Waist Circumference Thresholds Provide an Accurate and Widely Applicable Method for the Discrimination of Diabetes

OBESITY IN ASIA COLLABORATION*

Excess weight, particularly central obesity, is recognized to be a major determinant of diabetes risk in all populations, with the magnitude of the association reported as being stronger in Asians than whites (1–3). Consequently, indicators of overweight have been incorporated into several guidelines for the early identification of individuals with type 2 diabetes (4). However, the anthropometric cut points for different ethnic groups have been determined in various ways, leading to uncertainty about their applicability to diabetes screening. Here, we clarify current uncertainty regarding ethnic differences in the relationship between overweight and diabetes and whether there is a single measure of overweight that can be determined routinely and applied universally in clinical practice to facilitate earlier detection of diabetes in the general population.

RESEARCH DESIGN AND METHODS

Eligibility criteria for studies in the Obesity in Asia Collaboration

Studies were eligible if they contained the following information: age, sex, weight, height, waist circumference, hip circumference, fasting plasma glucose, blood pressure, and smoking status (5). Diabetes was defined as fasting plasma glucose ≥7 mmol/l. Individuals with a history of diabetes or on diabetic medication were excluded.

Logistic regression models, stratified by sex and study and adjusted for age (and subsequently by smoking and blood pressure), were used to estimate the odds ratio (OR) and 95% CI for prevalent diabetes associated with a 0.5-SD increment in each of the measures. To assess the ability of each anthropometric variable to discriminate between those with and without diabetes, areas under the receiver operating characteristic curves were computed. The areas under the curve (AUCs) was subsequently pooled to find region-specific AUCs using a random-effects meta-analysis.

The dataset was randomly divided into two equal-sized samples, one of which was used to derive the anthropometric threshold values for diabetes. Cut points from the receiver operating characteristic that maximized the sum of sensitivity and specificity were identified for each sex and study. These thresholds were subsequently validated on the second random half-sample.

RESULTS — Data were available for 155,122 individuals (86% Asian; 52% female) from 18 study populations from 10 countries in the Asia-Pacific region (supplemental Tables 1 and 2 [available in an online appendix at http://dx.doi.org/10.2337/dc07-1455]).

In women, the association between BMI, waist circumference, and waist-to-hip ratio (WHR) with diabetes was ~10–20% stronger in whites compared with Asians (Fig. 1). In men, this was true only for BMI. This remained unchanged after adjustment for smoking and blood pressure. In all groups (with the exception of white men), measures of central obesity were more strongly associated with prevalent diabetes than BMI (Fig. 1).

At any given level of BMI, waist circumference, or WHR, the prevalence of diabetes was consistently higher in Asians than in whites. At a BMI of 24 kg/m^2, the proportion of men with diabetes was 5% in Asians compared with 2% in whites; in women, the corresponding values were 5 and 1%, respectively. At a waist circumference of 90 cm or WHR of 0.9, the proportion of Asian men with diabetes was 6% compared with 2% in white men; in women, at a waist circumference of 80 cm and a WHR of 0.8, the estimates were ~5 and 1%, respectively.

The ability of each of the measures to discriminate diabetes ranged from 0.63 to 0.71 in men and from 0.66 to 0.80 in women (supplemental tables 3 and 4). The AUCs tended to be slightly (but in most instances nonsignificantly) higher for waist circumference than for BMI or WHR across the groups. Measuring BMI and/or waist circumference or BMI and/or WHR did not improve the discriminatory capabilities of any single measure.

Anthropometric cut points for the optimal discrimination of diabetes were lower in Asians compared with whites. The optimal cut points for Asian men were BMI 23.7 kg/m^2, waist circumference 85 cm, and WHR 0.90 versus 27.7 kg/m^2, 99 cm, and 0.94, respectively, in white men. For Asian women, the corresponding values were 24.5 kg/m^2, 80 cm, and 0.80, and in white women the values were 27.9 kg/m^2, 85 cm, and 0.85, respectively. These cut points optimized sensitivity and specificity such that both values nearly always exceeded 60% in all groups.

CONCLUSIONS — Irrespective of which measure of excess weight is used, the prevalence of diabetes is consistently higher among Asians than whites at any given level, in agreement with earlier findings (6). The mechanisms that might underlie this apparent greater susceptibility among Asians are unknown, but the data

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Additional information for this article can be found in an online appendix at http://dx.doi.org/10.2337/dc07-1455.

Abbreviations: AUC, area under the curve; WHR, waist-to-hip ratio.

A table elsewhere in this issue shows conventional and Système International (SI) units and conversion factors for many substances.

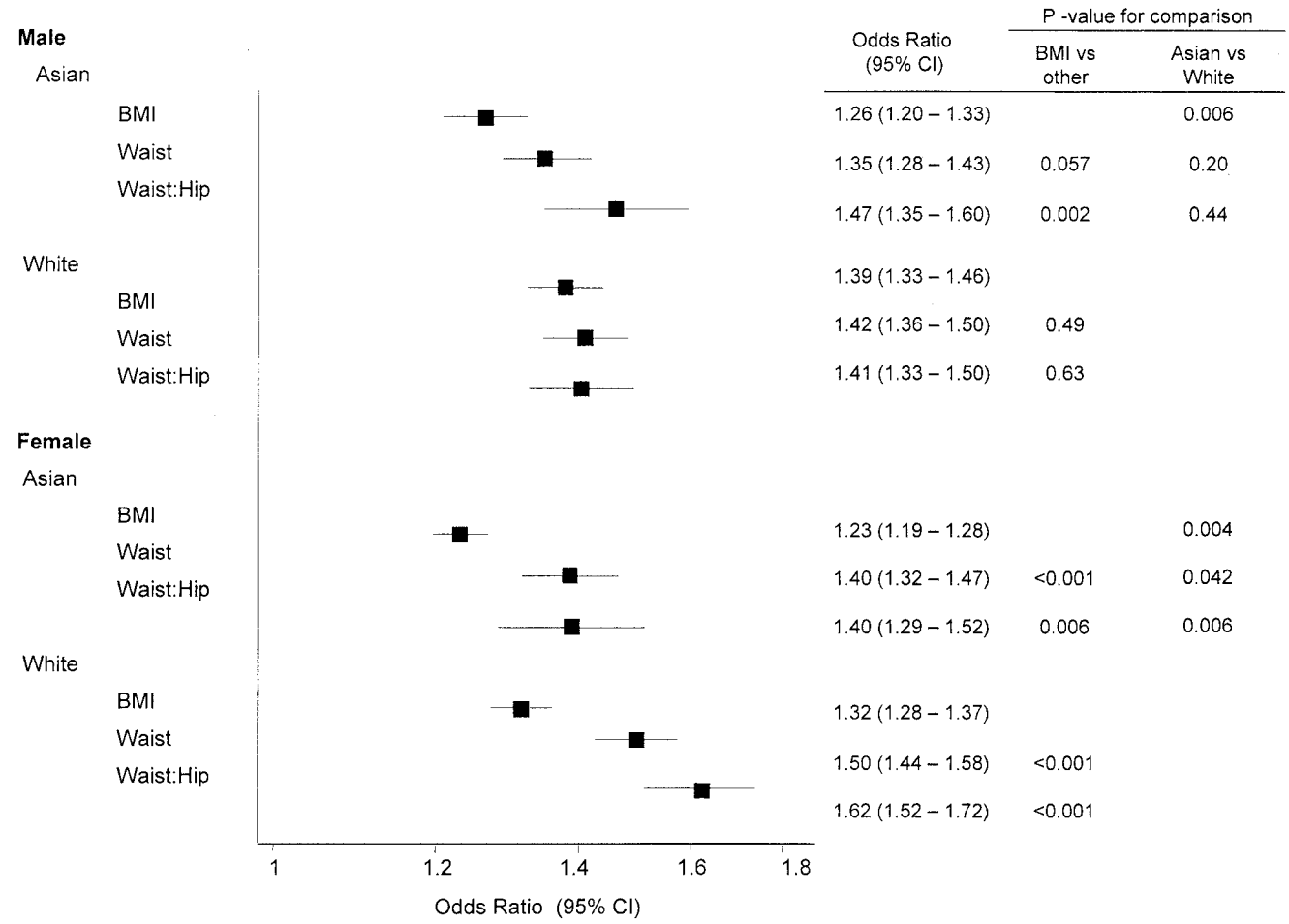

Figure 1—*Age-adjusted ORs and 95% CIs for prevalent type 2 diabetes associated with a 0.5-SD increment in each anthropometric measure: BMI, waist circumference (Waist), and WHR (Waist:Hip). Results are shown separately by sex and ethnic group (Asian and white). The strength of the association between waist circumference and diabetes and between WHR and diabetes are compared against the strength of the association between BMI and diabetes. For each variable the strength of the association with diabetes is compared between Asian and white individuals. P values for the differences are shown.*

do not consistently support the hypothesis that this is due to a stronger association between diabetes and body size among Asians compared with whites.

There were marginal differences in the capability of BMI, waist circumference, and WHR in discriminating diabetes, although measures of central obesity (waist circumference in particular) tended to perform slightly better than BMI. Compared with either BMI or WHR, waist circumference is a more readily understood measure that, with adequate training, is easily determined with a tape measure. Our findings suggest that current recommended waist circumference cut points should be modified to 80 cm in Asian women, 85 cm in white women, 85 cm in Asian men, and 99 cm in white men to optimize the discrimination of diabetes in these populations.

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APPENDIX

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