

Original Article

The value of HbA1c for diagnosing type 2 diabetes mellitus between Chinese Uyghurs and Hans in Xinjiang

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Abstract: Objective: To compare the difference of glycosylated hemoglobin (HbA1c) for diagnosing type 2 diabetes mellitus (T2DM) between Chinese Uyghurs and Hans in Xinjiang. Methods: we collected 707 subjects, including 456 Uyghurs and 251 Hans in Xinjiang Kashi region. All the subjects were underwent oral glucose tolerance test (OGTT) for diagnosing T2DM, at the same time their clinical biochemical markers and HbA1c levels were also measured. Then the data were analyzed, the receiver operating characteristic (ROC) curve was plotted and correlation analysis were made by SPSS 19.0 software. Results: 1. The levels of body mass index (BMI), 2-hour plasma glucose (2 h PG), diastolic blood pressure (DBP) total cholesterol (TC) and triglycerides (TG) were 26.6 ± 4.75 kg/m², 14.3 ± 6.2 mmol/l, 81.6 ± 13.4 mmHg, 4.5 ± 1.3 mmol/l and 4.3 ± 2.8 mmol/l in Uyghurs, moreover those were higher than Hans [25.4 ± 13.3 kg/m², 13.1 ± 6.9 mmol/l, 78.4 ± 9.9 mmHg, 2.3 ± 2.1 mmol/l and 2.0 ± 1.4 mmol/l, (P<0.05)]. 2. Otherwise, the optimal cut-off value for HbA1c to diagnose T2DM was 6.95% in Uyghurs. At this cut-off value, the sensitivity, specificity, positive likelihood ratio (+LR), negative likelihood ratio (-LR) and the area under the ROC curve (AUC) were 98.3%, 97.7%, 43.64, 0.017 and 0.997. While the optimal cut-off value was 7.05% in Hans, and, the sensitivity, specificity, +LR, -LR and AUC separately were 91.1%, 92.8%, 0.971, 12.6, 0.096 and 0.971. 3. The correlation analysis was made in two populations. It demonstrated that HbA1c was positively correlated with BMI, TC and TG in Uyghurs (r=0.138, 0.273, 0.482, P<0.05). However, in Hans, the HbA1c only was positively correlated with TG (r=0.178, P<0.05). Conclusion: The Uyghurs have higher metabolic markers, for example, BMI, TC, DBP and TG. It reveals that Uyghurs may have more severe insulin resistance (IR) comparing with Hans. And then, the cut-off value of HbA1c for diagnosing and screening T2DM is different between Uyghurs and Hans in Xinjiang.

Keywords: Type 2 diabetes mellitus (T2DM), glycosylated hemoglobin (HbA1c), receiver operating characteristic (ROC) curve, diagnose

Introduction

Diabetes mellitus (DM) is a group of chronic endocrine metabolic disorder diseases caused by high blood glucose. The global prevalence of diabetes is increasing rapidly, and in 2030 over 500 million individuals are expected to suffer from diabetes, mostly is type 2 diabetes mellitus (T2DM) [1]. In order to halt T2DM progression in high-risk individuals and to avoid the likely burden of future T2DM complications, the undiagnosed diabetes is particularly concerned. So, the earlier diagnosis T2DM is becoming hot in recently study.

Today the diagnosis of diabetes mellitus was determined according to oral glucose tolerance tests (OGTTs) in the world [2]. Since 2009, the

recommendation of the International Expert Committee use glycosylated hemoglobin (HbA1c) test as criteria to diagnose diabetes [3]. The American Diabetes Association (ADA), the Endocrine Society [4], the World Health Organization (WHO) [5] and most scientists in different countries all over the world have endorsed to use HbA1c to diagnose diabetes following. However, until now, China hasn't use HbA1c as criteria for diagnosing T2DM yet. The reason is that it's difficult to measure HbA1c accurately in uniform standard in different region. On the other hand, different cut-off values of HbA1c have been reported for diagnosing diabetes in different ethnic groups in the world. In conclusion, ethnicity seems to have a strong influence on cut-off values to diagnose diabetes [6, 7]. Especially for China, which has

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Table 1. Comparison of the general clinical and biochemical marks between Uyghurs and Hans

Items	Uyghurs	Hans	T	P
age (year)	56.8±8.7	54.9±13.3	-2.1	>0.05
BMI (kg/m ²)	26.9±4.75	25.4±3.7	-4.362	<0.001**
HbA1C (%)	8.4±2.7	8.2±2.2	-1.367	>0.05
FPG (mmol/L)	8.4±3.7	8.3±3.3	-0.363	>0.05
2-h PG (mmol/L)	14.3±6.2	13.1±6.9	2.369	<0.05*
TC (mmol/L)	4.5±1.3	2.3±2.1	-14.769	<0.001**
TG (mmol/L)	4.3±2.8	2.0±1.4	17.844	<0.001**
SBP (mm/Hg)	129.5±18.8	131.4±15.4	1.36	>0.05
DBP (mm/Hg)	81.6±13.4	78.4±9.9	-3.252	<0.001**

*P<0.05, **P<0.001.

56 ethnic groups, hasn't recommended to use HbA1c as diagnosed criteria for diabetes.

This study aims at to compare the optimal cut-off value of HbA1c for diagnosing and screening T2DM between Chinese Uyghurs and Hans in Xinjiang, and get more comprehensive understanding of the HbA1c variance for diagnosing T2DM on different races in China.

Materials and methods

Participants

We collect the samples 456 Uyghur and 251 Han populations (men: 338, women: 379) who aim as to diagnose T2DM in the department of endocrine of the first affiliated hospital of medicine school in Shihezi University, in Xinjiang, China, during from June 2012 to December 2014. The subjects that participated in this study haven't been diagnosed T2DM and received the hypoglycemic therapy. Written informed consent was obtained from all participants involved in the study.

Procedures

To determine the subject's height, weight and blood pressure, then calculate the body mass index (BMI). The subjects were tested fasting plasma glucose (FPG), the 2-hour blood glucose after oral glucose tolerant test (2-h OGTT PG), haemoglobin A1c (HbA1c), total lipid profile including total cholesterol (TC), and triglycerides (TG). FPG, 2-h OGTT PG, TC and TG were measured by Chemwell chemistry analyzer, and HbA1c was tested by high pressure liquid phase method (HPLC).

Diagnostic criteria

T2DM were diagnosed by 1999 WHO criteria: DM (FPG \geq 7.0 mmol/L and/or 2-h OGTT PG \geq 11.1 mmol/L); Impaired glucose regulation (IGR) (6.1 mmol/L \leq FPG < 7.0 mmol/L and/or 7.8 mmol/L \leq 2-h PG < 11.1 mmol/L); Normal glucose tolerant (NGT) (FPG < 6.1 mmol/L and 2-h PG < 7.8 mmol/L). OGTT as the gold standard record the different optimal cut-off values through ROC curve.

Statistics

The data were analyzed by using SPSS 19.0 software. Receiver operating characteristic (ROC) curves were plotted and calculated the sensitivity, specificity, area under the curve (AUC), positive likelihood ratio (+LR), and negative likelihood ratio (-LR) at different cut-off values for HbA1c. At last, the correlation analysis was made between HbA1c and BMI, TC and TG. Statistical significance was accepted at P<0.05.

Results

Comparison of the general clinical and biochemical markers between Uyghurs and Hans

This text is present expression of the **Table 1**. The data shows that the Uyghurs have more serious glucose and lipids disorder than Hans. The data demonstrated that in Uyghurs, the BMI (26.6±4.75 kg/m²), 2-h PG (14.3±6.2 mmol/L), DBP (81.6±13.4 mmHg), TC (4.5±1.3 mmol/L) and TG (4.3±2.8 mmol/L) were all higher than Hans [25.4±3.7 kg/m², 13.1±6.9 mmol/L, 78.4±9.9 mmHg, 2.3±2.1 mmol/L, 2.0±1.4 mmol/L (P<0.05)].

The ROC curve of HbA1c for diagnosing T2DM in Chinese Uyghurs and Hans

The ROC curve of HbA1c for diagnosing T2DM was drawn by making OGTT as the gold standard. The results demonstrated that the optimal cut-off value of HbA1c for diagnosing T2DM in Uyghurs was 6.95%, with the sensitivity of 98.3%, specificity of 97.7%, AUC of 0.997, +LR of 43.64 and -LR of 0.017. However, the optimal cut-points of HbA1c for diagnosing T2DM was 7.05% in Hans, with the sensitivity of 91.1%, specificity of 92.8%, AUC of 0.971, +LR of 12.6 and -LR of 0.096 (**Figure 1**).

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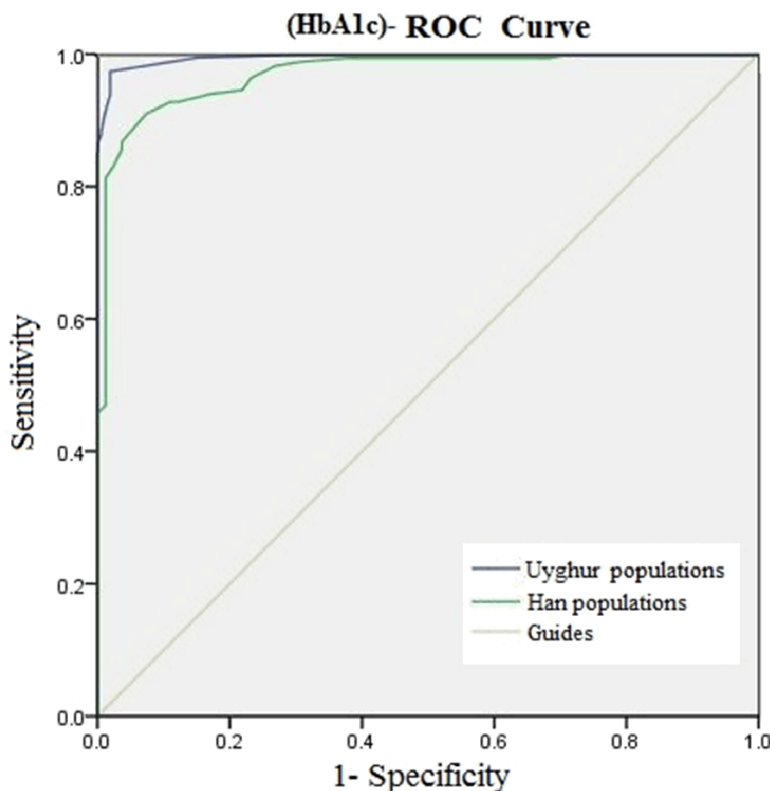


Figure 1. The ROC curve of HbA1c for diagnosing T2DM in Uyghurs and Hans.

Table 2. The comparisons of correlation analysis between HbA1c with BMI, TC and TG in Uyghurs and Hans

	The correlation coefficient		
	BMI	TC	TG
Uyghur	0.138*	0.273**	0.482**
Han	-	-	0.178*

*P<0.05, **P<0.001.

The correlation analysis of HbA1c with BMI, TC and TG in Uyghurs and Hans

When making the correlation analysis between HbA1c with BMI, TC and TG in Uyghurs, it discovered that HbA1c was positively correlated with BMI, TC and TG ($r=0.138, 0.273, 0.482, P<0.05$). However, in Hans, the HbA1c was only positively correlated with TG ($r=0.178, P<0.05$) (Table 2).

Discussion

T2DM is a group of chronic high blood glucose, insulin resistant (IR) and the progressively

recession of pancreatic β -cell function that caused by multiple causes as the main feature of the endocrine metabolic disorder diseases. And HbA1c $\geq 6.5\%$ was defined as one of the criteria for the diagnosis of T2DM by the American Diabetes Association (ADA) [3]. However, the usefulness and validity of HbA1c for diagnosing and screening T2DM in certain populations have been questioned, especially in China, which contributes with expanse lands and multiple nations. As a result, HbA1c has not been used to diagnose T2DM in China. In patients with T2DM, lipid metabolism disorder is very common. The mechanism of lipid metabolism disorder was in relation to insulin resistance (IR). In this study, the levels of BMI, DBP, 2 h PG, TC and TG were all higher than Hans ($P<0.05$). When

making the correlation analysis between HbA1c and TC, TG and BMI, it discovered that HbA1c was positively correlated with BMI, TC and TG in Uyghurs. It is confirmed by the study of Keane WF [8]. The results show there is serious IR in Uyghurs comparing with Hans in Xinjiang. It also shows HbA1c can be used for indicator markers, also IR. That also has been identified by previous study [9].

New data has shown that HbA1c is affected by races [10], which leads the cut-off value of HbA1c to be different for diagnosing T2DM [11]. In our report, it reveals that the optimal cut-off value of HbA1c for diagnosing T2DM was 6.95% in Uyghurs, while in Hans, the cut-off value of HbA1c was 7.05%. Moreover, based on the results of several other studies in the world, it also has been displayed that different races or the same race that are living in different regions may have corresponding HbA1c criteria points to diagnose T2DM [12, 13].

The cut-off value of HbA1c were various in different races and regions, therefor to establish

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precise and objective cut-off of HbA1c for diagnosing T2DM may help HbA1C apply to clinical better in China.

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Disclosure of conflict of interest

None.

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