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Understanding and Addressing Unique Needs of Diabetes in Asian Americans, Native Hawaiians, and Pacific Islanders

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The Asian American (AA) population is currently the fastest growing population in the U.S., having expanded six times faster than the general population in the 1990s (1). In addition, diabetes prevalence continues to rise in this population, as observed for other populations around the world. However, given the diverse natures, cultures, and physiologies among the AA, Native Hawaiian (NH), and Pacific Islander (PI) (AANHPI) populations, and in particular the distinct diabetes profiles, an understanding of these factors can provide important clues to understand the genesis, pathophysiology, and treatment response of diabetes, as well as characterize community outreach programs needed for the wider net of diverse communities throughout the U.S. In this regard, a meeting, whose theme was "Diabetes in Asian Americans, Native Hawaiians, and Pacific Islanders: A Call to Action," was held in Honolulu, Hawaii, in September 2011 by a coalition of health care organizations and scientists with strong interests in the topic and in the health of AANHPI populations. There was consensus that there is a great need to understand the prevalence and pathophysiology and discuss potential intervention strategies regarding diabetes in AANHPI populations given the unique characteristics of this population. This information may help health care providers understand and improve diabetes prevention, treatment outcomes, and complications in AANHPI populations. In this review, we examine diabetes prevalence in different AANHPI populations to highlight the similarities and differences.

AANHPI POPULATION OVERVIEW—The various groups that comprise AANHPI populations are hugely diverse geographically, culturally, and genetically. The U.S. census defines AAs as persons who have origins in the East, Southeast, or South Asia. NHs and PIs are people who have origins in Hawaii, Samoa, or any other Pacific island (2,3). Diversity within each of these groups is also large. For example, although grouped as AAs, the language, culture, and genetics of someone originating in India are very different than a person from Japan or the Philippines. According to the 2010 census, 4.8% of the U.S. population describe themselves as being AAs alone, and about 0.2% identify themselves as NHs or PIs (4). The largest subgroup of AAs are Chinese at 23.8%, followed by Filipinos at 18.3%, Asian Indians at 16.2%, Vietnamese at 10.9%, Koreans at 10.5%, and Japanese at 7.8% (4,5).

Approximately 31% of AAs were born in the U.S., but this number varies greatly depending on the country of origin because of immigration laws that limited the entrance of Asians from the 1920s to the 1960s. Before the 1920s, most Asian immigrants were from Japan and China. Since the immigration law reforms after World War II, there has been a large influx of immigration from many Asian countries, with the exception of Japan, mostly due to socioeconomic and geopolitical reasons. Thus, most Japanese Americans and many Chinese Americans (CAs) come from families that have resided in the U.S. for several generations, whereas other Asian subgroups are more recent immigrants. For example, 60% of Japanese Americans were born in the U.S. compared with 22% of Thai Americans. As a result, 80% of AAs report speaking a language other than English at home, and only ~60% of AAs report that they speak English very well (6).

Sociodemographic differences among various Asian groups, such as recent immigration, acculturation to lifestyle, and age distribution, can be large. For example, Japanese Americans have an older age distribution, with 31% aged older than 65 years, compared with just 5% of the Asian Indian population (5). Among AAs, ~45% have a bachelor degree or higher; however, among NHs and PIs, only 25% have attained this level of education (5). More than 75% of Japanese, Filipino, and Asian Indian adults have income 200% above the poverty threshold or greater, which is a higher proportion than other ethnic groups (5). Discussions regarding disease and prevalence rate compared with other ethnic groups need to take these factors into consideration.

GENERAL CHARACTERISTICS OF DIABETES IN AANHPI—The prevalence rate of diabetes has been increasing very rapidly in developed nations, from 1 to 2% and reaching a prevalence rate of 5 to 7% in the adult population of most developed nations (7). In 2010, the world prevalence of diabetes among adults aged

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20–79 years was estimated at 6.4%, affecting 285 million. This number will increase to 7.7%, or 439 million adults, by 2030. This represents a 69% increase of adults with diabetes in developing countries and a 20% increase in developed countries (7).

In the AANHPI populations, type 1 diabetes is quite rare, being 5- to 10-fold less than that observed in the white population (8–10). In addition, the association of type 2 diabetes with increased obesity, as measured by BMI, is also different in the AA population compared with those in other ethnic groups (11). This lack of clarity regarding diabetes prevalence is mainly due to paucity of national data focusing on AANHPIs in general and among its various populations. In the following, we will survey most of the known national and regional studies regarding differences in AANHPI populations in the prevalence of diabetes. In addition, we will support the hypothesis that, in general, the risk of developing type 2 diabetes is increased in AANHPI populations compared with other ethnic groups.

NATIONAL DATA: THE BEHAVIORAL RISK FACTOR SURVEILLANCE SYSTEM—The Behavioral Risk Factor Surveillance System (BRFSS) began in the 1980s when a few state health departments started conducting telephone surveys to gather basic information about the health and health behaviors of their residents. Details on the methodology are provided elsewhere (12). Currently, annual data from all 50 states, the District of Columbia, Guam, Puerto Rico, and the U.S. Virgin Islands are compiled by the Centers for Disease Control and Prevention.

The first year that AAs and PIs were categorized separately was 2001. In 2004, BRFSS data from 2001 were analyzed to help clarify whether AAs and PIs are at increased risk for type 2 diabetes compared with whites (13). Because BRFSS does not include information on type of diabetes, people aged younger than 30 were excluded to minimize the proportion of those with type 1 diabetes among those who reported diabetes. Of 163,584 participants, 3,071 (2.4%) were Asian and 626 (0.3%) were NH or PI. The mean age of AA participants was ~46 years, which was significantly younger than the other groups, and more than 6 years younger than the average age of non-Hispanic white respondents. AAs had a mean BMI of ~24 kg/m^2, which was significantly lower than other groups, where average BMI was in the overweight range at ~27 to 28.5 kg/m^2.

Type 2 diabetes was defined as a positive response to the question: Have you ever been told by a doctor that you have diabetes? People who responded that they were diagnosed before age 30 were presumed to have type 1 diabetes, and women who responded that they had only been told they had diabetes during pregnancy were presumed to have gestational diabetes. After adjusting for age and sex, AAs did not have increased risk compared with whites, but the odds of prevalent diabetes was threefold higher in PIs compared with whites. However, the odds of prevalent diabetes were approximately 60% higher for AAs than whites in analyses adjusted for BMI as well as age and sex.

THE NATIONAL HEALTH INTERVIEW STUDY—The National Health Interview Study (NHIS) is similar to BFRSS in that it is also a survey of health status and health behaviors (14). However, there are some important differences. The NHIS is designed to provide a statistically representative sample of the U.S. population, whereas BRFSS is designed to provide a representative sample of each state. In-person interviews are done in the person's home by employees of the U.S. Bureau of the Census, and it also includes children. Some information is obtained by proxy, such that a relative or household member can report information for other people in the household. The NHIS has only recently started procedures to begin over-sampling Asian populations to get reliable statistics on these populations.

A recent study published by Lee et al. (15) included information on 3,562 AAs and 38,946 non-Hispanic whites obtained from 2006 to 2008 NHIS data. These data include variables not available from the 2001 BFRSS, including country of birth and Asian subgroups. Only ~23% of Asians in this sample were born in the U.S. compared with >95% of whites. Participants were not considered to have type 2 diabetes if they reported being diagnosed with diabetes before age 25, reported only borderline diabetes or prediabetes, or diabetes only diagnosed during pregnancy.

The odds of prevalent diabetes, after accounting for differences in age and sex, were ~40% higher in AAs relative to whites. After further adjustment for BMI (normal, overweight, and obese categories using published lower thresholds for Asians), the odds of prevalent diabetes was 70% higher among AAs than whites, similar to findings in the BRFSS study. The fully adjusted analysis showed a statistically significant odds ratio (OR) of 1.4 for AAs after taking into account age, sex, BMI category, education, nation of birth, income, smoking, alcohol use, and leisure time physical activity. For the three largest Asian subgroups in this fully adjusted model, the OR relative to whites was highest in Asian Indians, followed by Filipinos and lowest in CAs (OR 1.0), pointing out the importance of desegregating the AANHPI population to provide a clear picture of the effect of diabetes on AANHPI populations.

These national surveys have several limitations, particularly with regard to understanding diabetes health risks for AAs and PIs. Non–English-speaking people are under-represented, which likely disproportionately affects AAs. Because these surveys do not include any blood test screening, they do not capture undiagnosed diabetes. Clinicians may be more likely to screen patients for diabetes if they have risk factors for diabetes such as obesity. But obesity, as traditionally defined (BMI >30 kg/m^2), is less common in AAs, and they may be less likely to be screened. In addition, information about the health of PIs from these data is limited, and NHIS does not include publically available information specifically on PIs (15).

NEW YORK CITY RESULTS—Several regional studies on diabetes in AANHPIs have been published. For example, studies from New York City surveillance initiatives have helped to characterize burden of diabetes among Asian residents in the urban Northeast region (16–18). Two studies examined findings from the 2004 New York City Health and Nutrition Examination Survey (NYC HANES), a population-based interview and physical examination survey conducted in 2004 that measured the prevalence of diagnosed and undiagnosed diabetes, as well as impaired fasting glucose (IFG) (16,17). Details on the methodology of NYC HANES have been published elsewhere, but the response rate for this analysis was 53% (n = 1,336) (18). The third study combined results from 8 years of the New York City Community Health Survey (NYC CHS) random digit dialing telephone survey (18). The data from the annual NYC CHS for years 2002 to 2008 were combined and presented, excluding 2005, when diabetes information was not collected.

On the basis of the NYC HANES survey in 2004, the estimated total prevalence of diabetes among New Yorkers aged 20 years or older was 12.5%. The prevalence of diagnosed diabetes was 8.7% (95% CI 6.8–11.2), and undiagnosed diabetes 3.8% (2.6–5.4), indicating that 30.4% of adults with diabetes were undiagnosed. The highest prevalence of undiagnosed diabetes was in blacks (12.1%) and Asians (11.4%).

The prevalence of IFG among adults was 23.5%. IFG was highest in Asians (32.4%), higher than in whites (P = 0.02) or blacks (P = 0.03). Foreign-born adults were more likely to have IFG than those born in the U.S. (26.9 vs. 20.7%, P = 0.02). Among foreign-born adults, IFG levels were elevated in foreign-born Asians (32.7%, P = 0.02) and foreign-born Hispanics (30.3%, P = 0.03) compared with foreign-born whites (19.6%).

In multivariate models, after adjusting for other factors, diabetes was present in a higher proportion of Asians (8.3%) and blacks (7.6%) with normal weight than whites (1.0%; P = 0.05). Disparities between normal-weight Asians and other races/ethnicities were even more striking (1.5–2 times higher) when modeling levels of diabetes and IFG (Fig. 1) (16). A second study further classified Asians by region of birth (17) and found that Asians born in South Asia were nearly five times as likely to have diabetes (adjusted OR [AOR] 4.88 [95% CI 1.52–15.66]) and five times more likely to have the metabolic syndrome (MS) (5.59 [1.69–18.50]), compared with whites. Other foreign-born Asians were at increased risk for IFG compared with whites (AOR 2.89 [1.65–5.07]) but were not at increased risk of diabetes or the MS compared with whites (Table 1) (11).

The larger NYC CHS telephone survey confirmed this pattern, finding a self-reported prevalence among foreign-born South Asians (13.6%) to be nearly twice that of foreign-born Asians (7.4%) from other areas. The prevalence of diabetes was similar in foreign-born South Asians (13.6%) and U.S.-born Hispanics (14.4%), yet by standard BMI cutoff points, 67.1% of U.S.-born Hispanics were overweight or obese compared with 45.6% of foreign-born South Asians. At normal BMI, the prevalence of diabetes among foreign-born South Asians was more than five times higher than among U.S.-born non-Hispanic whites (14.1% vs 2.7%) and was significantly higher than among all other racial/nativity groups, even after adjusting for multiple covariates (P < 0.05). When the Asian BMI cutoff points were used, the distribution of diabetes prevalence by BMI category among foreign-born South Asians shifted to a pattern more similar to that seen in the other race/nativity groups. However, the burden of disease remained high among foreign-born South Asians.

These studies documented a high prevalence of diabetes among NYC adults and quantified an even larger proportion of adults with prediabetes. All three studies found that Asian residents had the highest levels of diabetes, MS, or glucose impairment of any race/ethnicity, with nearly one-half having glucose levels above the normal range. Among those in the normal-weight range, Asians had higher levels of diabetes even after adjusting for other demographic factors. By stratifying Asians into subgroups, the studies demonstrated that risks among South Asians and other Asians differed, with South Asians having about five times the odds of having diabetes and the MS as U.S.-born white residents. Other Asian residents (largely consisting of Chinese NYC residents) had modestly elevated levels of IFG and diabetes compared with U.S.-born whites.

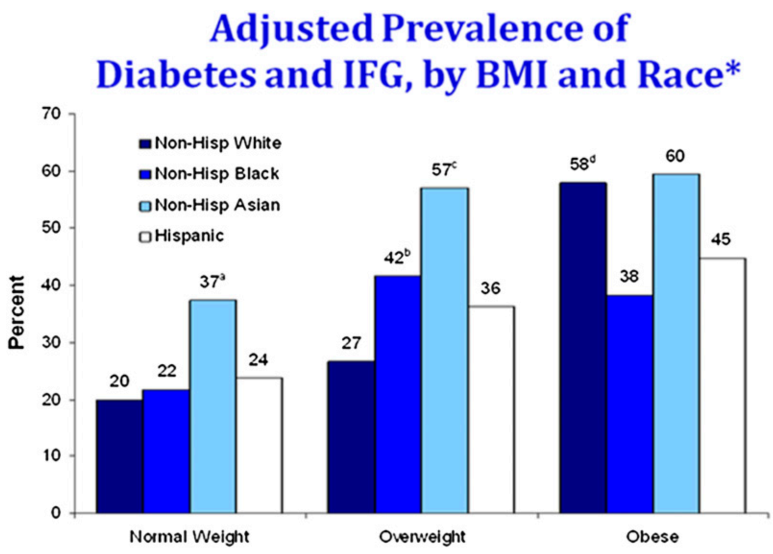

Figure 1—*Adjusted prevalence of diabetes and IFG by BMI and race. *Models were adjusted for age, sex, place of birth, income, and physical activity. [a]Estimate is higher than all other racial/ethnic groups at P < 0.05. [b]Estimate is higher than whites at P < 0.05. [c]Estimate is higher than whites at P < 0.01 and Hispanics at P < 0.05. [d]Estimate is higher than blacks at P < 0.05. Reprinted from Thorpe et al. Prevalence and control of diabetes and impaired fasting glucose in New York City. Diabetes Care 2009;32:57–62. (A high-quality color representation of this figure is available in the online issue.)*

NHs AND PIs—Kanaka O`iwi (NHs), like many other indigenous people in the U.S., have high rates of diabetes, obesity, and MS (19–23). To address this and other health disparities in NHs, the U.S. Congress enacted the Native Hawaiian Health Care Improvement Act in the early 1990s. Papa Ola Lokahi and the Native Hawaiian Health Care Systems began in earnest to study a broad spectrum of health and health care disparities experienced by NHs, including diabetes (24).

Diabetes is the fourth leading cause of death in NHs and has an important role in the health disparities observed in the NH population. NHs have an age-adjusted death rate (per 100,000) due to diabetes of 38.8 compared with 12.5 in whites and 16.3 in the general population of State of Hawaii (25). Several epidemiologic studies of large community-based NH populations on the islands of Hawaii, Kauai, and Molokai, have confirmed the prevalence of type 2 diabetes among NH adults to be ~19–24%, with ~15–47% of individuals having impaired glucose tolerance (IGT) or fasting hyperglycemia (IFG) (20,22). When compared with data for non-Hispanic whites from the National Health and Nutrition Examination Survey (NHANES), the NH study population had a fourfold greater age-adjusted prevalence of type 2 diabetes (20).

The high BMIs among NHs may contribute to the increased diabetes prevalence

Table 1—*Multivariable OR (95% CI) for prevalent diabetes, IFG, and MS comparing Asians born in South Asia and other foreign-born Asians with whites*

	Multivariable models*	
Outcome	Asians born in South Asia	Other foreign-born Asians
Diabetes	4.88 (1.52–15.66)	1.08 (0.44–2.62)
MS†	5.59 (1.69–18.50)	1.53 (0.80–2.94)
IFG†	1.81 (0.67–4.89)	2.89 (1.65–5.07)

Data are derived from Rajpathak et al. (17). *Adjusted for age, sex, body mass index, smoking, sedentary lifestyle, income, insurance status, and family history of diabetes. The reference category is non-Hispanic whites. †Participants with diabetes were excluded.

observed in this population. In NHs, BMI and waist-to-hip ratio has been significantly and positively associated with age, percentage of indigenous ancestry, and total dietary intake (26). Data from the Native Hawaiian Health Research (NHHR) Project has shown that the combined prevalence of overweight and obesity in NHs is 81.5%, compared with the national prevalence of 52.6%, and that IGT strongly correlated with increased body weight (20,26). The Multi-Ethnic Cohort Study also confirmed the positive correlation between diabetes and BMI and further found that the relationship was magnified in the NH population (27,28). Moreover, NHs and other minority populations had a higher diabetes prevalence in every BMI category compared with their white counterparts (27). Interestingly, in the Multi-Ethnic Cohort Study, prevalence of diabetes in NHs remained more than two times higher than that of whites, even after adjusting for sex, age, BMI, education, physical activity, and total energy intake (27).

In addition to BMI, certain dietary patterns and a traditional mode of acculturation have been associated with risk of diabetes in NHs. Studies on the Multi-Ethnic Cohort and the North Kohala Cohort concluded that NHs have the highest energy intake compared with all ethnic groups and that fat and meat dietary patterns are associated with diabetes risk in NHs and all minority populations (29,30).

Psychosocial factors may also contribute to increased diabetes risk in NH. One study showed that NHs with a traditional mode of acculturation had a greater prevalence of type 2 diabetes (27.9%) than NHs with an integrated (15.4%), assimilated (12.5%), or marginalized (10.5%) mode of acculturation. NHs from a traditional mode of acculturation strongly affiliated only with their ethnic heritage and not with mainstream culture. The authors proposed that accumulative stress, with increased release of stress hormones, which are known to promote gluconeogenesis, in the form of depression and perceived discrimination, has been associated with a traditional mode of acculturation, may underlie the observed relationship between acculturation and diabetes (31).

NHs have a higher prevalence not only of diabetes but also of diabetes complications. Among all ethnic groups represented in the TransPacific Renal Network, NHs were the most likely to have end-stage renal disease induced by diabetes compared with other causes of end-stage renal disease (32). In the Hawaii site of the National Kidney Foundation–Kidney Early Evaluation Program (KEEP-2) study, NHs had the highest occurrence of chronic kidney disease at 40%, whereas the Japanese had the lowest occurrence at 18% and the total study sample had a chronic kidney disease occurrence of 27% (33). For those discharged with a diagnosis of diabetes in 2007 in Hawaii, NHs had the second highest number of individuals with lower-extremity amputations, which also occurred at the youngest age compared with all other ethnic groups (34).

Cross-sectional data collected from 1,198 individuals in a rural community of Hawaii from 1997 to 2000 revealed that NHs had the highest prevalence of the MS (41.9%) compared with whites, who had the lowest prevalence (13.9%) (20). In a study of 855 NHs from the Hua Kanawao Ka Liko Study on Molokai, the only CVD outcome study of NH to date, diabetes was the strongest risk factor for CVD morbidity and mortality (35).

The PILI Study culturally adapted the DPP lifestyle protocol for NHs and other PIs (NHOPI) using a community-based participatory research approach that involved five principal investigators from the community and included focus groups and interviews with more than 100 NHOPI (36,37). The PILI Lifestyle Program (PLP) was a weight loss maintenance program for NHOPI that consisted of six monthly sessions delivered by trained community-peer educators in a community setting (38). In a randomized control trial comparing PLP (n = 72) with a 6-month standard behavioral weight loss maintenance program (n = 72), PLP participants were 5.1-fold more likely to maintain weight loss than the standard program participants for those who attended at least half of the sessions (38). The use of community engagement and community-based participatory research approaches offer hope for NHOPI with or at increased risk for diabetes to take ownership of their health and wellness

PEDIATRIC POPULATIONS—Youth obesity is increasing in AANHPIs, raising concerns that type 2 diabetes will also emerge as an epidemic in this age group (13,39). In an earlier report, the SEARCH for Diabetes in Youth Study reported that the incidence of type 2 diabetes was considerably higher among Asian and PI youth compared with non-Hispanic white youth (8). Given limited reports on diabetes among AANHPI youth, the study examined the clinical characteristics, incidence, and prevalence of diabetes among Asian, PI, and mixed Asian-PI (API) youth in the SEARCH for Diabetes in Youth study—the largest cohort of API youth with diabetes in the U.S. (40).

Data were collected from 245 Asian, PI, and API participants in the SEARCH for Diabetes in Youth study. SEARCH is a population-based, multicenter observational study that began conducting population-based ascertainment of cases of nongestational diabetes in youth aged younger than 20 years beginning in 2001 and continuing through the present (10). Diabetes cases were considered valid if diagnosed by a health care provider. Given the heterogeneity within the broad Asian and PI racial category, we examined characteristics of Asian, PI, and mixed API groups separately. In addition, the incidence and prevalence of type 1 and type 2 diabetes for Asian, PI, and API youth was combined.

Asian (n = 150), PI (n = 34) and mixed API (n = 61) subgroups encompassed numerous ethnicities. Asians were primarily Filipino, Japanese, and Chinese (in descending order). The PI subgroups were predominantly NH and Samoan. All five groups were well represented among the mixed API youth.

Most of the Asian, PI, and mixed API youth had type 1 diabetes. Only 23–30% of youth had type 2 diabetes, and the distribution by type did not differ by ethnic subgroups. Approximately 70% of youth were 10–19 years old and 55% were female. Although there were no significant differences by age or sex among the Asian, PI, and mixed API subgroups, the income and education distributions differed significantly, with Asians having higher education and income than mixed API and PI subgroups.

Most participants with type 2 diabetes were obese (range 71 [Asian]–100% [PI]) and all three groups had a mean BMI >33 kg/m^2 (range 33.7 [Asian]–42.4 [PI]). In those with type 1 diabetes, PIs were more likely to be obese, with a mean BMI of 26 vs. 20 for Asian and mixed API youth ($P < 0.0001$). There were also differences among subgroups in glycemic control and treatment. Asians with type 1 or type 2 diabetes were more likely to have lower $HgBA_{1c}$ than PIs, with mixed APIs having intermediate values. Asians were also more likely to have appropriate treatment with insulin (for type 1) or metformin (for type 2) than PIs.

The incidence of type 1 diabetes for youth aged 0–9 years was 6.4/100,000 person-years and 7.4/100,000 person-years for youth aged 10–19 years. The incidence of type 2 diabetes was 12.1/100,000 person-years for youth aged 10–19 years (Table 2) (10).

In summary, pediatric Asians and mixed APIs with type 1 and type 2 diabetes had lower mean BMI than PIs, and all Asian, PI, and API with type 2 diabetes had mean BMIs above the adult ethnicity-specific definitions of obesity. Although most pediatric Asian, PI, and API youth had type 1 diabetes, the incidence of type 2 diabetes in older Asian, PI, and API youth (10–19 years) was almost double that of type 1. Public health efforts to prevent type 2 diabetes and obesity in Asian, PI, and API adolescents are needed.

PREVALENCE AND INCIDENCE OF DIABETES OF VARIOUS ASIAN COUNTRIES—The possibility of AANHPIs having high risk of diabetes is supported by its high prevalence in many countries in Asia and the Pacific Islands. A recent population-based study in China reported prevalence rates of 9.7% of both diagnosed and undiagnosed diabetes. This represents a threefold increase from 1994, when it was reported to be 2.5%, clearly demonstrating the importance of environment in the epidemic of diabetes (41). Similar increases have also been reported in Japan, India, and urban areas in Viet Nam, at 12.8%, 15.5%, and 10.8%, respectively (42–44). These reports strongly support that all of the AANHPI groups will have a higher risk of diabetes compared with non-AAs, especially at lower BMI.

ASIAN OVERSAMPLING IN NHANES—It is clear from the discussion above that more detailed and desegregated information on a national level is needed regarding diabetes and its effect on AANHPIs. The Centers for Disease Control and Prevention's National Center for Health Statistics has been conducting examination surveys for more than 50 years. Specifically, NHANES is a program of studies designed to assess the health and nutritional status of adults and children in the U.S.

NHANES samples the civilian, noninstitutionalized household population in the U.S. (45). Since 1999, with continuous NHANES, the sampling domains are set and remain the same for 4 years at a time, or two 2-year cycles. Since 1988, NHANES has oversampled Mexican Americans, African Americans, low-income whites, and individuals aged 60 and older to be able to produce reliable prevalence estimates for these groups (46). In addition to those groups, NHANES oversampled the entire Hispanic population in 2007–2010 and retained sufficient numbers of Mexican Americans in the sample design so that trends in the health of Mexican Americans could continue to be monitored.

The NHANES health interview asks whether a doctor or other health professional has ever told the participant he or she has diabetes, and data collected from 2005 to 2008 suggests that approximately 8.2% of the population has diabetes as diagnosed by a physician, and clearly, there are disparities by race/ethnicity (47). Because NHANES combines self-reported data with objectively measured laboratory data, NHANES gets closer to the true prevalence of diabetes in the population, which is 11.3%, with an additional 3.1% who are unaware they have diabetes. The ability to combine self-reported data with objectively measured data is one of the strengths of NHANES.

NHANES will soon add objectively measured national prevalence estimates of diabetes in the U.S. for Asians. All those sampling domains were kept for the 2011–2014 NHANES, and Asians, as defined by the Census Bureau, were added. Thus, AAs will constitute 15% of the NHANES samples. For sample persons who identify themselves as being Asian or of Asian descent, detailed data on Asian origin or ancestry is collected.

Before the Asian oversample was added, NHANES was conducted in English and Spanish. On the basis of the sample locations selected for the next 4 years, the populations expected to be encountered in those locations, and consulting with the Asian and Pacific Islander American Health Forum, it was decided that materials would be translated into Chinese, traditional and simplified, Korean, and Vietnamese. Multiple avenues were explored to facilitate the sampling efforts in the AA population. Native speakers of each of these languages

Table 2—*Prevalence and incidence rates of type 1 and type 2 diabetes by age group among all Asian, PIs, and mixed API youth combined*

	Type 1 diabetes		Type 2 diabetes	
	Aged 0–9 years*	Aged 10–19 years*	Aged 0–9 years*	Aged 10–19 years*
Denominator (*N*)	154,899	165,504	154,899	165,504
Cases (*n*)	40	127	2	86
Prevalence per 1,000 (95% CI)	0.26 (0.19–0.35)	0.77 (0.65–0.92)	NP†	0.52 (0.42–0.64)
Denominator (*N*)	753,299	806,921	753,299	806,921
Cases (*n*)	48	59	5	98
Incidence per 100,000 (95% CI)	6.4 (4.8–8.5)	7.4 (5.8–9.6)	NP†	12.1 (9.9–14.8)

Data are derived from Liu et al. (10). *Age at the time of diagnosis for incident cases and age in the year 2001 for prevalent cases. †Rate not presented (NP) due to small numerator size.

on staff, who are familiar with NHANES, review the professional translations to be sure the meaning of the questions or phrases come through properly.

NHANES staff has participated in cultural competency training to help them recognize and respect cultural differences. In addition, advance survey arrangements now include actively seeking out help from and connecting with the Asian communities, and various interpretation services are being explored for better serving the non–English-speaking participants throughout the whole survey process.

CHALLENGES AND BARRIERS IN DIABETES MANAGEMENT AMONG AANHPI—It is clear that interventions with lifestyle changes, such as weight loss, diet, and exercise, and medications can prevent and delay the onset of diabetes and its complications in all racial and ethnic groups in the U.S. (36). However, the translations of these study-based results into communities have been difficult. The translational programs into AANHPIs will be even more difficult because there are the additional barriers of language, large gaps of differences in cultures, and the shortage of resources due to the minority status of the AANHPI populations. We provide several examples of various factors that can be potential barriers to translating prevention and intervention programs in AAs.

The Chinese American (CA) experience is complex because it is composed of a large segment of people who have had a long history of being Americans and an equally large group who are recent immigrants with English as a second language. Barriers such as cultural attitudes and beliefs, language, diet, support system, technology, other socioeconomic barriers, and alternative health pathways may hinder diabetes education and management outcomes among CAs (48). This pattern of health-seeking pathway includes self-care, health remedies, traditional medicine, and professional help. Some patients use folk healing and home remedies before seeking professional help, whereas others combine professional help with folk remedies (49).

Diabetes management among immigrant CAs is also partly influenced by the Eastern holistic concept of health (50). Eastern medicine emphasizes harmony, respect, yin–yang balance, collectiveness, and community, whereas Western medicine encourages forwardness, independence, and autonomy in individual decision making. Eastern medicine promotes that disease can be prevented and controlled by maintaining a balanced internal energy level (50). Therefore, some CA diabetic patients will take herbal medicines or home remedies first in an attempt to balance their yin–yang energy. Chinese who practice traditional medicine believe that foods are consumed for their warming and cooling properties to balance a deficiency of or excess energy in the body (51). They are classified into three major groups: hot, cold, and toxic. Hot and cold does not refer to temperature but food's energy warming and cooling properties. If the body has an excess of hot food intake, health consequences may include acne, bad breath, constipation, dry mouth, nosebleeds, and sore throat. An excess of cold food intake may weaken the body's immune function. Toxic foods, such as chicken, beef, and shellfish, are considered not suitable for postsurgery patients. Some may avoid foods recommended by major health organizations for their rich content of antioxidants, such as melons and green leafy vegetables, because of their cooling properties.

Currently, diabetes self-management programs have mainly been available for those with higher socioeconomic status and whose primary language is English (52). In 2006, the Chinese Community Health Resource Center in San Francisco conducted a pilot study to test the efficacy of a culturally tailored educational support group program on the improvement of diabetes knowledge and hemoglobin A_{1c} (HbA_{1c}) among Chinese immigrants with type 2 diabetes. Although the preliminary data indicated statistical significance in improved HbA_{1c} levels and knowledge gain, further research is needed.

Recommendations that are likely to be applicable to other AANHPIs are *1*) collaborations with community members, academia, and government entities to leverage resources and promote community engagement; *2*) using technology (i.e., DVDs, Web-based, Vodcasts, and mobile applications) to increase access to culturally appropriate diabetes education and management resources; *3*) allocating funds for community-based participatory research and programs focusing on obesity education, especially during early childhood; *4*) modifying the existing health systems that allow opportunities for culturally appropriate programs; *5*) implementing measures to prevent digital and technologic disparities so patients can easily access diabetes-related health information; *6*) reducing stigma associated with mental health issues, such as depression, which is prevalent among patients living with diabetes; and *7*) cultivating the next generation to be culturally competent health care professionals.

ASIAN AMERICAN DIABETES INITIATIVE AT JOSLIN DIABETES CENTER—In response to the rising rate of diabetes among Asians worldwide and AAs, the Asian American Diabetes Initiative (AADI) was established in 2000 at the Joslin Diabetes Center to promote awareness and to understand the pathogenesis of the diabetes epidemic to AAs through relevant research, outreach, education, and culturally appropriate treatment. To assess the extent of the language barrier in CA populations, AADI published a 2006 report, *Identification of Linguistic Barriers to Diabetes Knowledge and Glycemic Control in Chinese Americans with Diabetes,* which evaluated diabetic subjects with a working knowledge of English, Mandarin, or Cantonese (53). They found that although subjects followed comparable self-management diabetes instructions and received health care in a culturally sensitive setting, those who preferred to speak Chinese, regardless of the use of translation services, had less diabetes knowledge and displayed a tendency toward higher HbA_{1c} levels compared with their English-speaking counterparts. In addition, the fact that only the Chinese-speaking subjects improved their knowledge of diabetes after the study highlights the need for accessibility to and the importance of linguistically appropriate diabetes educational materials as an integral part of diabetes care for AAs. The bilingual (Chinese/English) guidebook used in the study, *Staying Healthy with Diabetes: A Guide for the Chinese American Community*, was created by AADI and is an important resource for CA patients. As one of the first Chinese–English culturally appropriate illustrated guides on diabetes, the guidebook serves as an essential tool for patients.

COMMON PORTALS TO REACH AANHPI POPULATIONS—Owing to the huge diversity of AANHPI populations, approaches that can access large numbers of these populations have been difficult to identify. One potential avenue is a common Web site that can contain many subsites for the various AANHPI groups. In 2004, AADI created one of the first interactive diabetes Web sites designed specifically with the intention of impacting the Asian population worldwide.

Operating through three languages so far (Chinese, Japanese and English), the AADI Web site equips diabetic individuals, family members, caregivers, health care providers, and interested friends with the necessary tools to remain proactive in diabetes prevention and/or self-management. Accessed by 133 countries worldwide, users have the opportunity to educate themselves through interactive online tools, including: *Ask the Experts*, *Asian BMI Calculator*, *Risk Assessment*, and the *Joslin Interactive Wok*, which allows users to learn the nutritional value of their meals containing Asian ingredients through cooking their own dishes virtually.

CONCLUSIONS—This review has provided strong supportive evidence that AANHPIs are at increased risk to develop diabetes, which needs to be documented by national population-based studies. New support is needed to understand the needs of various diverse populations of AANHPIs on the prevention and treatment of diabetes because the significant differences in genetics, physiology, and culture among the AANHPIs have a major impact on the course of diabetes.

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