

# Association Between Acculturation Modes and Type 2 Diabetes Among Native Hawaiians

JOSEPH KEAWE'AIMOKU KAHOLOKULA, PHD<sup>1,2</sup>  
ANDREA H. NACAPOY<sup>3</sup>

ANDREW GRANDINETTI, PHD<sup>2,4</sup>  
HEALANI K. CHANG, DPH<sup>2,5,6</sup>

**OBJECTIVE** — To examine the association between acculturation modes (integrated, assimilated, traditional, and marginalized) and type 2 diabetes prevalence in Native Hawaiians.

**RESEARCH DESIGN AND METHODS** — Cross-sectional data were analyzed from 495 Native Hawaiians, including acculturation modes, diabetes status, triglycerides, fasting insulin, BMI, age, and education level. Acculturation modes were assessed using an eight-item cultural affiliation questionnaire.

**RESULTS** — Native Hawaiians in a traditional mode of acculturation were more likely to have type 2 diabetes (27.9%) than those in integrated (15.4%), assimilated (12.5%), or marginalized (10.5%) modes.

**CONCLUSIONS** — The higher prevalence of type 2 diabetes among Native Hawaiians in a traditional mode of acculturation could not be attributed to any of the sociodemographic or biological factors included in this study. We discuss the role of psychosocial factors as possible mediators in the relationship between acculturation modes and type 2 diabetes.

*Diabetes Care* 31:698–700, 2008

Acculturation is believed to affect type 2 diabetes among certain U.S. ethnic groups because of lifestyle and environmental changes (e.g., diet, physical activity, and exposure to environmental stressors) (1,2). Previous studies have found an association between acculturation factors and type 2 diabetes among immigrant groups in the U.S. such as Arab Americans and Hispanics (3,4), but a dearth of such studies exists among Native populations. Native Hawaiians, the indigenous people of Hawai'i, have high type 2 diabetes prevalence and diabetes-related mortality rates that could be associated with acculturation factors (5).

Past studies of acculturation and type 2 diabetes used proxy factors of acculturation such as length of stay in the U.S., generational status, and language preference (3,4), which are not appropriate for Native populations. A relevant acculturation model for Native groups suggests that health status can differ across four modes of acculturation: integrated, high affiliation with ethnic heritage and mainstream culture; assimilated, high affiliation with mainstream culture only; separatist, high affiliation with ethnic heritage only (renamed here as traditional); and marginalized, low affiliation with both ethnic heritage and mainstream cul-

ture (6). We examined the association between these four acculturation modes and type 2 diabetes among Native Hawaiians.

## RESEARCH DESIGN AND METHODS

Cross-sectional data from 495 Native Hawaiians (225 male, 270 female) who participated in the Kohala Health Research Project (KHRP), a community-based epidemiological study of diabetes and cardiovascular risk factors, were analyzed in this study. The KHRP's design and methods have been previously described(7).

Diabetes was determined using World Health Organization criteria of fasting blood glucose  $\geq 126$  mg/dl or 2-h postchallenge blood glucose  $\geq 200$  mg/dl (8). All participants, except those taking insulin or oral diabetic medication, underwent a 2-h, 75-g oral glucose tolerance test after a 10- to 14-h overnight fast. Only fasting blood samples were collected from those participants taking insulin or oral diabetic medication.

Acculturation modes were assessed using an 8-item cultural affiliation questionnaire designed by the KHRP. The questionnaire has two subscales, including a four-item ethnic cultural identity subscale and a four-item Western U.S. cultural identity subscale, designed to assess the degree of identity/affiliation with, feelings toward, and knowledge about each cultural group and the impact each cultural group has on lifestyle. A 5-point response scale was used for each item, ranging from 1, very knowledgeable, very positive, or very involved, to 5, not knowledgeable at all, very negative, or disinterested. Scores  $\leq 12$  on each subscale (median score 12, range 4–20) indicated higher levels of affiliation. Participants were considered integrated with scores  $\leq 12$  on both subscales, traditional with scores  $\leq 12$  on the ethnic subscale and  $> 12$  on the western U.S. subscale, assimilated with scores  $> 12$  on the ethnic subscale and  $\leq 12$  on the western U.S. subscale, and marginalized with scores  $> 12$  on both subscales. Cronbach's  $\alpha$  was 0.72 for each subscale, indicating good internal reliability estimates.

From the <sup>1</sup>Department of Native Hawaiian Health, John A. Burns School of Medicine, University of Hawai'i at Mānoa, Honolulu, Hawaii; the <sup>2</sup>Native Hawaiian Health Research Project, University of Hawai'i at Mānoa, Honolulu, Hawaii; the <sup>3</sup>Department of Psychology, University of Hawai'i at Mānoa, Honolulu, Hawaii; the <sup>4</sup>Department of Public Health Sciences and Epidemiology, University of Hawai'i at Mānoa, Honolulu, Hawaii; the <sup>5</sup>Pacific Biosciences Research Center, University of Hawai'i at Mānoa, Honolulu, Hawaii; and the <sup>6</sup>Division of Ecology and Health, John A. Burns School of Medicine, University of Hawai'i at Mānoa, Honolulu, Hawaii.

Address correspondence and reprint requests to Joseph Keawe'aimoku Kaholokula, PhD, Department of Native Hawaiian Health, 651 Ilalo St., MEB 307-H, Honolulu, Hawaii 96813. E-mail: kaholoku@hawaii.edu.

Received for publication 7 August 2007 and accepted in revised form 8 January 2008.

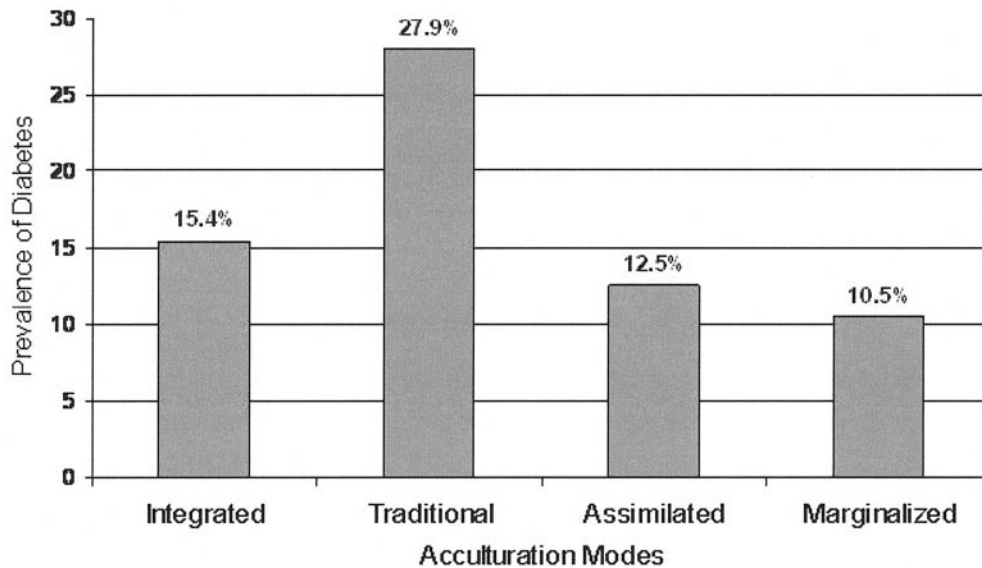
Published ahead of print at <http://care.diabetesjournals.org> on 17 January 2008. DOI: 10.2337/dc07-1560.

The ideas and opinions in this article are those of the authors and do not reflect those of the institutions that supported this research.

**Abbreviations:** KHRP, Kohala Health Research Project.

© 2008 by the American Diabetes Association.

The costs of publication of this article were defrayed in part by the payment of page charges. This article must therefore be hereby marked "advertisement" in accordance with 18 U.S.C. Section 1734 solely to indicate this fact.



**Figure 1**— Prevalence of type 2 diabetes in Native Hawaiians across four acculturation modes.

Age, education level, BMI (calculated as the weight in kilograms divided by the square of height in meters), degree of Native Hawaiian ancestry, triglycerides, and fasting insulin were selected from the KHRP dataset to examine as possible confounders for inclusion in our analysis. These specific factors were chosen because they have been identified as correlates of diabetes in Native Hawaiians (7). Degree of Native Hawaiian ancestry was based on self-reported (ascertained from an interview) blood quantum categories of 100, 75, 50, 25, and <25%. These factors were adjusted for in a logistic regression model examining the effects of acculturation modes on diabetes status (0 = no diabetes, 1 = diabetes) if they were found to have a significant association ( $P \leq 0.05$ ) with both diabetes status and acculturation modes based on bivariate analyses (ANOVA and  $\chi^2$ ). JMP statistical software, version 6.0.2, was used for data analysis (SAS Institute).

**RESULTS**— The majority of the participants were integrated ( $n = 382$ , 77.2%), followed by traditional ( $n = 86$ , 17.4%), marginalized ( $n = 19$ , 3.8%), and assimilated ( $n = 8$ , 1.6%). Significant differences in type 2 diabetes status were observed across acculturation modes [ $\chi^2 = (3,495) 7.71$ ,  $P = 0.05$ ], with the traditional mode having more cases of diabetes ( $n = 24$ , 27.9%), followed by the integrated ( $n = 59$ , 15.4%), marginalized ( $n = 2$ , 10.5%), and assimilated ( $n = 1$ , 12.5%) modes (Fig. 1). Of the potential confounders examined, increased age ( $F = 55.58$ ,  $P < 0.0001$ ), higher BMI

( $F = 26.64$ ,  $P < 0.0001$ ), triglycerides ( $F = 24.39$ ,  $P < 0.0001$ ), and fasting insulin ( $F = 25.38$ ,  $P < 0.0001$ ) were significantly associated with having diabetes, but only education level was significantly associated with acculturation modes [ $\chi^2 = (9,495) 28.19$ ,  $P < 0.001$ ]. None of the potential confounders examined were significantly associated with both diabetes status and acculturation modes.

A logistic regression model was used to calculate the odds ratio (OR) and CI and also as a post hoc analysis to determine which modes significantly differed in diabetes prevalence. The results showed that participants with traditional mode were more likely to have type 2 diabetes [OR 2.12 (95% CI 1.23–3.65)] ( $P = 0.01$ ) compared with integrated mode (reference group). There were no significant differences in diabetes status between integrated mode and assimilated and marginalized modes.

**CONCLUSIONS**— Native Hawaiians in the traditional mode of acculturation had a greater prevalence of type 2 diabetes than those in the integrated, assimilated, and marginalized modes that could not be attributed to any of the sociodemographic or biological factors included in this study. These findings suggest that psychosocial or other factors associated with the traditional mode of acculturation not accounted for in this study may increase the risk for type 2 diabetes among Native Hawaiians in this mode of acculturation.

Research in other ethnic groups

found that people in the traditional and marginalized modes have greater acculturative stress (e.g., depression and greater perceived discrimination) than those in the integrated and assimilated modes (9). Studies also show that people with depression, a common response to environmental stressors, have a 37% increased risk of type 2 diabetes (10). One hypothesis needing investigation is that Native Hawaiians in the traditional mode may experience more psychosocial or environmental stressors than Native Hawaiians in the other three modes, thus increasing their risk for type 2 diabetes.

Inferences from our study should be limited to comparisons between the integrated and traditional modes due to small sample sizes among the assimilated and marginalized groups. There appears to be adequate statistical power to detect differences between the integrated and traditional modes, given the effect size (OR 2.12) found for their association and the fact that these two modes combined make up 94.6% of our entire sample.

**Acknowledgments**— The KHRP was a project of the Pacific Biosciences Research Center, University of Hawai'i, and was supported in part by grants to the University of Hawai'i from the National Center for Research Resources (G12RR003061, P20RR011091, and P20RR016467) and the National Heart, Lung, and Blood Institute (U01HL079163) of the National Institutes of Health.

Parts of this study were presented in abstract form at the 65th annual meeting of the American Diabetes Association, San Diego, California, 10–14 June 2005.

We thank the investigators and staff of the KHRP (formerly known as the Native Hawaiian Health Research Project) for their assistance and the North Kohala community for their support of the KHRP.

References

1. Finch BK, Hummer RA, Kol B, Vega WA: The role of discrimination and acculturative stress in the physical health of Mexican-origin adults. *Hisp J Behav Sci* 23: 399–429, 2001
2. Marshall JA, Hamman RF, Baxter J, Mayer EJ, Fulton DL, Orleans M, Rewers M, Jones RH: Ethnic differences in risk factors associated with the prevalence of non-insulin-dependent diabetes mellitus: the San Luis Valley Diabetes Study. *Am J Epidemiol* 137:706–718, 1993
3. Jaber LA, Brown MB, Hammad A, Zhu Q, Herman WH: Lack of acculturation is a risk factor for diabetes in Arab immigrants in the U.S. *Diabetes Care* 26:2010–2014, 2003
4. Mainous AG, 3rd, Majeed A, Koopman RJ, Baker R, Everett CJ, Tilley BC, Diaz VA: Acculturation and diabetes among Hispanics: evidence from the 1999–2002 National Health and Nutrition Examination Survey. *Public Health Rep* 121: 60–66, 2006
5. Hirokawa R, Huang T, Pobutsky A, Nogues M, Salvail F, Nguyen HD: *Hawaii Diabetes Report, 2004*. Honolulu, Hawaii, Hawaii State Department of Health, 2004
6. Berry JW: Conceptual approaches to acculturation. In *Acculturation: Advances in Theory, Measurement and Applied Research*. Chun KM, Balls-Organista P, Marin G, Eds. Washington DC, American Psychological Association, 2003, p. 17–37
7. Mau MK, Grandinetti A, Arakaki RF, Chang HK, Kinney EK, Curb JD, the Native Hawaiian Health Research (NHHR) Project: The insulin resistance syndrome in Native Hawaiians. *Diabetes Care* 20: 1376–1380, 1997
8. World Health Organization: *Definition, Diagnosis, and Classification of Diabetes Mellitus and Its Complications: Report of a WHO Consultation*. Part 1. Diagnosis and Classification of Diabetes Mellitus. Geneva, World Health Org., 1999
9. Zheng X, Sang D, Wang L: Acculturation and subjective well-being of Chinese students in Australia. *J Happiness Stud* 5:57–72, 2004
10. Knol MJ, Twisk JWR, Beckman ATF, Heine RJ, Snoek FJ, Pouwer F: Depression as a risk factor for the onset of type 2 diabetes mellitus: a meta-analysis. *Diabetologia* 49:837–845, 2006