OBSERVATIONS

Validation of Diabetes Risk Scores for Predicting Diabetes Diagnosed by Oral Glucose Tolerance Test

Recently, we have reported a study evaluating the performance of 11 diabetes risk scores (DRSs) to find subjects with diabetes, metabolic syndrome, and chronic kidney diseases (1), including a DRS developed by that database (DRS-Lin), i.e., in male subjects, $x = -8.3805 + \text{age}*0.0325 + \text{waist circumference}*0.0423 + 0.5866$ if using hypertension drugs $+ 0.2429$ if there was a positive diabetes family history; in female subjects, $x = -9.523 + \text{age}*0.0446 + \text{waist circumference}*0.0468 + 0.4264$ if using hypertension drugs $+ 0.5060$ if there was a positive diabetes family history; risk of diabetes $= 1/(1 + e^{-x})$. In that report, diabetes was diagnosed based on fasting plasma glucose instead of a 75-g oral glucose tolerance test (OGTT), which is recommended by the American Diabetes Association (2) and the World Health Organization (3). Here we extend our observation on the performance of those different DRSs for diabetes where the diagnosis was based on OGTT (see the supplemental Table in the online appendix at http://care.diabetesjournals.org/cgi/content/ full/dc09-1986/DC1).

From February 2006 to September 2009, 1,205 residents without reported diabetes in Yunlin County, Taiwan, were screened with OGTT. Written informed consent was obtained from each individual, and the study was reviewed and approved by the institutional review board. The mean age was 49.8 ± 13.3 years, including 741 female subjects and 463 male subjects. Diabetes was diagnosed if fasting plasma glucose concentration was >126 mg/dl or 2-h postchallenge plasma glucose concentration was >200 mg/dl. Eighty-six subjects (7.1%) were found to have diabetes. Age; sex; waist circumference; family history of diabetes in grandparents, parents, siblings, or children; and use of hypertension drugs were identified as the risk factors of screened diabetes by logistic regression models. DRS was constructed based on the coefficients in the logistic regression models as follows: Taiwan DRS $= 0.0487*\text{age (years)} - 0.2887$ if male $+ 0.0696*\text{waist circumference (cm)} + 0.0769$ if using hypertension drugs $+ 0.0045$ if there was a positive diabetes family history. The area under the receiver operating characteristic curve was 0.76 (95% CI 0.71–0.81) for Taiwan DRS (present report), 0.77 (0.71–0.82) for the Atherosclerosis Risk in Communities study (ARIC) DRS (U.S.), 0.74 (0.69–0.80) for Cambridge DRS (U.K.), 0.72 (0.67–0.77) for DRS-Lin, 0.72 (0.66–0.78) for the Finnish Type 2 DRS (FINDRISC), 0.72 (0.67–0.77) for Oman DRS, 0.72 (0.67–0.77) for Danish DRS, 0.72 (0.67–0.78) for Thai DRS, 0.75 (0.71–0.80) for Asian Indian DRS, 0.68 (0.62–0.74) for Dutch DRS, and 0.68 (0.62–0.74) for the Data from an Epidemiological Study on the Insulin Resistance Syndrome (DESIR) DRS (French). All DRSs had a good model fit by Losmer-Lemeshow goodness-of-fit test, except DRS-Lin ($P < 0.0001$), Cambridge DRS ($P = 0.013$), and Oman DRS ($P = 0.002$). The sensitivity and specificity were 0.71 and 0.72 for Taiwan DRS, 0.78 and 0.63 for ARIC DRS, 0.65 and 0.72 for Cambridge DRS, 0.67 and 0.64 for DRS-Lin, 0.77 and 0.58 for FINDRISC, 0.73 and 0.60 for Oman DRS, 0.62 and 0.69 for Danish DRS, 0.74 and 0.62 for Thai DRS, 0.69 and 0.69 for Asian Indian DRS, 0.55 and 0.73 for Dutch DRS, and 0.64 and 0.65 for DESIR DRS, when cutoff value with the least $(1\text{-sensitivity})^2 + (1\text{-specificity})^2$ was chosen.

In conclusion, we confirmed that the Taiwan DRS, the ARIC DRS, and the FINDRISC outperformed other DRSs in finding diabetes diagnosed by OGTT, considering the model fit and discrimination ability.

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References

1. Lin J-W, Chang Y-C, Li H-Y, Chien Y-F, Wu M-Y, Tsai R-Y, Hsieh Y-C, Chen Y-J, Hwang J-J, Chuang L-M. Cross-sectional validation of diabetes risk scores for predicting diabetes, metabolic syndrome, and chronic kidney disease in Taiwanese. Diabetes Care 2009;32:2294–2296
2. American Diabetes Association. Diagnosis and classification of diabetes mellitus. Diabetes Care 2004;27(Suppl. 1):S5–S10
3. World Health Organization, International Diabetes Federation. *Definition and Diagnosis of Diabetes Mellitus and Intermediate Hyperglycemia: Report of a WHO/IDF Consultation.* Geneva, World Health Organization Document Production Services, 2006