43.15, P = 0.000; χ^2_{trend} = 18.09, P = 0.000; respectively) (Table 4).

HDL-C abnormality

The prevalence rates of HDL-C abnormality in Uygur, Kazak, and Han adults were 33.6, 20.8, and 11.1%, respectively. Multiple comparisons after Bonferroni correction showed that there were significant differences among the 3 ethnicities (P < 0.001). The prevalence rates in Uygur and Kazak adults decreased gradually with increasing age (χ^2_{trend} = 33.58, P = 0.000; χ^2_{trend} = 7.10, P = 0.008) (Table 5).

Table 4. Prevalence rates of TC abnormality in three nationalities with different gender and age (%).

Age (years)	Uygur			Kazak			Han			χ^2	P
	N1	N2	Prevalence rate (%)	N1	N2	Prevalence rate (%)	N1	N2	Prevalence rate (%)		
18-	894	23	2.6	633	35	5.5	178	11	6.2	10.67	0.005
30-	784	26	3.3	962	35	3.6	636	25	3.9	0.39	0.825
40-	768	50	6.5	1021	57	5.6	1066	57	5.3	1.19	0.551
50-	537	47	8.8	1005	118	11.7	963	70	7.3	11.89	0.003
≥60	642	56	8.7	527	70	13.3	890	84	9.4	7.56	0.023
Total	3625	202	5.6	4148	315	7.6	3733	247	6.6		
Standardized total			5.2			6.9			6.0	10.25	0.006

N1 = number of residents surveyed; N2 = number of residents with dyslipidemia.

Table 5. Prevalence rates of HDL-C abnormality in three nationalities with different gender and age (%).

Age (years)	Uygur			Kazak			Han			χ^2	P
	N1	N2	Prevalence rate (%)	N1	N2	Prevalence rate (%)	N1	N2	Prevalence rate (%)		
18-	894	331	37.0	633	159	25.1	178	18	10.1	61.92	0.000
30-	784	267	34.1	962	211	21.9	636	57	9.0	127.22	0.000
40-	768	237	30.9	1021	214	21.0	1066	173	16.2	56.69	0.000
50-	537	168	31.3	1005	132	13.1	963	147	15.3	85.75	0.000
≥60	642	202	31.5	527	89	16.9	890	58	6.5	164.90	0.000
Total	3625	1205	33.2	4148	805	19.4	3733	453	12.1		
Standardized total			33.6			20.8			11.1	552.82	0.000

N1 = number of residents surveyed; N2 = number of residents with dyslipidemia.

LDL-C abnormality

The prevalence rates of LDL-C abnormality in Uygur, Kazak, and Han adults were 2.4, 2.9, and 2%, respectively. Multiple comparisons after Bonferroni correction showed that there was no significant difference among the 3 ethnicities ($P > 0.0125$). The prevalence rates in Uygur and Kazak adults decreased gradually with increasing age ($\chi^2_{trend} = 31.96$, $P = 0.000$; $\chi^2_{trend} = 16.66$, $P = 0.000$; respectively) (Table 6).

Table 6. Prevalence rates of LDL-C abnormality in three nationalities with different gender and age (%).

Age (years)	Uygur			Kazak			Han			χ^2	P
	N1	N2	Prevalence rate (%)	N1	N2	Prevalence rate (%)	N1	N2	Prevalence rate (%)		
18-	894	9	1.0	633	9	1.4	178	3	1.7	0.86	0.650
30-	784	17	2.2	962	20	2.1	636	12	1.9	0.14	0.931
40-	768	23	3.0	1021	23	2.3	1066	22	2.1	1.78	0.411
50-	537	19	3.5	1005	59	5.9	963	21	2.2	17.95	0.000
≥60	642	26	4.0	527	28	5.3	890	21	2.4	8.67	0.013
Total	3625	94	2.6	4148	139	3.4	3733	79	2.1		
Standardized total			2.4			2.9			2.0	6.49	0.039

N1 = number of residents surveyed; N2 = number of residents with dyslipidemia.

DISCUSSION

Dyslipidemia is a risk factor for a variety of cardiovascular and cerebrovascular diseases and is affected by many factors including genetic factors, eating habits, and lifestyle (Gupta et al., 2009; Merkin et al., 2009). The present results demonstrate that there are obvious

differences in mean blood lipid levels among adults of 3 ethnicities in Xinjiang, China and that the overall prevalence rate is higher than that of residents aged ≥18 years in China in 2002 (18.6%) (Zhao et al., 2007). Among these 3 ethnicities, the prevalence rate of dyslipidemia was higher in men than women. Furthermore, the patterns of the prevalence rate differed among the ethnicities. The prevalence rate in men initially increased and subsequently decreased, which may be closely associated with men's social roles. Young men encounter unhealthy habits including smoking (Chelland Campbell et al., 2008), drinking, and overeating as a result of social interaction, increasing the risk of dyslipidemia. However, with increasing age and reduced social interaction, awareness protecting one's health increases, leading to the reduction of dyslipidemia risk. On the other hand, the prevalence rate of dyslipidemia in women initially decreases and subsequently increases. This may be closely related to changes in hormone levels. Maryfran et al. (Sowers et al., 2008) studied the relationship between sex hormones and blood lipid levels before and after menopause in 3302 Caucasians and non-Caucasians (42-52 years of age) in 7 cities and regions in the United States; they found that sex hormones can reduce LDL receptor levels as well as inhibit hepatic lipase activity, reducing the degradation of HDL; this increases the ratio of HDL-C to LDL-C. Furthermore, Stefania et al. (Ali and Al-Zaidi, 2011) studied the relationship between sex hormones and dyslipidemia before menostasia in 177 Caucasians and African-Americans and found that sex hormone level is an independent risk factor for dyslipidemia.

The present results show that Han adults had a higher TG level and prevalence rate of dyslipidemia than Kazak and Uygur adults. The Uygur subjects lived in plains, while the Kazakh subjects are nomadic and reside in mountainous areas. The staple foods of these 2 ethnicities are mainly wheaten food, beef, mutton, and dairy products, resulting in high fat intake. However, Uygur and Kazak adults have lower prevalence rates of high TG than Han adults. Whether this is related to the unique genetic factors of these 2 ethnicities requires further investigation (Sarwar et al., 2007). The standardized prevalence rates of high TG in Uygur and Kazak adults were 9.3%, which is substantially less than that of residents in the Beijing area (15.1%) (Cai et al., 2012) as well as the urban and rural adult residents of Liaoning province (17.8%) (Zhang et al., 2007). Meanwhile, the standardized prevalence rate of Han adults (17.3%) is not significantly different from that of adults in Beijing and Liaoning but is substantially higher than the national average.

The prevalence rates of high TC of all 3 ethnicities surveyed in the present study are lower than those of residents of the U.S. (16.2%) (Miller et al., 2011) and South Korea in 2005 (8.7%) (Lee et al., 2012) but higher than that of residents in China aged ≥18 years in 2010 (3.3%). This may be related to the high proportion of residents consuming a high-fat diet in this area. The prevalence rate of high TC increases with increasing age, whereas that in Kazak people increases significantly after 50 years of age and is higher than those in Uygur and Han people. The prevalence rates of low HDL-C in Uygur, Kazak, and Han adults were 33.6%, 20.8%, and 11.1%, respectively. The prevalence rates in Uygur and Kazak people are much higher than those in adult urban and rural residents in Liaoning (8.8%) (Zhang et al., 2007) and residents in Beijing (12.2%) (Cai et al., 2012); however, that in Han adults is close to those of the residents Liaoning and Beijing. The prevalence rates of all 3 ethnicities are lower than that of residents in China aged 18 years and above in 2010 (44.8%).

It is worth noting that the prevalence rates of low HDL-C in the present study were high in Uygur and Kazak adults, which decreased gradually with increasing age. The preva-

lence rates of low HDL-C in Uygur adults in all age groups were significantly higher than those in Han and Kazak adults. The prevalence rate of high LDL-C in Han adults (2%) is similar to that of residents in China aged ≥18 years in 2010 (2.1%) but higher than those in Uygur (2.9%) and Kazak adults (2.4%), and increases with increasing age. As part of the Population Architecture using Genomics and Epidemiology (PAGE) Study, Logan et al. (Dumitrescu et al., 2011) studied blood lipid genetic factors in different groups on the basis of a genome-wide association study (GWAS); they found that genes decisively influence HDL-C, LDL-C, and TG levels in Europeans, European-Americans, and non-European Americans. In the present study, there were significant differences among the 3 ethnicities with respect to the prevalence rates of the 4 studied blood lipid parameters. Therefore, these differences may be due to ethnic differences.

In conclusion, the prevalence rates of dyslipidemia in residents of Uygur, Kazak, and Han ethnicity in Xinjiang are higher than the average prevalence rate in China and differ with respect to ethnicity, age, and sex. The prevalence rates of high TG and low HDL-C were the highest in Han and Uygur adults, respectively. In Kazak adults, the prevalence rates of high TC, low HDL-C, and high LDL-C are all high. In this region, dyslipidemia should be prevented and treated differently according to ethnicity and age. Special attention should be paid to dyslipidemia in young men of Uygur and Kazak ethnicity.

Conflicts of interest

The authors declare no conflict of interest.

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