Int J Clin Exp Med 2015;8(12):22403-22410
www.ijcem.com /ISSN:1940-5901/IJCEM0011452

Original Article

Differences of prevalence of dyslipidemia and risk factors related to LDL-c in the patients with abnormal fasting glucose between Uygur and Han in Xinjiang

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Received June 15, 2015; Accepted September 7, 2015; Epub December 15, 2015; Published December 30, 2015

Abstract: Aims: To evaluate the incidence of dyslipidemia among Uygur and Han patients with impaired fasting glucose (IFG). To investigate the influence factors on LDL-c in this population. Methods: This cross-sectional study included a total of 4709 participants, consisting of Uygurs patients (n=2053) and Han patients (n=2656) from Xinjiang province, who were screened for diabetes mellitus. A stratified multistage sampling design was used to collect the participants. The influence factors on LDL-c were analyzed by Logistic regression analysis. Results: Among the IFG patients (n=1757), Uighur IFG group had a higher prevalence of dyslipidemia than that of Han IFG group, 99.8% vs. 63.7%, P<0.05. Similar trends were existed in the prevalence of hypercholesteremia, hypertriglyceridemia, high LDL-c and low HDL-c (all P<0.05). Among the Uighur groups, IFG group had higher dyslipidemia rate than that of euglycemia group (74%). However, there was no such difference in the Han groups. Logistic regression analysis revealed that risk factors associated with LDL-c were age, total cholesterol and 2 h postprandial blood glucose for the Uighur IFG patients. However, gender and total cholesterol were risk factors for Han IFG patients. Conclusions: Uighur IFG patients had higher incidence of dyslipidemia than that of Han IFG patients. For Uyghur IFG patients, closing follow-up of total cholesterol and 2 h postprandial blood glucose were necessary. As to the Han IFG patients, we should pay more attention to male and total cholesterol in order to lower LDL-c levels. So, appropriately preventive and therapeutic measures should be chosen based on the characteristics of abnormal lipid profiles in different nationality.

Keywords: Uygur, han nationality, IFG, dyslipidemia, LDL-c

Introduction

Pre-diabetes, defined as IFG and/or impaired glucose tolerance, represents an intermediate step in the pathogenesis to diabetes mellitus. The prevalence of pre-diabetes is predicted to steeply rise globally over the next few decades, from the currently estimated 314 million to 418 million in 2035 [1].

Horizontal and vertical epidemiological studies had showed that, IFG could decrease the quality of life [2]. IFG, as a key pre-diabetes condition at the early stage in the course of the diabetes natural disease, was reversible. By diet control, lifestyle modification and drug interventions, 10-30% of IFG patients could resort to euglycemia [3, 4]. Therefore, early screening and intervention for patients with IFG has important clinical significance.

Meanwhile, IFG and dyslipidimea were independent risk factors for T2DM and coronary heart disease (CHD) [5]. Dyslipidimea may contribute significantly to accelerating the progression of T2DM and CHD for IFG patients. Till now, there have been rare reports in view of the Uighur IFG group, whether coexists with various metabolic abnormalities. Our study is aimed to describe the difference of dyslipidemia between the Uygur and Han patients with IFG, and to analyze the possible influence factors on LDL-c. Our study was expected to provide more evidence-based medical information for the primary pre-

Table 1. The baseline characteristics of all complete physical examination (X ± SD)

Item	Uyghur		Han	
	Male	Female	Male	Female
Age (year)	49.44±13.07	46.43±11.39	48.42±12.14	44.91±10.58
BMI (Kg/M^2)	25.63±4.29	26.34±4.8	23.96±4.39	26.07±4.92
FPG (mmol/L)	5.58±2.59	5.32±1.9	5.76±1.40	5.46±0.99
PPG (mmol/L)	7.1±3.8	6.87±3.21	7.19±3.34	5.84±2.03
SBP (mmHg)	116.9±17.9	114.6±19.4	121.40±20.11	112.86±15.50
DBP (mmHg)	74.5±11.8	74.1±12.5	76.76±11.58	73.89±10.18
TC (mmol/L)	3.29±1.49	3.38±1.49	5.26±1.01	5.03±1.04
TG (mmol/L)	2.89±1.95	2.61±1.73	1.53±0.95	1.41±1.05
HDL-C (mmol/L)	1.22±0.32	1.23±0.31	1.50±0.55	1.44±0.55
LDL-C (mmol/L)	1.49±1.60	1.63±1.64	2.84±1.03	2.60±1.08
WC (cm)	89.86±12.12	89.23±12.51	84.61±10.11	80.32±10.51

Table 2. Physical and biochemical indexes of IFG patient group (X ± SE)

Item	Uyghur		Han	
	Male	Female	Male	Female
Age (year)	49.35±0.48	46.85±0.50	47.78±0.44	44.30±0.52
BMI (Kg/M^2)	25.92±0.26	27.16±0.26	24.20±0.17	26.86±0.25
PPG (mmol/L)	9.86±0.30	9.08±0.27	8.37±0.15	6.33±0.14
SBP (mmHg)	115.79±0.94	116.95±1.06	124.25±0.78	114.71±0.81
DBP (mmHg)	74.35±0.65	76.32±0.72	77.61±0.454	74.64±0.52
TC (mmol/L)	3.49±0.09	3.56±0.08	5.42±0.04	5.23±0.05
TG (mmol/L)	3.29±0.13	2.68±0.11	1.72±0.04	1.58±0.07
HDL-C (mmol/L)	1.20±0.02	1.17±0.02	1.51±0.02	1.41±0.03
LDL-C (mmol/L)	1.63±0.09	1.86±0.09	2.93±0.04	2.60±0.05
WC (cm)	91.45±0.70	92.20±0.72	86.53±0.37	81.98±0.52

vention of T2DM and CHD, and provide different therapeutic strategies for patients with different ethnics.

Subjects and methods

Objects of study

We analyzed data from a sample which were adopted a multistage, stratified clustering sampling scheme. Residents health information from cities of Urumqi, Altay and Kashi, was collected. Their ages were between 30 and 80 years old. The participants included Uighur and Han ethnics. This research was approved by the ethics committee from the first affiliated hospital of Xinjiang Medical University. Informed consents were obtained from all participants. The privacy rights of subjects must always be observed. All this study has complied with the recommendations of the Declaration of Helsinki (British Medical Journal, 1964, ii, 177).

Methods

The patients' demographic indicators were collected and put into computers by trained investigators. Blood pressure, height, weight, and waist circumference were measured according to the standard method and the body mass index (BMI) was calculated by the formula. Blood pressure was measured using an Omega-1400 automatic blood pressure monitor. The systolic blood pressure (SBP) and diastolic blood pressure (DBP) of each participant were measured 3 times using a mercury sphygmomanometer, with the participants in a sitting position, and after 15-min rest periods; the three values were then averaged. Waist circumference was measured at the narrowest point between the lower borders of the rib cage and iliac crest. The participants' BMI was calculated as weight (kg) divided by height squared (m). A fasting blood sample was obtained in the morning after at least an 8 h fast. The lab test indexes contained the levels of fasting plasma glucose (FPG), TC, TG, HDL-c, LDL-c and 2 h OGTT test blood sugar (PPG). Blood glucose was detected by Glucose Oxidase method and blood lipid was tested by enzymatic colorimetric method.

The definition of IFG refers to a FPG between 5.6 and 7.0 mmol/L without consumption of diabetic medication [6]. In addition, dyslipidemia was diagnosed if the patients meet any one of the following criteria [7]: (1) Hypercholesterolemia, TC≥5.18 mmol/L; (2) Hypertriglyceride, TG≥1.7 mmol/L; (3) High LDL-c, LDL-c≥3.37 mmol/L; (4) Low HDL-c, HDL-c< 1.04 mmol/L.

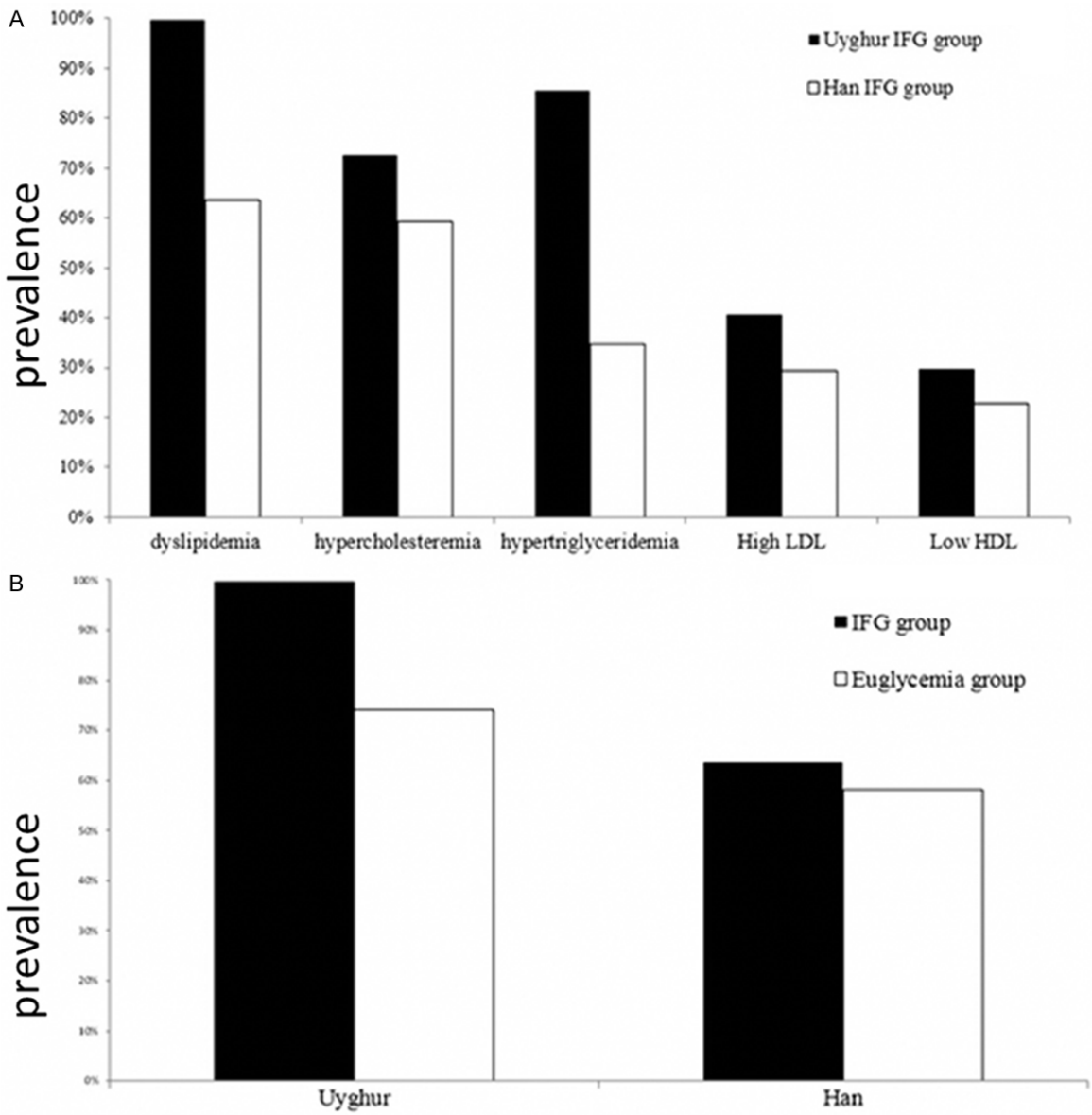

Figure 1. A. The prevalence comparison among groups, all $P<0.05$. B. The prevalence comparison in the group, all $P<0.05$.

Statistical analysis

For descriptive statistics, categorical variables were described using frequency distribution and percentage, and continuous variables were described using the mean and standard deviation (SD) or standard error (SE). For correlational statistics, an independent samples t-test and a chi-square test were adopted. For inferential statistics, logistic regression was performed to examine LDL-c related factors, as using the backward stepwise conditional method. The strength of association between the dependent variables was assessed using odds ratios (ORs). All reported *P*-values were two-tailed, and $P<0.05$ was considered statistically significant. All statistical analyses were performed using SPSS version 17.

Results

The number of completed surveys

A total of 2140 Uygur participated in the study, and 2053 subjects, including 969 men and 1084 women, provided the anthropometry measurements and laboratory data. The response rate was 95.93%. A total of 2700 Han subjects participated in the study, and 2656 anthropometry measurements and laboratory

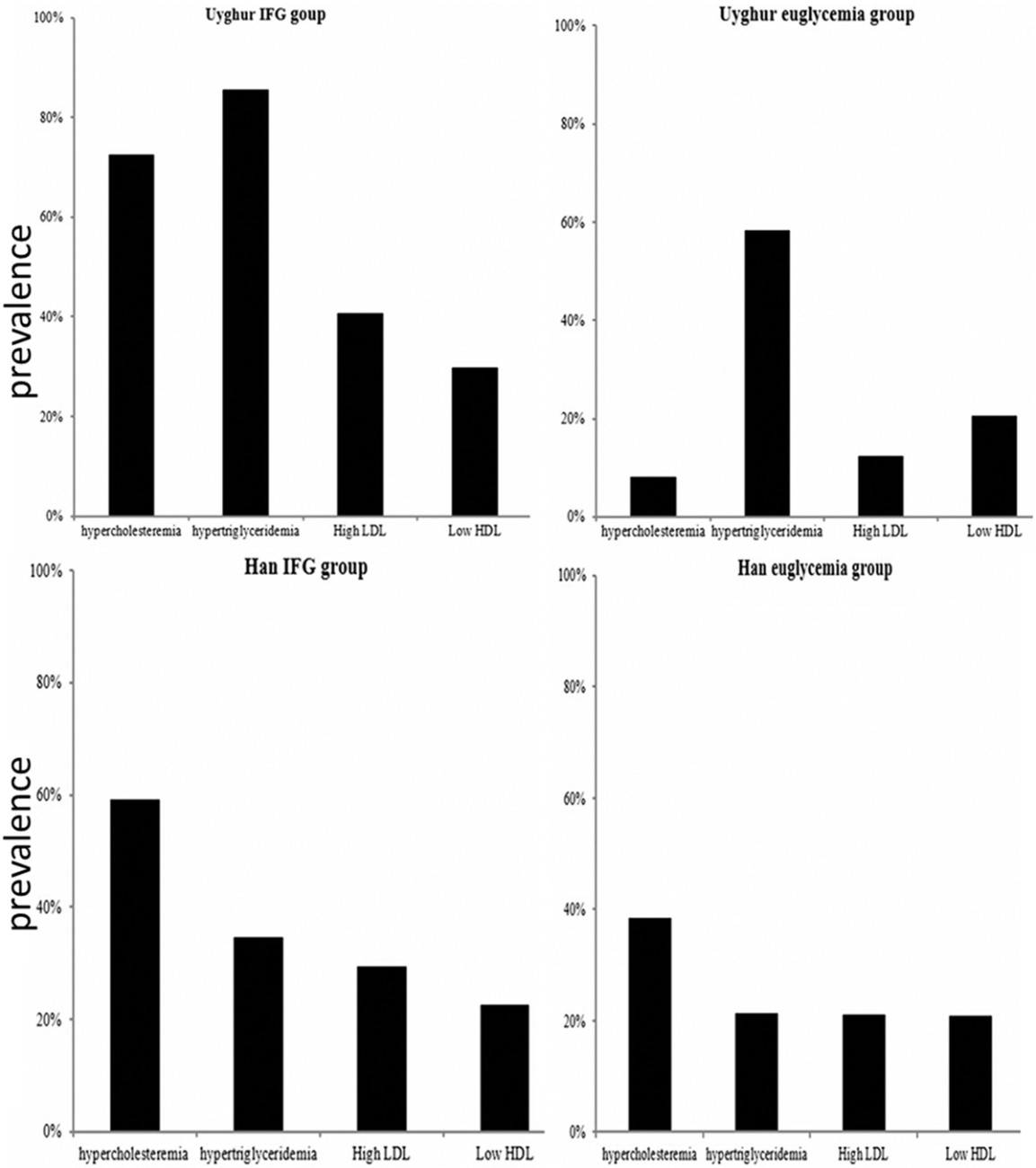

Figure 2. The prevalence comparison in the group, all $P<0.05$.

data, including 1588 men and 1068 women, were collected. The response rate was 98.37%. The anthropometric, geographic, and laboratory data were shown in **Table 1**.

IFG patients

Among 4709 screened participants, 1757 IFG patients were identified, accounting for 37.3%. It included 614 Uygur (296 men and 318 women) and 1143 Han patients (744 men and 399 women). The nationality, gender, age distribution, biochemical indicators and physical examination were displayed in **Table 2**.

The prevalence of dyslipidemia

Overall, among the IFG patients, the prevalence of dyslipidemia was higher in Uygur (99.8%) than in Han nationality (63.5%, P<0.05). Furthermore, for the Uighur IFG patients, the prevalence of hypercholesteremia, hypertriglyceridemia, high blood LDL-c disease and low HDL-c disease, all were higher than that of the

Table 3. Different gender: the different prevalence of blood lipid spectrum in the different race

Item	Uyghur		Han	
	Male	Female	Male	Female
Hypercholesteremia n (%)	222 (75%)	223 (70.1%)	462 (61.2%)*	215 (52.9%)
Hypertriglyceridemia n (%)	254 (85.8%)	271 (85.2%)	284 (38.2%)	113 (28.3%)
High LDL n (%)	155 (52.4%)*	95 (29.9%)	247 (33.2%)*	89 (22.3%)
Low HDL n (%)	83 (28.0%)	100 (31.4%)	139 (18.7%)	120 (30.1%)

Different gender: the difference in the Uyghur group (P<0.05*); the difference in the Han group (*P*<0.05*).

Table 4. Logistic regression analysis: the influence factors of LDL-c

Item	Uyghur				Han			
	B	OR	95% CI	P	B	OR	95% CI	P
Age (year)	0.072	0.931	0.818-1.059	0.027	-0.085	0.918	0.806-1.046	0.198
Gender M=1 F=0	-0.181	0.834	0.598-1.164	0.287	0.386	1.471	1.038-2.084	0.030
SBP (mmHg)	0.258	1.329	0.720-2.455	0.363	0.248	1.282	0.814-2.017	0.283
DBP (mmHg)	0.285	0.897	0.520-1.547	0.697	0.160	1.173	0.747-1.845	0.489
BMI (Kg/M^2)	-0.089	0.914	0.703-1.189	0.505	-0.001	0.999	0.956-1.044	0.962
WC (cm)	0.175	1.192	0.681-2.087	0.539	0.007	1.007	0.974-1.041	0.677
PPG (mmol/L)	0.585	1.795	1.256-2.564	0.001	0.008	1.008	0.813-1.250	0.944
TC (mmol/L)	0.960	1.550	1.020-1.580	0.035	2.846	1.722	1.077-2.756	0.000
TG (mmol/L)	-0.621	0.537	0.283-1.019	0.057	0.162	1.193	0.869-1.639	0.274
HDL-c (mmol/L)	-0.636	1.205	0.817-1.779	0.347	0.187	1.205	0.817-1.779	0.347

Han IFG patients (72.5% vs. 59.2%, 85.5% vs. 34.7%, 40.7% vs. 29.4%, 29.8% vs.22.7%; all P<0.05) (**Figure 1A**).

Compared with the corresponding euglycemia participants (the Uighur n=1317 and Han nationalities n=1349), the Uighur IFG patients had a dyslipidemia rate 99.8%, higher than that of euglycemia Uighur participants (74.0%, P< 0.05). For the Han nationality, the dyslipidemia rate in IFG patients and euglycemia participants were 63.7% and 58.2%, respectively, P>0.05 (**Figure 1B**).

In addition, no matter IFG group or euglycemia group, among Uighur groups, the characteristic of abnormal blood lipid spectrum was performed mainly on hypertriglyceridemia. While among the Han groups, it was performed primarily on hypercholesteremia (**Figure 2**).

Gender differences in the two ethnic IFG patients groups

Among Uyghur IFG patients, for the male, the prevalence of hypercholesteremia, hypertriglyceridemia, high LDL-c and low HDL-c, respectively was 75.0%, 85.8%, 52.4% and 28.0%; for the female the corresponding prevalence was 70.1%, 85.2%, 29.9% and 31.4%. In addition, male IFG patients had higher prevalence of high LDL-c disease than that of female (P<0.05).

Among the Han IFG patients, for the male, the prevalence of hypercholesteremia, hypertriglyceridemia, high blood LDL-c disease and low HDL-c disease, respectively was 61.2%, 38.2%, 33.2% and 18.7%; for female IFG patients, the corresponding prevalence was 53.9%, 28.3%, 22.3% and 30.1%. The gender differences were statistically significant in hypertriglyceridemia and high LDL-c disease (P<0.05) (**Table 3**).

The influence factors on LDL-c

Logistic regression was performed to examine LDL-c related factors: age, gender, SBP, DBP, BMI, WC, FPG, PPG, HDL-c, TC and TG. As shown in **Table 4**, the results showed that the following variables may significantly influence the level of LDL-c. For Uighur IFG patients, these variables were age, TC and PPG; while for Han IFG patients, only gender and TC may have an impact on the level of LDL-c.

Discussion

The prevalence of diabetes and pre-diabetes condition in adults above 18 years are 11.6% and 50.1% in china, according to a latest survey

[8]. The risk of new diabetes mellitus would be increased 7.85 times when FPG was rose up each additional 1 mmol/L from 5.6 mmol/L. While FPG>5.6 mmol/L (IFG), the tendency was increased 14.28 times [9]. In addition, in IFG population, the rate of artery intima-media thickness, atherosclerosis integral, the prevalence of CHD and stroke, risk of CHD related death and total mortality risk, were all significantly elevated compared to euglycemia population. There are high overlaps between pathogenic conditions of pre-diabetes and other abnormal metabolic parameters, such as abdominal obesity, hypertension and dyslipidemia [10, 11].

Some prospective study showed that the IFG often accompanied by a variety of dyslipidemia, principally high TG and LDL-c, and low HDL-c [12]. Our study showed that IFG patients in Xinjiang, the Uighur had near a hundred percent of dyslipidemia, higher than that of Han ethnic. Meanwhile, no matter IFG group or euglycemia group, among Uighur groups, the characteristic of abnormal blood lipid spectrum was performed mainly on hypertriglyceridemia. While among the Han groups, it was performed primarily on hypercholesteremia. In addition, as to the same ethnic IFG group, different gender had different characteristics of dyslipidemia. The difference of dyslipidemia prevalence and characteristics may be contributable to the following factors. First, the Uighur have a diet habit with high fatty meat, which may lead to dyslipidemia with higher level of TG. Second, compared with Han ethnic, the Uighur have different genetic background [13-16], which might be the cause of high incidence of dyslipidemia. The last, in view of the different incidence of dyslipidemia between male and female, sex hormone and different way of lifestyle might be the contributory causes, while the specific mechanisms were unknown.

Hyperglycemia and dyslipidemia could work together to have a detrimental effect on insulin sensitivity and insulin released [17]. TG≥1.7 mmol/L is an independent risk factor for IFG [18], because with the elevation of TG, insulin sensitivity could be significantly reduced. This phenomenon might be induced by the effects of TG on insulin receptor signaling pathways [17]. It may prompt that if the hypertriglyceridemia corrected, the progression of T2DM could be slowed down. In addition, for IFG patients, the progress into T2DM may be delayed by elevation of levels of HDL-c [19, 20]. HDL-c plays a major role in reverse transportation of cholesterol, anti-inflammation and anti-oxidation [21]. It may directly affect glucose metabolism by promoting insulin secretion and improving insulin sensitivity [22].

Some clinical studies found that the risk factors of cardiovascular disease begun to aggregate in patients with IFG, indicating that vascular damage may start in the IFG stage [23, 24]. Meanwhile, improvement of dyslipidimea in IFG states may bring to a reduction of cardiovascular disease in the future [25]. LDL-c is one of the key links in atherosclerosis. The risk of cardiovascular disease would decrease about 25% as long as its level decreases 1 mmol/L [26, 27].

Our study showed that the main factors influencing high LDL-c, for Uighur IFG patients, were age, TC and 2hPBG. While, for the Han IFG patients, the factors were male and TC. It is postulated that the influence factors for dyslipidemia in IFG patients may vary according to different ethnics. Based on this result, the preventive and therapeutic measures on dyslipidemia for IFG patients should be changed accordingly.

In conclusion, this study confirmed that the incidence of dyslipidemia has significantly increased in IFG patients. As to Uyghur IFG patients, the incidence of dyslipidemia was dramatically higher than that of Han nationality IFG and Uighur with euglycemia. Considering that dyslipidemia might lead to increasing risks of cardiovascular disease in the future, appropriate lipid-lowering drugs should be chosen based on the characteristics of abnormal lipid profiles in different ethnics. As to the Han patients, we should pay more attention to male and total cholesterol in order to lower LDL-c levels. For Uyghur IFG patients, total cholesterol and 2hPBG may be the important follow-up indexes.

Acknowledgements

This work was supported by the Natural fund project in xinjiang (Name of the fund: The study about Xinjiang uygur and hui people's osteocalcin level difference and its relationship with insulin resistance. No. 2014211C058).

Disclosure of conflict of interest

None.

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