Journal of Clinical Lipidology (2017) ■, ■–■

Journal of Clinical Lipidology

Original Contribution

Low levels of ApoA1 improve risk prediction of type 2 diabetes mellitus

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KEYWORDS:
Type 2 diabetes mellitus;
Apolipoproteins;
Dyslipidemia;
Body mass index;
Population study

BACKGROUND: Type 2 diabetes mellitus (T2DM) has reported to be a major public health crisis in China.

OBJECTIVE: We examined the incidence of new T2DM over 4 years for association of clinical factors and lipids with development of T2DM in a community-based population.

METHODS: We included 923 Chinese subjects who participated in community-organized health checkout in both 2009 and 2013. Health history was collected; physical examination was performed; biochemistry, lipids, and glucose were measured. Of 923, 819 were confirmed without T2DM in 2009 and included in the analysis. Unadjusted and adjusted logistic regression models were used to estimate the effects of clinical factors and biomarkers on the risk of new T2DM.

RESULTS: Of 819 subjects without T2DM in 2009, 65 were identified as T2DM in 2013, 8% over 4 years. These 65 subjects, compared with those 754 without new T2DM, were older, more likely to be male and smokers. They had higher body mass index (BMI), fasting glucose, blood pressure and triglycerides, and lower levels of high-density lipoprotein-cholesterol and apolipoprotein A1 (ApoA1). Multivariate logistic regression identified larger BMI (odds ratio [OR] = 1.7; 95% confidence interval [CI], 1.22–2.39, $P = .002$), higher fasting glucose levels (OR = 4.2, 95% CI, 2.90–6.19, $P < .001$), and low levels of ApoA1 (OR = 0.51, 95% CI 0.33–0.76, $P = .002$) were independently associated with new T2DM. Furthermore, receiver operating characteristics curves for multivariate models for new T2DM showed that area under the curve improved from 0.87 to 0.89 when adding ApoA1 to the Framingham Diabetes Risk Scoring Model and from 0.85 to 0.89 when adding ApoA1 to a 4-variable (age, BMI, glucose, and triglycerides) Chinese model.

CONCLUSIONS: There is a high incidence of new T2DM at 8% over 4 years among Chinese. Larger BMI, higher glucose levels, and lower levels of ApoA1 are significantly and independently associated with new T2DM. Lower ApoA1 improves the risk prediction of new type 2 diabetes when it was added to the existing risk models.

Disclosure: No conflicts of interest for all authors.

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Submitted September 21, 2016. Accepted for publication January 13, 2017.

http://dx.doi.org/10.1016/j.jacl.2017.01.009

Introduction

Type 2 diabetes mellitus (T2DM) has become a major public health issue with strong socioeconomic impact worldwide.[1,2] The prevalence of T2DM in China has increased substantially over recent decades with more than 100 million Chinese people estimated to have this condition.[3] Previous studies demonstrated that the most commonly identified risk factors for development of T2DM include older age,[4] positive family history of diabetes,[5] higher body mass index (BMI),[4] abdominal obesity,[6] smoking,[7] hypertension,[8] higher fasting glucose level,[9] physical inactivity,[10] and metabolic syndrome.[11] There have been inconsistent reports on associations of apolipoprotein A1 (ApoA1) and high-density lipoprotein-cholesterol (HDL-C) with development of T2DM.[12–18] We examined the incidence of new T2DM over 4 years for association of clinical factors and lipids with development of T2DM among Chinese subjects who participated in a community-organized health checkout in both 2009 and 2013.

Materials and methods

Study population

Among 983 subjects who participated in the community-organized health checkout in 2009 at Beijing Xihongmen Community Hospital in China, 923 had a repeat checkout in 2013. The community-organized health checkout was funded by the local government and performed by the certified health care providers. It was offered to all community members aged ≥18 years. At the health checkout, health history was collected; a physical examination was performed; liver and renal functions, biochemistry, lipids, and glucose were measured.

As shown in Figure 1, among the 923 subjects, 104 were identified as having T2DM or fasting glucose levels ≥7 mmol/L in 2009 and excluded from the study. The remaining 819 were selected for this analysis of examining risk association of development of T2DM over 4 years.

Clinical evaluations and laboratory measurements

Height (meter) and weight (kilogram) were measured. BMI was calculated as weight in kilograms divided by the square of height in meters. Blood pressure (BP) was measured using an automatic manometer with an appropriate cuff size on the right arm after a resting period of ≥5 minutes. Blood sample was collected after fasting for a minimum of 9 hours and subsequently analyzed for concentrations of glucose, lipids, and liver enzymes by a certified laboratory at Beijing Xihongmen Community Hospital. These laboratory measurements were performed

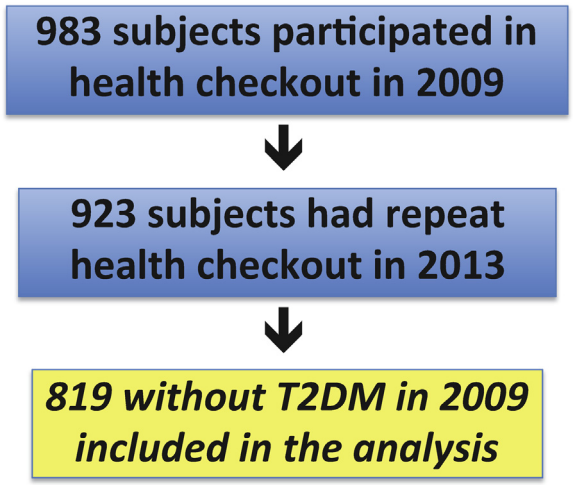

Figure 1 Study population and selection.

at the time of samples were collected. Specifically, HDL-C was measured by the Direct Method using HDL Cholesterol Assay Kit (Mindray, China) with inter-assay variability ≤2.5%. ApoA1 was measured using turbidimetric immunoassay (Mindray) with inter-assay variability ≤4%. Renal function and other biochemistry were also measured at the same laboratory.

Definition of new T2DM

In 2013, positive T2DM was identified using the fasting plasma glucose ≥7.0 mmol/L or if subjects were receiving active treatment for T2DM.

Statistical analyses

Descriptive statistics were expressed as the mean ± standard deviation (SD) for continuous variables and the relative frequency (%) for categorical variables. In addition, the median and the interquartile range were calculated for highly skewed continuous variables. The demographic and biochemical characteristics of the study population were compared between patients with and without new T2DM using the 2-sample t-test or the Wilcoxon rank sum test for continuous characteristics (the latter was used for highly skewed characteristics) and the chi-squared test for categorical characteristics. Unadjusted and adjusted logistic regression models were used to estimate the effects of biochemical characteristics on the risk of T2DM development (with the odds ratios [ORs] and their 95% confidence intervals [CIs] presented). ORs for continuous risk factors are presented for a 1 SD increase. The adjusted models were adjusted for age, gender, BMI, and smoking and also adjusted for multiple comparisons. Receiver operating characteristics curves were generated to demonstrate the sensitivity and specificity of risk factors predicting development of T2DM. Area under the curve (AUC), also referred to as the