Comparative Analysis of the Differences in Metabolic Disorder and Atherosclerotic Cardiovascular Disease (Ascvd) Risk Between Han and Kazakh Populations in Xinjiang

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Abstract

Background: Our study aimed to analyse the characteristics of glucose and lipid metabolism in a healthy Han and Kazakh population in Barkol Kazakh Autonomous County.

Methods: We enrolled 4,400 subjects in Barkol Kazakh Autonomous County. The patients' basic characteristics were recorded, chemical parameters were tested, and the characteristics of glucose and lipid metabolism between the Han and Kazakh ethnic groups were evaluated.

Results: We found significant differences in glucose and lipid metabolism between Han and Kazakh people; individuals of the Han ethnicity had higher FPG and TGs but lower BMI, blood pressure, TC and LDL-C than those of the Kazakh ethnicity. Similar results remained after the participants were divided by sex. Regarding the detection rate of metabolic disorders, we observed higher rates of glucose and TG disorders but lower rates of TC, HDL-C and LDL-C disorders in individuals of the Han ethnicity than in those of the Kazakh ethnicity. For atherosclerotic cardiovascular disease (ASCVD) risk, the detection rate of an LDL-C level ≥ 4.1 mmol/L was significantly higher in Kazakh individuals than in Han individuals. However, regarding hyperglycaemic patients aged 40 years orolder with 1.8 ≤ LDL-C ≤ 4.9 mmol/L, the detection rate was higher in the Han individuals than in the Kazakh individuals. Similar results were also observed after we divided these participants by sex.

Conclusion: Our study evaluated metabolic disorders in the Han and Kazakh people in Balikun County and found that metabolic disorders showed sex, ethnic and metabolite component heterogeneity.

1. Introduction

With improvements in living conditions and changes in lifestyles, the prevalence of metabolic diseases is consistently increasing. Metabolic factors such as glucose and lipid metabolism disorders have been shown to be important risks for cardiovascular and cerebrovascular diseases[1, 2], which have become a worldwide burden and a prominent issue affecting human health. According to previous studies, age, sex, lifestyle habits, dietary habits, ethnicity and financial situation are all important factors affecting the incidence and distribution of metabolic, cardiovascular and cerebrovascular diseases in different regions[3, 4].

Xinjiang, as the largest province of our country, has 47 ethnic groups with different origins and various lifestyles, and among these people, many metabolic differences exist[5, 6]. Many previous studies have tried to explore the characteristics of people of different ethnicities in Xinjiang areas, and the related data offer many useful clues for health promotion in local populations[7, 8]. The Kazakh ethnicity, as the most populous nomadic ethnic group in Xinjiang, is highly representative among all ethnic groups in Xinjiang. Metabolic syndrome and cardiovascular diseases have been observed among Kazakhs in Xinjiang[9, 10], and these data are important in characterising the spectrum of metabolic and cardiovascular diseases.

Therefore, taking advantage of the 2016 national health examination in Xinjiang, we analysed the parameters of glucose and lipid metabolism among individuals who underwent a physical examination at the People's Hospital in Balikun County, thus calculating the rate of glucose and lipid metabolism disorders in this region as well as comparing the ethnic and sex differences between the Han and Kazakh nationalities.

Our study aimed to clarify the metabolic characteristics of the Han and Kazakh ethnicities in the Xinjiang region and offer some clues for the prevention and control of metabolic diseases in different ethnic groups in Xinjiang.

2. Materials And Methods

2.1. Ethics Statement

This study was approved by the ethics committee of People's Hospital in Balikun County in accordance with the principles of the second revision of the Declaration of Helsinki, and informed consent was obtained from participants before the investigation.

2.2. Subjects

A total of 4,400 participants who underwent a physical examination in Hami, Xinjiang from October to December 2016 were included in this study. Among these participants, 2,124, including 1,068 males and 1,056 females with an average age of 47.5 ± 12.7 years, were from the Han ethnic group. A total of 2,276 participants, including 1,114 males and 1,162 females with an average age of 46.8 ± 12.2 years, were from the Kazakh ethnic group. The inclusion criteria were as follows: (1) age 20–70 years, (2) blood relatives within three generations who had been residents in the sampling area for more than 20 years, and (3) absence of consanguineous relationships among the participants. In addition, according to the medical history questionnaire of each participant, we excluded patients with diabetes, malignant tumours, cardiovascular or cerebrovascular diseases or other severe infections that may have affected the results.

2.3. Instruments and Reagents

A BS-800M automatic biochemical analyser (XP-3100023, Mindray Bio-Medical Electronics Co. Ltd, Shenzhen) was used in this study. A triglyceride (TG) determination kit (oxidase method, Lot No. 141716023), total cholesterol (TC) determination kit (oxidase method, Lot No. 141616020), high-density lipoprotein cholesterol (HDL-C) determination kit (direct Method, Lot No. 142116013), and low-density lipoprotein cholesterol (LDL-C) determination kit (direct Method, Lot No. 142016017) were used. All kits were supplied by Mindray Bio-Medical Electronics Co. Ltd in Shenzhen. A fasting plasma glucose (FPG) testing kit (oxidase method, Lot No. 201605P0516, Shanghai Yulan Biotechnology Co., Ltd) was also employed.

2.4. Collection and Management of Specimens

Approximately 2 mL of venous blood was collected after an overnight 12 h fast using blood collection tubes coated with K2-EDTA anticoagulant. Tubes were centrifuged for 10 min at 3,500 r/min to collect upper level serum. Sample analysis was performed according to the user manual within 4 h after blood collection using a BS-800M automatic biochemical analyser. We performed quality control testing of kit batches; thus, the quality of all kit batches was assured.

2.5. Quantitative Estimation of Blood Biochemical Parameters

FPG levels were estimated using the glucose oxidase method. Serum TG levels were estimated using glycerol-3-phosphate oxidase, and serum TC levels were tested using the cholesterol oxidase method. HDL-C and LDL-C levels were measured by direct methods. The reference ranges for the blood tests are as follows: TGs (0 to 2.3 mmol/L), TC (0 to 5.6 mmol/L), HDL-C (1.15 to 4.00 mmol/L), LDL-C (0 to 4.11 mmol/L) and FPG (3.33 to 6.11 mmo/L). Intra-assay coefficients of variation were less than 1.5%, and inter-assay coefficients of variation were less than 2.5%; data quality was assured. Disorders of glucose and lipid metabolism were defined as follows according to the 2016 Chinese guidelines for the prevention and control of dyslipidaemia in adults: (1) FPG level ≥ 6.1 mmol/L; (2) TG level ≥ 2.3 mmol/L; (3) TC level ≥ 6.2 mmol/L; (4) HDL-C level < 1.0 mmol/L; (5) LDL-C level ≥ 4.1 mmol/L; and (6) presence of ASCVD risk defined by the following criteria: 1. LDL-C ≥ 4.9 mmol/L and 2. diabetic patients aged 40 years or older with LDL-C levels in the range of 1.8 mmol/L (70 mg/dL) ≤ LDL-c ≤ 4.9 mmol/L (190 mg/dL).

2.6. Statistical Analysis

Data analysis was performed using SPSS software (Statistical Program for Social Sciences, version 16.0). Tests for normality and homogeneity of variance were performed. The data are summarised as the mean ± SD or the median (interquartile range) for continuous variables and proportions for categorical variables. Differences in the clinical characteristics of the participants were assessed using the t-test or Kruskal Wallis test for continuous variables. Categorical variables were analysed using the Chi-square test. A significance level α of 0.05 was used; $p < 0.05$ indicated statistical significance.

3. Results

3.1. Comparison of general characteristics and glucose and lipid metabolism parameters of Han and Kazakh ethnic groups

The clinical characteristics of the participants are summarised according to ethnicity in Table 1. There was no significant difference in age or sex distribution between the two ethnic groups; thus, we can exclude their influence on glucose and lipid metabolism. There were statistically significant differences in body mass index (BMI), diastolic blood pressure (DP), systolic blood pressure (SP), FPG, TGs and TC ($p < 0.0001$). The levels of FPG and TGs in the patients of Han ethnicity were higher than those in patients of Kazakh ethnicity, whereas BMI, DP, SP, TC and LDL-C were higher in Kazakh individuals than in Han individuals. However, no significant difference was observed in HDL-C.

Table 1
Comparison of glucose and lipid metabolism parameters in Han and Kazak populations (± *s*)

Parameters	Han (*n* = 2 124)	Kazakh (*n* = 2 276)	P value
Age (years)	47.5 ± 12.7	46.8 ± 12.2	0.1093
Sex (Male/Female)	1068/1056	1114/1162	0.3754
BMI (kg/m^2)	26.31 ± 2.29	28.76 ± 5.17	**0.0020**
SP (mmHg)	127.23 ± 10.56	146.56 ± 15.24	**< 0.0001**
DP (mmHg)	88.19 ± 17.45	90.41 ± 14.77	**< 0.0001**
FPG (mmol/L)	5.32 (4.84, 6.09)	5.00 (4.44,5.53)	**< 0.0001**
TGs (mmol/L)	1.63 (1.04, 2.55)	1.11 (0.79, 1.52)	**< 0.0001**
TC (mmol/L)	4.61 (3.97, 5.29)	4.91 (4.10, 5.77)	**< 0.0001**
HDL-C (mmol/L)	1.20 (0.99, 1.44)	1.18 (0.96,1.46)	0.2259
LDL-C (mmol/L)	2.70 (2.18, 3.20)	2.86 (2.23, 3.57)	**< 0.0001**

Data are shown as the mean ± SD or the median (interquartile range). BMI: body mass index; SP: systolic blood pressure; DP: diastolic blood pressure; FPG: fasting plasma glucose; TGs: triglycerides; TC: total cholesterol; HDL-C: high-density lipoprotein cholesterol; LDL-C: low-density lipoprotein cholesterol. $p < 0.05$ was considered statistically significant.

3.2. Comparison of glucose and lipid metabolism parameters among males and females of the Han and Kazakh ethnic groups

As shown in Table 2, among males, elevated FPG and TG levels were observed in the Han population, whereas higher levels of TC and LDL-C were observed in the Kazakh population. The differences were all statistically significant ($p < 0.0001$). Among females, the FPG and TG levels in the Han population were higher than those in the Kazakh population, whereas the TC and HDL-C levels in the Kazakh population were higher than those in the Han population. There was no significant difference with respect to the level of LDL-C.

Table 2
Comparison of glucose and lipid metabolism parameters in men and women between the Han and Kazakh ethnic groups

Parameters	Male		P	Female		P value
	Han	Kazakh		Han	Kazakh	
N	1068	1114	–	1056	1162	–
FPG (mmol/L)	5.32 (4.81, 6.00)	5.10 (4.55, 5.66)	**< 0.0001**	5.32 (4.90, 6.20)	4.91 (4.40, 5.39)	**< 0.0001**
TGs (mmol/L)	1.76 (1.14, 2.76)	1.22 (0.90, 1.72)	**< 0.0001**	1.50 (1.00, 2.20)	1.01 (0.73, 1.36)	**< 0.0001**
TC (mmol/L)	4.58 (3.93, 5.28)	5.00 (4.19, 5.89)	**< 0.0001**	4.62 (4.01, 5.29)	4.86 (4.04, 5.64)	**< 0.0001**
HDL-C (mmol/L)	1.12 (0.94, 1.35)	1.12 (0.92, 1.38)	0.9203	1.29 (1.07, 1.53)	1.25 (1.01, 1.51)	0.0711
LDL-C (mmol/L)	2.70 (2.22, 3.22)	3.10 (2.48, 3.87)	**< 0.0001**	2.66 (2.14, 3.19)	2.66 (2.03, 3.29)	0.8815

Data are shown as the mean ± SD or the median (interquartile range). FPG: fasting plasma glucose; TGs: triglycerides; TC: total cholesterol; HDL-C: high-density lipoprotein cholesterol; LDL-C: low-density lipoprotein cholesterol. $p < 0.05$ was considered statistically significant.

3.3. Comparison of the detection rate of metabolism disorders in the Han and Kazakh ethnic groups

As shown in Table 3, there were significant differences in the detection rates of glucose and lipid metabolism disorders in the Han and Kazakh ethnic groups. For glucose and TG disorders, the detection rate among the Han population was higher than that among the Kazakh population. Regarding TC, HDL-C and LDL-C, the detection rates of disorders related to these parameters were all higher in the Kazakh population. For LDL-C levels ≥ 4.1 mmol/L, the detection rate was also significantly higher in the Kazakh population than in the Han population. However, among hyperglycaemic patients over 40 years old with 1.8 ≤ LDL-C ≤ 4.9 mmol/L, the detection rate was higher in the Han population than in the Kazakh population.

Table 3
Comparison of the detection rate of metabolic disorders in the Han and Kazakh ethnic groups

Ethnic group	High FPG	High TGs	High TC	Low HDL-C	High LDL-C	LDL-C > 4.9 mmol/L	Hyperglycaemic patients aged 40 years and older with 1.8 ≤ LDL-c ≤ 4.9 mmol/L
Han (n = 2124)	529 (24.9)	638 (30.0)	140 (6.6)	533 (25.1)	91 (4.3)	23 (1.1)	237 (11.2)
Kazak (n = 2276)	226 (9.9)	204 (9.0)	338 (14.9)	655 (28.8)	316 (13.9)	98 (4.3)	71 (3.1)
χ2	173.35	315.34	77.40	7.57	120.61	42.67	109.06
P value	**< 0.0001**	**< 0.0001**	**< 0.0001**	**0.0059**	**< 0.0001**	**< 0.0001**	**< 0.0001**

Data are shown as n (%). High FPG: fasting plasma glucose ≥ 7.0 mmol/L; High TGs: triglycerides ≥ 2.3 mmol/L; High TC: total cholesterol ≥ 6.2 mmol/L; Low HDL-C: high-density lipoprotein cholesterol ≤ 1.0 mmol/L; High LDL-C: low-density lipoprotein cholesterol ≥ 4.1 mmol/L.

3.4. Comparison of the detection rate of metabolic disorders among men and women in the Han and Kazakh ethnic groups

We further observed the gender differences in the detection rate of glucose and lipid metabolism disorders between the Han and Kazakh nationalities. As shown in Table 4, after dividing the participants by sex, we found that the detection rates of high FPG, high TGs, and hyperglycaemia in patients over 40 years old with 1.8 ≤ LDL-C ≤ 4.9 mmol/L were higher in the Han population than in the Kazakh population for both males and females. The detection rates of high TC, high LDL-C and LDL-C levels ≥ 4.1 mmol/L were higher in the Kazakh population than in the Han population in both males and females.

Table 4
Comparison of the detection rate of metabolic disorders among men and women of the Han and Kazakh ethnic groups n (%)

Ethnic group	High FPG		High TGs		High TC		Low HDL-C		High LDL-C		LDL-C higher than 4.9 mmol/L		Hyperglycaemic aged 40 years or with 1.8 ≤ LDL-c 4.9 mmol/L;	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Fe
Han (n = 2124)	251 (23.5)	278 (26.3)	389 (36.4)	249 (23.6)	78 (7.3)	62 (5.9)	340 (31.8)	193 (18.3)	48 (4.5)	43 (4.1)	9 (0.84)	14 (1.33)	108(10.11)	12
Kazakh (n = 2276)	138 (12.4)	88 (7.6)	143 (12.8)	61 (5.2)	198 (17.8)	140 (12.0)	388 (34.8)	267 (23.0)	224 (20.1)	92 (7.9)	73(6.55)	25 (2.15)	44(3.95)	27
χ2	45.98	141.20	164.53	154.60	54.10	25.50	2.20	7.44	121.82	14.31	49.16	2.18	31.95	80
P value	**< 0.0001**	**< 0.0001**	**< 0.0001**	**< 0.0001**	**< 0.0001**	**< 0.0001**	0.1381	**0.0064**	**< 0.0001**	**< 0.0001**	**< 0.0001**	0.1395	**< 0.0001**	**< (**

Data are shown as n (%). High FPG: fasting plasma glucose ≥ 7.0 mmol/L; High TGs: triglycerides ≥ 2.3 mmol/L; High TC: total cholesterol ≥ 6.2 mmol/L; Lo C: high-density lipoprotein cholesterol ≤ 1.0 mmol/L; High LDL-c: low-density lipoprotein cholesterol ≥ 4.1 mmol/L.

4. Discussion

According to our present data, we found that the prevalence of metabolic disorders is different between the Han and Kazakh populations. Compared with the Han population, the Kazakh population showed higher TC and LDL-C levels but lower FPG and TG levels, and similar results were also observed for the detection rate of metabolic disorders in the Han and Kazakh ethnic groups. Furthermore, these results were maintained after we divided these participants by sex.

The prevalence of metabolic syndrome has increased dramatically and has become a global public health focus. In this study, we tried to evaluate the glucose and lipid metabolism parameters in the Han and Kazakh ethnic groups, to find the metabolic characteristics in these groups. We observed differences in glucose and lipid metabolism between the Han and Kazakh ethnic groups, but the reason behind this phenomenon remains unknown. The Kazakh ethnic group in this county represents 35% of the total population. Their diet is rich in beef, mutton and dairy products, and they consume very little seafood, including shrimp, crab, and shellfish. Nang and milk tea are most frequently consumed for breakfast, and stir-fry or boiled meat are consumed for dinner. The high intake of high-protein, low-fibre foods has shifted the diet away from the traditional Chinese diet that is rich in low-protein food and characterised by a low intake of energy. The dietary energy intake is also slightly higher than the recommended standard of the Chinese dietary guidelines[11]. It is believed that this high-fat, high-protein and single type of food consumption in this area might be the primary reason for the high TC and high LDL-C detection rate relative to the national level[12, 13].

Similar to previous studies[14], we also observed sex differences in glucose and lipid metabolism among the Han and Kazakh populations. We found that most of the parameters and detection rate of metabolic disorders were all higher in men than in women. The sex differences in metabolic disorders between men and women may be related to dietary habits, lifestyle habits, hormones and other metabolic factors[15, 16]. This finding is an important clue for the management of sex-specific metabolic disease risk factors.

Among the detriments closely related to metabolic syndrome, cardiovascular and cerebrovascular diseases are the leading cause of death and disability, resulting in reduced quality of life and significant burdens on family and society[17]. Disorders of glucose and lipid metabolism eventually lead to metabolic syndrome and various cardiovascular and cerebrovascular diseases[18]. After lipid-lowering therapy, the risk of coronary heart disease and the incidence of cardiovascular and cerebrovascular disease decreases[19]. This study demonstrated that high FPG levels and high TG detection rates in the Han population in Balikun County were much higher than those in the Kazakh population, whereas the higher TC and LDL-C levels and high TC and LDL-C detection rates were significantly higher in the Kazakh population than in the Han population.

According to the 2016 Chinese guidelines for the prevention and control of dyslipidaemia in adults, LDL-C ≥ 4.9 mmol/L and 1.8 mmol/L (70 mg/dL) ≤ LDL-C ≤ 4.9 mmol/L (190 mg/L) in diabetic patients aged 40 years or over are both risk factors for ASCVD. For Kazakh people, LDL-C ≥ 4.9 mmol/L is the main ASCVD risk factor, and this value is much higher than in the Han population. Regarding 1.8 mmol/L (70 mg/dL) ≤ LDL-C ≤ 4.9 mmol/L (190 mg/L) in diabetic patients aged 40 years and over, the risk in the Han population was much higher than that in the Kazakh population. Analysing sex differences based on these two cut-off reference values, we observed similar patterns in both ethnic groups. Thus, ethnic differences with respect to ASCVD risk exist among the Han and Kazakh ethnic groups in Balikun County in Xinjiang, suggesting that future health education in this region should address the unique risks of different ethnic groups with respect to diabetes, coronary heart disease and ASCVD. Diabetes prevention and hypoglycaemia treatment are more important in the Han population, whereas the prevention of hyperlipidaemia and lipid-lowering treatment are more important in the Kazakh population.

The limitations of this study also deserve attention. First, due to limited manpower, material and time, we were unable to investigate the diet of the Han and Kazakh populations in this area during the study period. Second, the present data were obtained using a cluster sampling method and did not include physical examination data from the entire population. Therefore, bias may exist in the results. Future studies should focus on improvements in investigation methods

and should collect more comprehensive data to clearly reflect glucose and lipid metabolism disorders in this area in a more scientific manner. Third, we evaluated ASCVD risk only based on the status of glucose and lipid metabolism, and ASCVD prevalence in the real world was not recorded in this study.

In conclusion, our study examined the incidence of glucose and lipid metabolic disorders in the Han and Kazakh ethnic groups in Balikun County and observed the effects of differences in ethnicity, sex and region on glucose and lipid metabolism disorders and ASCVD risk. We found that the prevalence of metabolic disorders in the Han and Kazakh people in Balikun County were different with regard to sex, ethnicity and metabolite component heterogeneity. The risk of diabetes and increased TGs was higher in Han individuals, while the risk of increased LDL-C was higher in Kazakh individuals. This study provides a scientific basis and new idea for local ethnic groups for preventing and controlling cardiovascular and cerebrovascular diseases caused by metabolic disorders.

Abbreviations

TG
Triglyceride;
TC
total cholesterol;
HDL-C
high-density lipoprotein cholesterol;
LDL-C
low-density lipoprotein cholesterol;
FPG
fasting plasma glucose;
BMI
body mass index;
DP
diastolic blood pressure;
SP
systolic blood pressure;

Declarations

Data Availability

The data used to support the findings of this study areavailable from the corresponding author upon request.

Conflict of interest

The authors declare no competing interests.

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Author contributions

Yu-ping Sundid the drafting of this article, KahaerMayina,Xiao-boZhang and Bei Zhangdid the data collection, Ying Lu, Rui-rui Song, and San-san Yang did data analysis, Dandan Yandid the design of this manuscript, Cheng Hudid the critical revision of article, all the authors did the approval of article.

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