



# Impact of Lowering BMI Cut Points as Recommended in the Revised American Diabetes Association *Standards of Medical Care in Diabetes—2015* on Diabetes Screening in Asian Americans

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## OBJECTIVE

This study estimated the screening prevalence of prediabetes and diabetes using a lower BMI cutoff of 23 kg/m<sup>2</sup> in Asians in the U.S. using the National Health and Nutrition Examination Survey from 2011 to 2012.

## RESEARCH DESIGN AND METHODS

A cross-sectional analysis was conducted of non-Hispanic Asians, ages 45 years and older, with available BMI, HbA<sub>1c</sub>, and fasting glucose data. These overall criteria were met by 341 participants.

## RESULTS

Lowering the screening BMI to 23 kg/m<sup>2</sup> increased the sensitivity of screening for prediabetes and diabetes from 50.2 to 74.1% ( $P < 0.0001$ ) but decreased the specificity from 62.9 to 38.7% ( $P < 0.0001$ ).

## CONCLUSIONS

Although this will add additional health care costs resulting from more widespread screening, early identification of these conditions may be beneficial for primary and secondary prevention in this unique population that develops prediabetes and diabetes at lower BMI levels.

In the most recent *Standards of Medical Care in Diabetes—2015*, the American Diabetes Association recommended changing the BMI threshold for screening overweight or obese Asian Americans for prediabetes and type 2 diabetes from 25 to 23 kg/m<sup>2</sup> (1). Evidence has shown that this population is at increased risk for diabetes at lower BMI levels relative to the general population (2). The pragmatic effect of lowering the BMI cut point on identifying patients for further clinical evaluation has not been fully studied. We thus sought to estimate the screening prevalence of prediabetes and diabetes using the new BMI cutoff in Asians participating in the National Health and Nutrition Examination Survey (NHANES) from 2011 to 2012.

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## RESEARCH DESIGN AND METHODS

The NHANES is an ongoing series of sample surveys designed to collect nationally representative data from the non-institutionalized U.S. population. The surveys are conducted in 2-year cycles, and we used data from 2011 to 2012 because this cycle used oversampling of non-Hispanic Asians to increase the reliability of estimates pertaining to that segment of the population. NHANES assigns a sampling weight to each participant in a 2-year cycle of data to account for the complex survey design and provide appropriate estimates of specific population parameters of interest.

During our analysis, we used statistical software to code each participant's prediabetes (or diabetes) status as 1 if the participant was determined to have prediabetes (or diabetes) and as 0 if not. Prevalence of prediabetes and diabetes expressed as a percentage was calculated as the weighted average of the 1s and 0s. In a specific subset of participants, weights used in a given calculation were adjusted by dividing the original sampling weights by the sum of the sampling weights for the subset. Thus, assuming nonresponse occurs completely at random, the weighted average appropriately adjusts calculated estimates for oversampling of the U.S. Asian population, survey nonresponse, and poststratification.

Laboratory data were collected on a subsample of 3,239 from 9,756 participants. Ethnicity was self-reported, and we focused on a subset of people aged 45 years and older with available BMI, HbA<sub>1c</sub>, and fasting glucose classified in the non-Hispanic Asian group. People were considered to have diabetes if their fasting glucose was  $\geq 126$  mg/dL (7.0 mmol/L) or their HbA<sub>1c</sub> was  $\geq 6.5\%$  (48 mmol/mol) and were considered to have prediabetes if their fasting glucose was 100–125 mg/dL (5.6–6.9 mmol/L) or their HbA<sub>1c</sub> was 5.7–6.4% (39–46 mmol/mol) inclusive (3).

Prevalence, sensitivity, specificity, positive predictive value, and negative predictive value were assessed using a BMI cutoff of 23 and 25 kg/m<sup>2</sup>. Rao-Scott  $\chi^2$  tests were used to compare prevalence. Sensitivity and specificity were compared with the McNemar test. Statistical analyses were performed using SAS 9.4 software (SAS Institute, Inc., Cary, NC). *P* values  $< 0.05$  were considered statistically significant. Given that

we used publicly available de-identified data for all analyses, our study did not meet the definition of human subject research based on guidelines provided by our institution's institutional review board.

## RESULTS

The NHANES 2011–2012 evaluation consisted of 9,756 participants, of which 1,282 (13.1%) were identified as non-Hispanic Asian. From this demographic group, 341 participants were reported to be aged 45 years and older and had available BMI, HbA<sub>1c</sub>, and fasting glucose data. The population estimates were based on these 341 participants.

When the population was divided into BMI cohorts, 69.4% had a BMI  $\geq 23$  kg/m<sup>2</sup>. The combined estimated prevalence of prediabetes and diabetes in the population was 63.4% (Table 1). In the lower-BMI cohort ( $< 23$  kg/m<sup>2</sup>), 53.7% had prediabetes or diabetes as identified with standard testing. Moreover, lowering the screening BMI to 23 kg/m<sup>2</sup> increased the sensitivity of screening for prediabetes and diabetes from 50.2 to 74.1% ( $P < 0.0001$ ) but decreased the specificity from 62.9 to 38.7% ( $P < 0.0001$ ). The prevalence of prediabetes was double the prevalence of diabetes (42.5% vs. 20.9%), as summarized in Table 1. The difference in the prevalence of prediabetes was not significantly different between cohorts with a BMI  $< 23$  kg/m<sup>2</sup> or  $\geq 23$  kg/m<sup>2</sup> (40.6% vs. 43.4%,  $P = 0.6739$ ). However, the difference in the prevalence of diabetes between these two BMI cohorts was statistically significant (13.1% vs. 24.3%,  $P = 0.0052$ ).

## CONCLUSIONS

Since 1993, the World Health Organization has recommended standard BMI cut points of 25–29.9 kg/m<sup>2</sup> to be classified as overweight and  $\geq 30$  kg/m<sup>2</sup> to be

classified as obese (4). However, as reported, Asians tend to have a consistently lower BMI than whites after controlling for age, sex, and body fat (5). Asians are also more likely to have a higher percentage of body fat at a lower BMI and waist circumference compared with Europeans, potentially leading to a higher prevalence of cardiovascular disease risk factors at a relatively lower BMI (6). Thus, conventional BMI cut points do not portend similar prevalences of obesity-related comorbidities, such as type 2 diabetes, hypertension, and hyperlipidemia, in all ethnicities (7). As an example, our data showed that the prevalence of prediabetes was similar in both cohorts with a BMI  $< 23$  or  $\geq 23$  kg/m<sup>2</sup>, suggesting that BMI alone may not be a good predictor of prediabetes. In 2002, the World Health Organization proposed lowering BMI cut points in Asians, categorizing 23–27.5 kg/m<sup>2</sup> as overweight and BMI  $\geq 27.5$  kg/m<sup>2</sup> as obese (8).

Until recently, however, these lower cut points have not been recommended in screening guidelines for clinical use. By lowering the BMI cut point to 23 kg/m<sup>2</sup>, the sensitivity of screening for prediabetes and diabetes increased by nearly 25%, identifying more people with these conditions. However, the specificity of screening declined, likely due at least in part to the similarity in the prevalence of prediabetes in the cohort with BMI  $< 23$  kg/m<sup>2</sup> and the cohort with BMI  $\geq 23$  kg/m<sup>2</sup>.

Data from the 2009 California Health Interview Survey showed that the prevalence of overweight/obesity in Asian Americans was as high, and in some subgroups higher, than other ethnicities surveyed and that the prevalence of diabetes in the BMI 23–24.9 kg/m<sup>2</sup> category was higher in the Vietnamese, Korean, Filipino, and South Asian groups compared with non-Hispanic whites (5).

**Table 1—Estimated population prevalence of prediabetes and diabetes by BMI cutoff in Asian Americans aged 45 years or older**

	Asian Americans $\geq 45$ years old	BMI (kg/m <sup>2</sup> )			
		$< 23$	23–25	$\geq 25$	$\geq 23$
Combined prevalence (%)	63.4	53.7	63.2	70.0	67.7
Prediabetes (%)	42.5	40.6	38.8	45.8	43.4
Diabetes (%)	20.9	13.1	24.4	24.2	24.3

The data summarize the estimated prevalence of prediabetes and diabetes for Asian Americans aged  $\geq 45$  years participating in the NHANES 2011–2012 with available diagnostic laboratory values.

These data, along with our analyses of the NHANES data, support expanded screening using the lower BMI cutoff of 23 kg/m<sup>2</sup> in Asian Americans. Moreover, it appears that for prediabetes, there should be a consideration for a lower BMI cutoff for screening versus potentially universal screening given a similar prevalence of prediabetes above and below the BMI cutoff of 23 kg/m<sup>2</sup>.

Admittedly, our sample size was small, despite using NHANES data from a year when Asians were oversampled. HbA<sub>1c</sub> and fasting glucose were measured on one occasion, which limits the validity of the diagnosis of prediabetes and diabetes because abnormal laboratory values should be repeated to confirm the diagnosis. In addition, the prevalence of prediabetes and diabetes appeared to be high in this particular cohort and very much driven by the high prevalence of prediabetes. However, we used laboratory values to diagnose both diabetes and prediabetes, making these prevalence estimates more robust.

Although establishing a diagnosis at an earlier stage potentially will add additional health care costs as a result of more widespread screening, early identification of diabetes and other obesity-related comorbidities would be beneficial for primary and secondary prevention in this unique population that develops prediabetes and diabetes at lower BMI

levels. The percentage of Asians with prediabetes suggests that the BMI cutoff for screening may need to be lowered to capture as many people with prediabetes as possible. As an example of how we can improve diabetes screening in Asians, 35.7% of people in a cohort of Chinese adults aged 60 years and older in the Greater Chicago area had never been screened for diabetes (9). More research is indicated to determine if this lower cutoff should apply to younger populations and to more specific ethnic subgroups within the non-Hispanic Asian demographic.

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## References

1. Standards of medical care in diabetes—2015: summary of revisions. *Diabetes Care* 2015; 38(Suppl. 1):S4
2. Hsu WC, Araneta MR, Kanaya AM, Chiang JL, Fujimoto W. BMI cut points to identify at-risk Asian Americans for type 2 diabetes screening. *Diabetes Care* 2015;38:150–158
3. American Diabetes Association. (2) Classification and diagnosis of diabetes. *Diabetes Care* 2015;38(Suppl. 1):S8–S16
4. Physical status: the use and interpretation of anthropometry. Report of a WHO Expert Committee. *World Health Organ Tech Rep Ser* 1995; 854:1–452
5. Jih J, Mukherjea A, Vittinghoff E, et al. Using appropriate body mass index cut points for overweight and obesity among Asian Americans. *Prev Med* 2014;65:1–6
6. Zeng Q, He Y, Dong S, et al. Optimal cut-off values of BMI, waist circumference and waist: height ratio for defining obesity in Chinese adults. *Br J Nutr* 2014;112:1735–1744
7. Pan WH, Flegal KM, Chang HY, Yeh WT, Yeh CJ, Lee WC. Body mass index and obesity-related metabolic disorders in Taiwanese and US whites and blacks: implications for definitions of overweight and obesity for Asians. *Am J Clin Nutr* 2004;79:31–39
8. WHO Expert Consultation. Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. *Lancet* 2004;363:157–163
9. Dong X, Chen R, Simon MA. The prevalence of medical conditions among U.S. Chinese community-dwelling older adults. *J Gerontol A Biol Sci Med Sci* 2014;69(Suppl. 2):S15–S22