POSITION STATEMENT

BMI Cut Points to Identify At-Risk Asian Americans for Type 2 Diabetes Screening

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ASIAN AMERICAN POPULATION

According to the U.S. Census Bureau, an Asian is a person with origins from the Far East (China, Japan, Korea, and Mongolia), Southeast Asia (Cambodia, Malaysia, the Philippine Islands, Thailand, Vietnam, Indonesia, Singapore, Laos, etc.), or the Indian subcontinent (India, Pakistan, Bangladesh, Bhutan, Sri Lanka, and Nepal); each region has several ethnicities, each with a unique culture, language, and history. In 2011, 18.2 million U.S. residents self-identified as Asian American, with more than two-thirds foreign-born (1). In 2012, Asian Americans were the nation's fastest-growing racial or ethnic group, with a growth rate over four times that of the total U.S. population. International migration has contributed >60% of the growth rate in this population (1). Among Asian Americans, the Chinese population was the largest (4.0 million), followed by Filipinos (3.4 million), Asian Indians (3.2 million), Vietnamese (1.9 million), Koreans (1.7 million), and Japanese (1.3 million). Nearly three-fourths of all Asian Americans live in 10 states—California, New York, Texas, New Jersey, Hawaii, Illinois, Washington, Florida, Virginia, and Pennsylvania (1). By 2060, the Asian American population is projected to more than double to 34.4 million, with its share of the U.S. population climbing from 5.1 to 8.2% in the same period (2).

OVERWEIGHT/OBESITY AND TYPE 2 DIABETES RISK FOR ASIAN AMERICANS

Although it is clear that increased body weight is a risk factor for type 2 diabetes, the relationship between body weight and type 2 diabetes is more properly attributable to the quantity and distribution of body fat (3–5). Abdominal circumference and waist and hip measurements, although highly correlated with cardiometabolic risk (6,7), do not differentiate subcutaneous from visceral adipose abdominal depots and are subject to interobserver variability. Imaging and other approaches can be used to more accurately assess fat distribution and quantify adiposity (4,8), but they are not readily available, economical, or useable on a large scale. Therefore, the measurement of body weight with various corrections for height is frequently used to assess risk for obesity-related diseases because it is the most economical and practical approach in both clinical and epidemiologic settings (9). The most commonly used measure is Quetelet's index or BMI, defined as weight $\div$ height^2, with weight in kilograms and height in meters. However, BMI does not take into account the relative proportions of fat and lean tissue and cannot distinguish the location of fat distribution (10,11).

The clinical value of measuring BMI from a diabetes diagnosis perspective lies in whether this measure can identify individuals who may have undiagnosed diabetes or may be at increased future risk for diabetes. In addition, measuring BMI also is important for managing diabetes for the purpose of weight control. BMI cutoffs have been established to identify overweight (BMI $\geq$25 kg/m^2) or obese (BMI $\geq$30 kg/m^2) individuals (12). However, these are based on information derived from the general population, based on risk of mortality, without consideration for racial or ethnic specificity and were not determined to specifically identify those at risk for diabetes. Recently, the U.S. Centers for Disease Control and Prevention presented initial findings from an oversampling of Asian Americans in the 2011–2012

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National Health and Nutrition Examination Survey. These data, utilizing general population criteria for obesity, showed the prevalence of obesity in Asian Americans was only 10.8% compared with 34.9% in all U.S. adults (13). Paradoxically, many studies from Asia, as well as research conducted in several Asian American populations, have shown that diabetes risk has increased remarkably in populations of Asian origin, although in general these populations have a mean BMI significantly lower than defined at-risk BMI levels (14,15). Moreover, U.S. clinicians who care for Asian patients have noticed that many with diabetes do not meet the published criteria for obesity or even overweight (16).

Epidemiologic studies have shown that there is a relationship between BMI and diabetes risk in Asians, but this risk is shifted to lower BMI values (17). At similar BMI levels, diabetes prevalence has been identified as higher in Asians compared with whites (18). This paradox may be partly explained by a difference in body fat distribution: there is a propensity for Asians to develop visceral versus peripheral adiposity, which is more closely associated with insulin resistance and type 2 diabetes than overall adiposity (19). Additionally, Asians of both sexes have been shown to have a higher percentage of body fat at any given BMI level compared with non-Hispanic whites; this suggests differences in body composition that may contribute to variations in diabetes prevalence (10).

DEFINING THE ISSUE

The established definitions of at-risk BMI for overweight and obesity appear to be inappropriate for defining diabetes risk in Asian Americans. Thus, there is a need to examine the existing literature to determine what might constitute at-risk BMI levels for Asian Americans. The clinical relevance is to clarify the use of BMI as a simple initial screening tool to identify Asian Americans who may have diabetes (diagnosis) or be at risk for future diabetes (to implement prevention measures). Also of importance is the use of specific BMI cut points to identify Asian Americans who are eligible for weight-reduction services or treatment reimbursable by payers.

Available data from Asia support the notion that Asians are already at risk for many obesity-related disorders even if they do not reach the BMI values associated with overweight or obesity in non-Asian populations (14). Population-wide weight gain is occurring throughout Asia. This has been attributed to environmental influences such as dietary changes and reductions in physical activity commonly associated with living in a Western culture (17). However, the impact of actually living in a Western culture may be different or more adverse than the effect of living in the native homeland and experiencing some of the lifestyle features representative of a Western culture. Rather than relying on hypothetical influences surmised from data from Asia, it is better therefore to directly examine the relationship of BMI to metabolic disorders such as type 2 diabetes among Asians living in the U.S. Although the U.S. Census has historically combined Asians, Native Hawaiians, and other Pacific Islanders, there are significant differences in physiology and body composition between Asians and the other two groups, so this review will focus only on examining studies in Asian Americans.

ASIAN AMERICAN STUDIES OF TYPE 2 DIABETES AND OVERWEIGHT/OBESITY

Prospective cohort or longitudinal studies are the most suitable designs to measure type 2 diabetes incidence and delineate the relationship between BMI and diabetes. This research requires clinical ascertainment of BMI and nondiabetic status at baseline, followed by periodic reascertainment for a defined follow-up period or until diabetes is diagnosed. Glucose tolerance status should be evaluated by blood test, preferably including a 2-h 75-g oral glucose tolerance test (OGTT). This recommendation is based on numerous studies, including research on Asian Americans, indicating that OGTT detects a greater number of individuals with diabetes compared with fasting glucose criteria (20–22). This type of longitudinal study design enables *1*) identification of baseline BMI values associated with increased diabetes risk over a defined follow-up and *2*) capture of BMI data at the earliest time point following diabetes diagnosis. The sensitivity and specificity of BMI cut points can then be identified using analytic techniques such as receiver operating characteristic curves or rate of misclassification.

Historically, such prospective cohort data are uncommon in Asian American populations. The majority of peer-reviewed publications on diabetes among Asian Americans are cross-sectional studies in which BMI, calculated from self-reported weight and height, and diabetes status are assessed simultaneously. In 2004, data from the Behavioral Risk Factor Surveillance System (BRFSS) showed that the odds of prevalent diabetes were 60% higher for Asian Americans than non-Hispanic whites after adjusting for BMI, age, and sex (23). The National Health Interview Survey (NHIS; 1997–2008 data) (24) found that the odds of prevalent diabetes were 40% higher in Asian Americans relative to non-Hispanic whites after adjusting for differences in age and sex. In fully adjusted logistic regression models including an adjustment for BMI as a categorical variable (underweight/normal weight: BMI $<$23 kg/m^2, overweight: 23 $\leq$ BMI $<$ 27.5 kg/m^2, and obese: BMI $\geq$27.5 kg/m^2), Asian Americans remained 30–50% more likely to have diabetes than their non-Hispanic white counterparts (24). Additionally, regional studies, such as the New York City Health and Nutrition Examination Survey (25), have confirmed that Asian residents in New York City had the highest levels of dysglycemia (diabetes and prediabetes combined) of any race/ethnicity based on prior history or fasting glucose measurement. By disaggregating subgroups from these studies, investigators found that South Asians consistently had the highest diabetes prevalence compared with other Asian subgroups and non-Hispanic whites (26). Although informative, these studies' cross-sectional designs were unable to identify BMI at the time of diabetes diagnosis thereby indicating minimum BMI cut points when diabetes is newly diagnosed.

A systematic review by Staimez et al. (27) summarized findings from 97 publications (1988–2009) on the prevalence of overweight, obesity, and diabetes among specific Asian American subgroups, including Chinese, Filipinos, Koreans, South Asians, and Vietnamese. Almost all the articles reviewed for this publication reported cross-sectional

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data for the variables of interest, and only two provided longitudinal data that were incorporated in the conclusion. These earlier studies reported tremendous heterogeneity in diabetes prevalence, ranging from 3.9 to 32.9% in Asian Indians, 1.0–11.3% among South Asians, 2.2–28.0% in Chinese, 3.7–30.9% among Filipinos, 5.3–15.6% in Vietnamese, and 10.0–18.1% among Koreans (27). Similar heterogeneity was reported for obesity prevalence. As the objectives, age and sex distribution, recruitment methods, and ascertainment of BMI and diabetes varied broadly among these studies, it is not feasible to use these data to identify BMI cut points for diabetes manifestation. To do this, it is imperative to establish BMI levels that place populations at risk for diabetes prior to diabetes diagnosis as weight loss may occur either with undiagnosed diabetes or following diagnosis due to glycosuria or treatment with lifestyle intervention or pharmacologic agents that promote weight loss.

Since publication of the article by Staimez et al. (27), prospective cohort studies on diabetes incidence among Asians in North America (comprising the U.S. and Canada) have been limited to just five prospective cohorts (based on a PubMed search of the English literature published since 2009). Table 1 summarizes the prospective studies that have reported incident diabetes rates in Asian American populations. We reviewed these studies, based on whether data were analyzed by specific Asian ethnicity (disaggregated) or not (aggregated).

Aggregated Data

The Women's Health Initiative (28) enrolled postmenopausal women aged 50–79 years from 40 clinical centers nationwide from 1993 to 1998 and followed them for 10.4 years. Participants included 14,618 African American, 133,541 non-Hispanic white, 6,484 Latino/Hispanic, and 4,190 Asian American women. Although the Asian American women self-reported as being Chinese, Indo-Chinese, Japanese, Korean, Pacific Islander, or Vietnamese, data were not disaggregated into these separate ethnic groups.

Baseline BMI was measured at the clinic visit, and incident diabetes was based on self-reported affirmative responses that a doctor prescribed "pills for diabetes" or "insulin shots for diabetes, collected at annual follow-up visits." As shown in Table 1, mean baseline BMI among Asians was 24.8 kg/m^2, cumulative diabetes incidence was 10.6%, and the incidence rate was 1.13 per 100 person-years. Compared with non-Hispanic whites, Asian Americans had the highest risk for incident diabetes after adjusting for age, study arm, baseline BMI, physical activity, dietary quality, smoking status, family history of diabetes, and educational attainment (hazard ratio [HR] 1.86 [95% CI 1.68−2.06]).

Disaggregated Data

The Diabetes Study of Northern California (DISTANCE) from Kaiser Permanente Northern California (29), a large integrated health-delivery system, was a prospective study in which enrolled adults were followed for 1 year. Data were disaggregated into 12 single racial/ethnic groups, including 7 distinct Asian subgroups. Of the 1,912,916 individuals without prevalent diabetes in 2010, a total of 15,357 incident diabetes cases were identified in the following year. The incidence rates for diabetes were highest among Pacific Islanders (19.9/1,000 person-years), followed by South Asians (17.2), and Filipinos (14.7). The mean BMI at diagnosis among those who developed incident diabetes was 27.2 kg/m^2 in Chinese, 28.7 kg/m^2 in Japanese, 29.0 kg/m^2 in Filipinos, and 29.6 kg/m^2 in South Asians, compared with a mean BMI of 33.4 kg/m^2 in non-Hispanic whites, 35.5 kg/m^2 in African Americans, and 34.3 kg/m^2 in Latinos (A. Karter, personal communication). There was a consistent pattern across all racial/ethnic groups of lower BMIs among individuals with prevalent diabetes when compared with those with incident diabetes. Those with normal glucose levels had even lower BMI compared with prevalent or incident diabetes cases. However, in other prospective studies discussed in this section, the BMI used for analyses was collected at baseline and may have preceded diabetes diagnosis by 5–10 years, depending on the duration of study follow-up (28,30–32).

The Seattle Japanese-American Community Diabetes Study, conducted in King County, WA, was a community-based prospective study of type 2 diabetes in second- and third-generation adults of 100% Japanese ancestry in Seattle. This research has yielded many publications on the relationship between body weight and body fat distribution, as well as the prevalence and incidence of type 2 diabetes (33). Although publications from the Japanese-American Community Diabetes Study have repeatedly shown the importance of central and especially visceral fat as a risk factor for coronary heart disease (20), hypertension (34), impaired glucose tolerance (35), type 2 diabetes (36), metabolic syndrome (37), and insulin resistance (11), investigators also identified a relationship between BMI and diabetes incidence when BMI was the sole measurement of body fat examined (38).

Among 466 nondiabetic Japanese Americans with a mean BMI 24.1 $\pm$ 0.2 kg/m^2 at baseline, 49 developed diabetes at 5 years, based on a 75-g OGTT (30). Study participants who developed diabetes had a mean BMI of 24.9 $\pm$ 0.5 kg/m^2, while those remaining nondiabetic had a mean BMI of 24.0 $\pm$ 0.2 kg/m^2. These differences approached statistical significance ($P = 0.068$). However, among participants aged $\leq$55 years, men who developed diabetes were heavier than nondiabetic individuals, with mean respective BMIs of 28.7 $\pm$ 0.8 and 25.1 $\pm$ 0.3 kg/m^2 ($P < 0.001$), while the difference in women (25.1 $\pm$ 1.2 and 22.8 $\pm$ 0.3 kg/m^2) did not reach statistical significance. Among men or women aged >55 years, incident diabetes was not associated with baseline BMI. In participants $\leq$55 years of age, the 5-year relative risk of diabetes associated with BMI was 26.5 (95% CI 3.4−204) but was 0.8 (95% CI 0.4−1.7) for those >55 years of age. Thus in this analysis at 5 years, BMI predicted risk for diabetes in Japanese Americans $\leq$55 years of age but not in those >55 years of age.

In a subsequent analysis of 424 initially nondiabetic Japanese Americans who were followed for additional 5 years (total of 10 years), 74 developed diabetes (36). Those developing diabetes had a mean BMI of 25.4 $\pm$ 3.7 kg/m^2, while those who remained nondiabetic had a mean BMI of 23.8 $\pm$ 3.1 kg/m^2. The odds of incident diabetes for a 1 SD increase in BMI were 1.57 (95% CI 1.23−2.02). Thus, these two studies

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Table 1—Prospective cohort studies (2009–2013) reporting incident diabetes in Asian American populations

Reference	Study, location, and follow-up	Sample size	Mean age, years	BMI, kg/m²	Diabetes ascertainment method	Diabetes incidence
Aggregated data						
Ma et al., 2012 (28)	Women's Health Initiative (1993–2009) 40 centers throughout the U.S. Follow-up: 10.4 years	Asian*: 4,190 Black: 14,618 Hispanic: 6,484 White: 133,541	Asian: 63.0 (7.5) Black: 61.6 (7.1) Hispanic: 60.2 (6.8) White: 63.6 (7.2)	Asian: 24.8 (4.6) Black: 31.2 (6.7) Hispanic: 29.1 (5.8) White: 27.6 (5.8)	Self-report: physician prescribed "pills or insulin shots for diabetes"	Cumulative incidence % Asian: 10.6 Black: 17.0 Hispanic: 14.6 Incidence rate (per 1,000 person-years) Asian: 1.13 Black: 1.87 Hispanic: 1.67 White: 0.82
Disaggregated data						
Karter et al., 2013 (29)	DISTANCE study Northern California Mean follow-up: 1 year	1,704,363 Kaiser Permanente Northern California members with known ethnicity Filipino: 82,781 Chinese: 68,831 Japanese: 16,032 South Asian: 6,768 SE Asian: 1,876 Korean: 1,130 Vietnamese: 1,671 White: 968,943 Latino: 253,821 Black: 135,934	Filipino: 49.1 (16.2) Chinese: 51.6 (16.8) Japanese: 58.7 (17.7) South Asian: 43.4 (15.0) SE Asian: 37.7 (12.2) Korean: 49.6 (15.7) Vietnamese: 39.5 (11.6) White: 53.6 (18.0) Latino: 44.8 (16.5) Black: 48.8 (17.5)	Mean BMI at baseline Filipino: 26.6 (4.7) South Asian: 26.4 (4.7) SE Asian: 26.4 (5.2) Japanese: 25.4 (4.9) Korean: 24.9 (4.2) Vietnamese: 23.9 (4.1) Chinese: 24.2 (4.0) White: 28.3 (6.4) Black: 30.9 (7.5) Latino: 29.7 (6.4)	Based on medical records: ICD-9: 250 (inpatient or two or more outpatient diagnoses) Either FPG ≥126 mg/dL; random or postchallenge glucose ≥200 mg/dL Prescription for insulin or oral antihyperglycemic medications	Age- and sex-adjusted prevalence % South Asian: 15.9 Filipino: 16.1 SE Asian: 10.5 Japanese: 10.3 Korean: 9.9 Vietnamese: 9.9 Chinese: 8.2 White: 7.3 Latino: 14.0 Black: 13.7 Incidence rate (per 1,000 person-years) Korean: 20.3 South Asian: 17.2 Filipino: 14.7 SE Asian: 11.4 Japanese: 7.5 Chinese: 6.5 Vietnamese: 4.6 White: 6.3 Latino: 11.2 Black: 11.2

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Table 1—Continued

Reference	Study, location, and follow-up	Sample size	Mean age, years	BMI, kg/m^2	Diabetes ascertainment method	Diabetes incidence
Wander et al., 2013 (36)	Japanese-American Community Diabetes Study Seattle, WA Follow-up: 10 years	421 Japanese Americans, 54% male	51.4 years (34.0–75.1)	Baseline Mean: 24.1 (range 16.6–36.9) After 5 years Incident T2D: 24.9 Nondiabetic: 24.0 After 10 years Incident T2D: 25.4 Nondiabetic: 23.8	2-h 75-g OGTT	Cumulative incidence 20.4% 5-year incidence 9.3% 10-year incidence 17.6%
Chiu et al., 2011 (31)	Multiethnic Cohort Ontario Study Ontario, Canada Mean follow-up: 12.8 years (1996–2009)	South Asian: 1,001 Chinese: 866 White: 57,210 Black: 747	South Asian: 42 (36–49) Chinese: 42 (36–50) White: 46 (38–57) Black: 42 (36–51)	Self-reported BMI at baseline South Asian: 24.6 (22–27) Chinese: 22.6 (20.0–24.0) White: 26.1 (23.0–28.0) Black: 26.1 (23.0–28.0)	Linkage with Ontario diabetes database (from multiple administrative sources)	Incidence rate (per 1,000 person-years) Baseline BMI 18.5–23 White: 3.1 (2.7–3.6) South Asian: 11.6 (6.0–17.8) Chinese: 3.7 (1.1–6.4) Black: 7.3 (1.1–16.9) Baseline BMI 23–27.5 White: 6.9 (6.4–7.6) South Asian: 20.2 (13.1–27.8) Chinese: 16.8 (8.4–25.2) Black: 14.1 (8.6–20.2) Baseline BMI ≥27.5 White: 19.0 (17.9–20.0) South Asian: 44.9 (28.1–63.9) Chinese: 30.9 (10.9–52.6) Black: 28.9 (17.0–42.9)
Maskarinec et al., 2009 (32)	Hawaii Component of the Multiethnic Cohort Hawaii Mean follow-up: 12 years	Caucasian: 35,042 Japanese: 44,513 Hawaiian: 14,346 Other: 9,997	% in age category Japanese men <55: 29.6% 55–64: 27.5% ≥65: 42.9% Japanese women <55: 29.9% 55–64: 29.6% ≥65: 40.5% White men <55: 42.6% 55–64: 27.6% ≥65: 29.8% White women <55: 44.4% 55–64: 26.9% ≥65: 28.7%	% in BMI category Japanese men BMI <22: 18.5% BMI 22–24.9: 37.2% BMI 25–29.9: 37.2% BMI ≥30: 7.2% Japanese women BMI <22: 41.5% BMI 22–24.9: 29.7% BMI 25–29.9: 22.6% BMI ≥30: 6.2% White men BMI <22.0: 13.8% BMI 22.0–24.9: 31.6% BMI 25.0–29.9: 40.7% BMI ≥30.0: 13.9% White women BMI <22: 33.2% BMI 22.0–24.9: 27.4% BMI 25.0–29.9: 25.2% BMI ≥30.0: 14.1%	Insurance data, blood test	Incidence rate (per 1,000 person-years) White: 5.8 (5.0–6.6) Japanese: 12.5 (11.4–13.5) Hawaiian: 15.5 (13.3–17.6) Other: 12.2 (9.9–14.4)

Data are mean (SD) unless otherwise indicated. FPG, fasting plasma glucose; SE, Southeast; T2D, type 2 diabetes. *Self-reported Chinese, Indo-Chinese, Japanese, Korean, Pacific Islander, and Vietnamese.

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indicate that BMI is a significant risk factor for incident diabetes in Japanese Americans and that the BMI levels at which diabetes develops are quite low. However, neither report provided an inflection point for BMI at which risk was significantly increased.

A multiethnic cohort study identified nondiabetic adults in Ontario, Canada, using Statistics Canada's 1996 National Population Health Survey and the Canadian Community Health Survey (31). Survey participants living in Ontario, aged ≥30 years at the time of survey, and who self-reported as South Asian (n = 1,001) or Chinese (n = 866) comprised the Asian cohorts and were followed for a median of 6 years. Also included were blacks (n = 747) and non-Hispanic whites (n = 57,210). BMI was based on self-reported weight and height at baseline, and incident diabetes cases were ascertained through record linkage with the population-based Ontario Diabetes Database using a validated administrative data algorithm. Participants were followed from the survey interview date to the date of diabetes diagnosis, death, or at the end of the study. At baseline, mean BMI was 24.6 kg/m^2 among South Asians, 22.6 kg/m^2 among Chinese, 26.1 kg/m^2 among blacks, and 26.1 kg/m^2 among non-Hispanic whites. Researchers found that incident diabetes risk, adjusted for age, sex, sociodemographic characteristics, and BMI, was significantly higher for South Asians (20.8/1,000 person-years; HR 3.40), blacks (16.3/1,000; 1.99), and Chinese (9.3/1,000; 1.87), compared with non-Hispanic whites (9.5/1,000). The BMI cutoff value at which diabetes incidence was equivalent to BMI 30 kg/m^2 for non-Hispanic whites was estimated at 24 kg/m^2 for South Asians, 25 kg/m^2 for Chinese, and 26 kg/m^2 for blacks. Additionally, the median age at diagnosis was younger for South Asians (49 years) and Chinese (55 years) compared with blacks (57 years) and non-Hispanic whites (58 years).

Last, the Multiethnic Cohort (32) in Hawaii included non-Hispanic whites, Native Hawaiians, and Japanese Americans. The Hawaii data from this cohort were linked to two diabetes care registries (Blue Cross/Blue Shield and Kaiser Permanente Hawaii). Incident type 2 diabetes was identified by self-report of medical conditions between 1999 and 2003, a medication questionnaire, and linkage with health insurance plans in 2007. Native Hawaiians had the highest incidence (15.5/1,000 person-years), followed by Japanese Americans (12.5/1,000), while non-Hispanic whites had the lowest incidence (5.8 cases/1,000). The authors compared the HR of incident diabetes at different BMI cut points for each racial/ethnic group and found that Japanese Americans had a significantly higher incidence of diabetes at BMI 22.0–24.9 kg/m^2 than Hawaiians or non-Hispanic whites. Diabetes risk for Japanese Americans was higher than for non-Hispanic whites at all BMI levels. Even at BMI cut points of <22 kg/m^2 and 22.0−24.9 kg/m^2, respectively, HRs were higher among Japanese Americans compared with non-Hispanic whites at BMI cut points of 25.0−29.9 kg/m^2.

NEW CROSS-SECTIONAL ANALYSIS

Most recently, in an effort to ascertain the lowest BMI cut point that might be practical for identifying Asian American adults (aged ≥45 years) with previously undiagnosed type 2 diabetes, a group of investigators presented a new analysis at the 2014 Scientific Sessions of the American Diabetes Association (ADA) based on combined data from four cohort studies (39).The data set included participants without a prior diabetes diagnosis, aged ≥45 years, with no non-Asian admixture. Participant data were obtained from the University of California San Diego Filipino Health Study, San Diego, CA (n = 421); North Kohala Study, Hawaii, HI (n = 115 Filipinos, 129 Japanese, 18 other Asian); Seattle Japanese-American Community Diabetes Study, Seattle, WA (n = 371); and the Mediators of Atherosclerosis in South Asians Living in America (MASALA), San Francisco, CA, and Chicago, IL (n = 609). All 1,663 participants underwent 2-h 75-g OGTT, and diabetes diagnosis was based on ADA 2014 criteria (40). In the total sample, a BMI ≥26 kg/m^2 cut point had the lowest misclassification rate (false-positive + false-negative rates) and highest Youden's index (sensitivity + specificity −1). Sensitivity approximated specificity at BMI ≥25.4 kg/m^2; however, limiting screening at BMI ≥25 kg/m^2 would miss 36% of Asian Americans with newly diagnosed type 2 diabetes. In the same study, Araneta et al. (39) found that screening Asian Americans at a BMI cut point of ≥23.5 kg/m^2 identified approximately 80% of those with undiagnosed type 2 diabetes. Among Japanese Americans, lowering the BMI screening cut point to ≥22.8 kg/m^2 achieved 80% sensitivity. The same study also showed that limiting screening to HbA_{1c} ≥6.5% fails to identify almost half of Asian Americans with diabetes and 44% who had isolated postchallenge hyperglycemia would be missed without an OGTT.

CONCLUSIONS

This comprehensive review and analysis of the association between BMI and diabetes in Asian Americans illustrates that Asian Americans have a higher prevalence of type 2 diabetes at relatively lower BMI cut points than whites. Given that established BMI cut points indicating elevated diabetes risk are inappropriate for Asian Americans, establishing a specific BMI cut point to identify Asian Americans with or at risk for future diabetes would be beneficial to the potential health of millions of Asian American individuals.

Generally, the rationale behind the conventional BMI cut point has been the observation that overweight and obese adults (18 years of age or older) with a BMI of ≥25 kg/m^2 have increased risks of both morbidity and mortality. Adults who meet or exceed the 25 kg/m^2 BMI threshold are at increased risk of developing coronary heart disease, hypertension, hypercholesterolemia, type 2 diabetes, and other diseases, in addition to showing increases in mortality (41). However, while the studies reviewed herein do indicate increased diabetes prevalence among Asian Americans with BMIs below the 25 kg/m^2 threshold, a recent study (42) found no evidence to suggest an increased risk of total mortality among Asian Americans within the BMI range of 20 to <25 kg/m^2. Therefore, it is important to note that the aim of this position statement is not to redefine BMI cut points that constitute overweight and obesity thresholds as they relate to mortality or morbidity in Asian Americans. Instead, the intent is to clarify how to use BMI as a simple initial screening tool to identify Asian Americans who may have diabetes or be at risk for future diabetes. The question being considered is the most appropriate BMI cut point indicative of

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elevated risk of diabetes in Asian Americans. Historically, there has been a general acknowledgment that a BMI cutoff point lower than 25 kg/m^2 would increase the likelihood of identifying diabetes or diabetes risk in Asians. Thus in the Diabetes Prevention Program (DPP), a BMI value of 22 kg/m^2 was selected as the eligibility BMI for Asians (43). The 2014 ADA "Standards of Medical Care in Diabetes" (40) indicates that there is compelling evidence that lower BMI cut points, specifically BMI cutoff value of 24 kg/m^2 in South Asians and 25 kg/m^2 in Chinese, denote increased diabetes risk in some racial and ethnic groups, although the ADA Standards fall short of identifying an exact cut point. However in 2000, a group cosponsored jointly by the Regional Office for the Western Pacific (WPRO) of the World Health Organization, the International Association for the Study of Obesity, and the International Obesity Task Force published in an extensive monograph a recommendation that the BMI value to denote overweight in Asians should be $\geq$23 kg/m^2 and $\geq$25 kg/m^2 for obesity (44). Subsequently, the World Health Organization consultation group identified potential public health action points along the BMI continuum ranging from 23.0 to 27.5 kg/m^2 and proposed that each country make decisions regarding the definitions of increased risk for its population (45). They did not identify an exact cut point. In addition, some Asian countries have taken steps to set new BMI obesity cut points for their populations. In 1992, the Japan Society for the Study of Obesity (JASSO) decided to define BMI $\geq$25 kg/m^2 as obesity (46). In China, a BMI of 24 kg/m^2 was found to have the best sensitivity and specificity for risk-factor identification and was recommended as the cutoff point for overweight. A BMI of 28 kg/m^2 was found to identify risk factors with specificity approximately 90% and was recommended as the cutoff point for obesity (47). Likewise, the diagnostic cutoff for overweight BMI in India (48) is 23 kg/m^2.

Determining the optimal BMI cut point for identifying Asian Americans at elevated risk for diabetes is complex. There is tremendous heterogeneity among the Asian American subgroups. For example, data from the DISTANCE study might suggest a conventional BMI cut point of 25 kg/m^2 as an acceptable threshold (29), especially for South Asians and Southeast Asians. In contrast, the Women's Health Initiative (28), the Seattle Japanese-American Community Diabetes Study (36), the multiethnic cohort study from Canada (31), and the Multiethnic Cohort in Hawaii (32) would lend support to lowering the BMI cut point, especially for East Asians (Chinese and Japanese).

In light of the diabetes epidemic, there is an urgent need to increase early detection and activate the at-risk public toward diabetes prevention. Adopting a single lower and uniform BMI cut point for Asian Americans would serve to increase opportunities for education, intervention, behavior and lifestyle change, and diagnosis. In support of this approach, data from Araneta et al. (39) suggest that for diabetes screening purposes BMI cut points with a sensitivity of 80% fall consistently between 23–24 kg/m^2 for nearly all Asian American subgroups (with levels slightly lower for Japanese). This makes a rounded cut point of 23 kg/m^2 practical. In determining a single BMI cut point, it is important to balance sensitivity and specificity so as to provide a valuable screening tool without numerous false positives. Furthermore, for a screening tool to be most valuable, it must be at least as useful as other commonly available tools. A BMI cut point of 23 kg/m^2 will have greater sensitivity than the ADA general screening questionnaire's (ADA Type 2 Diabetes Risk Test) sensitivity of 70–80% (49). An argument can be made to push the BMI cut point to lower than 23 kg/m^2 in favor of even further increased sensitivity. However, this would lead to an unacceptably low specificity (13.1%) (39).

The authors of this position statement propose that the analysis of BMI and diabetes in Asian Americans and subsequent recommendation of an Asian American–specific BMI cut point of 23 kg/m^2 for diabetes screening in the U.S. have the advantage of being predicated on available data for Asian Americans, not Asian country data. In this way, this recommendation takes into consideration not only genetic and physiologic factors but also environmental and lifestyle context. Further, it is based on a comprehensive review of available literature with focus on longitudinal studies and includes data from several large Asian American subgroups.

However, the analysis is limited in several ways. First, no uniform method of diagnosis was used in the studies upon which this recommendation is based. Diagnostic methods ranged from medication usage data, self-report, HbA_{1c}, fasting blood glucose, and OGTT. Studies using diagnostic methods other than OGTT might have understated diabetes prevalence (20–22,39). Second, some studies were not based on BMI data available at the time of incident diabetes. Rather, most studies reported the association between baseline BMI and diabetes diagnosis, with these measurements as much as 5–10 years apart in some instances. Therefore, these data do not accurately reflect the relationship of BMI to diabetes diagnosis at the time of diagnosis. Third, the number of robust studies is limited. Additional research will help to further elucidate current findings on the relationship between BMI and incident diabetes in Asian Americans. Fourth, while some data exist for several Asian ethnic subgroups, insufficient disaggregated data are available for many of the Asian ethnic groups that comprise this very heterogeneous population.

Much is known about how to prevent diabetes for those at risk (primary prevention) and about how to prevent or reduce complications in those with diabetes (secondary prevention). Diabetes is no longer the same life-threatening, life-limiting condition it was a century or even several decades ago. However, without increased prevention and early diagnosis the benefits of these strategies will not be fully realized. Because Asian Americans' risk for diabetes is under-recognized based on the existing BMI criteria, this population may not be afforded the same opportunity as others for increased prevention and early diagnosis. It is imperative to better screen and diagnose America's fastest-growing ethnic group based on the BMI cut point that more appropriately applies to them. While more research is needed to identify better risk markers than BMI and future research efforts will undoubtedly bring us closer to understanding the metabolic profiles of specific ethnic subgroups, with the subsequent development of appropriate

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personalized medicine, there is an urgent need for action now, even in the absence of perfect data.

ADA RECOMMENDATION

Testing for diabetes should be considered for all Asian American adults who present with a BMI of ≥23 kg/m^2.

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References

1. U.S. Census Bureau. The Asian population 2010. Available from http://www.census.gov/prod/cen2010/briefs/c2010br-11.pdf. Accessed 17 November 2014

2. U.S. Census Bureau. U.S. Census Bureau projections show a slower growing, older, more diverse nation a half century from now [Internet], 2012. Available from https://www.census.gov/newsroom/releases/archives/population/cb12-243.html. Accessed 17 November 2014

3. Després JP. Body fat distribution and risk of cardiovascular disease: an update. Circulation 2012;126:1301–1313

4. Fujimoto WY, Bergstrom RW, Boyko EJ, et al. Visceral adiposity and incident coronary heart disease in Japanese-American men. The 10-year follow-up results of the Seattle Japanese-American Community Diabetes Study. Diabetes Care 1999;22:1808–1812

5. Ohlson LO, Larsson B, Svärdsudd K, et al. The influence of body fat distribution on the incidence of diabetes mellitus: 13.5 years of follow-up of the participants in the study of men born in 1913. Diabetes 1985;34:1055–1058

6. Pouliot MC, Després JP, Lemieux S, et al. Waist circumference and abdominal sagittal diameter: best simple anthropometric indexes of abdominal visceral adipose tissue accumulation and related cardiovascular risk in men and women. Am J Cardiol 1994;73:460–468

7. Lemieux S, Prud'homme D, Bouchard C, Tremblay A, Després JP. A single threshold value of waist girth identifies normal-weight and overweight subjects with excess visceral adipose tissue. Am J Clin Nutr 1996;64:685–693

8. Enzi G, Gasparo M, Biondetti PR, Fiore D, Semisa M, Zurlo F. Subcutaneous and visceral fat distribution according to sex, age, and overweight, evaluated by computed tomography. Am J Clin Nutr 1986;44:739–746

9. World Health Organization. *Obesity: Preventing and Managing the Global Epidemic: Report of a WHO Consultation*. Geneva, Switzerland, World Health Organization; 2000 (WHO technical report series 894)

10. Wang J, Thornton JC, Russell M, Burastero S, Heymsfield S, Pierson RN Jr. Asians have lower body mass index (BMI) but higher percent body fat than do whites: comparisons of anthropometric measurements. Am J Clin Nutr 1994;60:23–28

11. Hayashi T, Boyko EJ, McNeely MJ, Leonetti DL, Kahn SE, Fujimoto WY. Visceral adiposity, not abdominal subcutaneous fat area, is associated with an increase in future insulin resistance in Japanese Americans. Diabetes 2008;57:1269–1275

12. National Institutes of Health. Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults—the evidence report. Obes Res 1998;6(Suppl. 2):51S–209S

13. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention. NCHS Data Brief. No.131. Prevalence of obesity among adults: United States 2011−2012 [Internet], October 2013. Available from http://www.cdc.gov/nchs/data/databriefs/db131.pdf. Accessed 17 November 2014

14. Ramachandran A, Ma RC, Snehalatha C. Diabetes in Asia. Lancet 2010;375:408–418

15. Nakagami T, Qiao Q, Carstensen B, et al.; DECODE-DECODA Study Group. Age, body mass index and type 2 diabetes-associations modified by ethnicity. Diabetologia 2003;46:1063–1070

16. Hsu WC, Boyko EJ, Fujimoto WY, et al. Pathophysiologic differences among Asians, Native Hawaiians, and other Pacific Islanders and treatment implications. Diabetes Care 2012;35:1189–1198

17. Chan JC, Malik V, Jia W, et al. Diabetes in Asia: epidemiology, risk factors, and pathophysiology. JAMA 2009;301:2129–2140

18. King GL, McNeely MJ, Thorpe LE, et al. Understanding and addressing unique needs of diabetes in Asian Americans, Native Hawaiians, and Pacific Islanders. Diabetes Care 2012;35:1181–1188

19. Araneta MR, Barrett-Connor E. Ethnic differences in visceral adipose tissue and type 2 diabetes: Filipino, African-American, and white women. Obes Res 2005;13:1458–1465

20. Liao D, Shofer JB, Boyko EJ, et al. Abnormal glucose tolerance and increased risk for cardiovascular disease in Japanese-Americans with normal fasting glucose. Diabetes Care 2001;24:39–44

21. Choi KM, Lee J, Kim DR, et al. Comparison of ADA and WHO criteria for the diagnosis of diabetes in elderly Koreans. Diabet Med 2002;19:853–857

22. Unwin N, Shaw J, Zimmet P, Alberti KG. Impaired glucose tolerance and impaired fasting glycaemia: the current status on definition and intervention. Diabet Med 2002;19:708–723

23. McNeely MJ, Boyko EJ. Type 2 diabetes prevalence in Asian Americans: results of a national health survey. Diabetes Care 2004;27:66–69

24. Lee JW, Brancati FL, Yeh HC. Trends in the prevalence of type 2 diabetes in Asians versus whites: results from the United States National Health Interview Survey, 1997-2008. Diabetes Care 2011;34:353–357

25. Thorpe LE, Upadhyay UD, Chamany S, et al. Prevalence and control of diabetes and impaired fasting glucose in New York City. Diabetes Care 2009;32:57–62

26. Gupta LS, Wu CC, Young S, Perlman SE. Prevalence of diabetes in New York City, 2002-2008: comparing foreign-born South Asians and other Asians with U.S.-born whites, blacks, and Hispanics. Diabetes Care 2011;34:1791–1793

27. Staimez LR, Weber MB, Narayan KM, Oza-Frank R. A systematic review of overweight, obesity, and type 2 diabetes among Asian American subgroups. Curr Diabetes Rev 2013;9:312–331

28. Ma Y, Hébert JR, Manson JE, et al. Determinants of racial/ethnic disparities in incidence of diabetes in postmenopausal women in the U.S.: the Women's Health Initiative 1993-2009. Diabetes Care 2012;35:2226–2234

29. Karter AJ, Schillinger D, Adams AS, et al. Elevated rates of diabetes in Pacific Islanders and Asian subgroups: the Diabetes Study of Northern California (DISTANCE). Diabetes Care 2013;36:574–579

30. McNeely MJ, Boyko EJ, Shofer JB, Newell-Morris L, Leonetti DL, Fujimoto WY. Standard definitions of overweight and central adiposity for determining diabetes risk in Japanese Americans. Am J Clin Nutr 2001;74:101–107

31. Chiu M, Austin PC, Manuel DG, Shah BR, Tu JV. Deriving ethnic-specific BMI cutoff points for assessing diabetes risk. Diabetes Care 2011;34:1741–1748

32. Maskarinec G, Erber E, Grandinetti A, et al. Diabetes incidence based on linkages with health plans: the Multiethnic Cohort. Diabetes 2009;58:1732–1738

33. Fujimoto WY, Boyko EJ, Hayashi T, et al. Risk factors for type 2 diabetes: lessons learned from Japanese Americans in Seattle. J Diabetes Investig 2012;3:212–224

34. Fujimoto W, Boyko EJ, Leonetti DL, Bergstrom R, Newell-Morris L, Wahl PW. Hypertension in Japanese Americans: the Seattle Japanese-American Community Diabetes Study. Public Health Rep 1996;111(Suppl. 2):56–58

35. Hayashi T, Boyko EJ, Leonetti DL, et al. Visceral adiposity and the risk of impaired glucose tolerance: a prospective study among Japanese Americans. Diabetes Care 2003;26:650–655

36. Wander PL, Boyko EJ, Leonetti DL, McNeely MJ, Kahn SE, Fujimoto WY. Change in visceral adiposity independently predicts a greater risk of developing type 2 diabetes over 10 years in Japanese Americans. Diabetes Care 2013;36:289–293

37. Tong J, Boyko EJ, Utzschneider KM, et al. Intra-abdominal fat accumulation predicts the development of the metabolic syndrome in non-diabetic Japanese-Americans. Diabetologia 2007;50:1156–1160

38. Onishi Y, Hayashi T, Sato KK, et al. Identifying Japanese Americans at risk for prevalent or incident type 2 diabetes by BMI, waist, or intra-abdominal fat. Poster presentation at American Diabetes Association 74th Scientific Sessions, 13−17 June 2014, San Francisco, CA

39. Araneta MR, Kanaya A, Fujimoto W, et al. Optimum BMI cut-points to screen Asian Americans for type 2 diabetes. Poster presentation at American Diabetes Association 74th Scientific Sessions, 13−17 June 2014, San Francisco, CA

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40. American Diabetes Association. Standards of Medical Care in Diabetes—2014. Diabetes Care 2014;37(Suppl. 1):S14–S80
41. Berrington de Gonzalez A, Hartge P, Cerhan JR, et al. Body-mass index and mortality among 1.46 million white adults. N Engl J Med 2010; 363:2211–2219
42. Park Y, Wang S, Kitahara CM, et al. Body mass index and risk of death in Asian Americans. Am J Public Health 2014;104:520–525
43. The Diabetes Prevention Program Research Group. The Diabetes Prevention Program: baseline characteristics of the randomized cohort. Diabetes Care 2000;23:1619–1629
44. World Health Organisation, International Association for the Study of Obesity, International Obesity Task Force. *The Asia-Pacific Perspective: Redefining Obesity and Its Treatment*. Sydney, Australia, Health Communications, 2000
45. WHO Expert Consultation. Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. Lancet 2004;363:157–163
46. Kanazawa M, Yoshiike N, Osaka T, Numba Y, Zimmet P, Inoue S. Criteria and classification of obesity in Japan and Asia-Oceania. Asia Pac J Clin Nutr 2002;11(Suppl. 8):S732–S737
47. Bei-Fan Z; Cooperative Meta-Analysis Group of Working Group on Obesity in China. Predictive values of body mass index and waist circumference for risk factors of certain related diseases in Chinese adults: study on optimal cut-off points of body mass index and waist circumference in Chinese adults. Asia Pac J Clin Nutr 2002;11(Suppl. 8):S685–S693
48. Misra A, Chowbey P, Makkar BM, et al.; Concensus Group. Consensus statement for diagnosis of obesity, abdominal obesity and the metabolic syndrome for Asian Indians and recommendations for physical activity, medical and surgical management. J Assoc Physicians India 2009;57:163–170
49. Rolka DB, Narayan KM, Thompson TJ, et al. Performance of recommended screening tests for undiagnosed diabetes and dysglycemia. Diabetes Care 2001;24:1899–1903

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