

Research Article

Risk of Type 2 Diabetes among US and Foreign Born Non-Hispanic Asians: Evidence from NHANES 2011-12

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Abstract

Aims/Introduction: The purpose of this study was to compare risks for metabolic dysfunction and type 2 diabetes among Non-Hispanic Asian and Non-Hispanic white adults using new nationally representative data in the U.S. We compared the metabolic profiles of U.S.-born vs. foreign-born Non-Hispanic Asian adults.

Materials and Methods: This study used NHANES 2011-2012 adult data for Non-Hispanic Asians (n=827) and Non-Hispanic Whites (n=2,108). Standardized risk threshold cutoffs for blood pressure, lipids, and glucose were used to determine metabolic dysfunction. Logistic regression models were used to estimate odds of metabolic dysfunction. Covariates included age, sex, education level, marital status, BMI, serum cotinine exposure (for smoking), and nativity.

Results: Compared to Non-Hispanic Whites, Non-Hispanic Asians were at increased risk for HDL ≤ 40 mg/dL (men) and ≤ 50 mg/dL (women) (OR=1.78, 95% CI=1.02-3.11), HbA1c ≥ 5.6 % (OR=3.23, 95% CI= 1.79-5.90), and HbA1c ≥ 6.5 % (OR=3.32, 95% CI=1.58-6.98). Relative to U.S.-born Non-Hispanic Asians, foreign-born Non-Hispanic Asians had elevated risk for HbA1c ≥ 6.5 % (OR=1.94, 95% CI=1.24-3.02), total cholesterol ≥ 200 mg/dL (OR= 1.77, 95 %CI = 1.31-2.39) and LDL ≥ 100 mg/dL (OR=1.79, 95% CI=1.23-2.59).

Conclusions: This is the first analysis of metabolic dysfunction and type 2 diabetes between U.S vs foreign-born Non-Hispanic Asians using nationally representative data. Non-Hispanic Asian immigrants appear to be the most at risk. Independent of BMI, Non-Hispanic Asians were at significantly higher risk for low HDL and type 2 diabetes compared to Non-Hispanic white adults.

Introduction

Non-Hispanic Asians are the fastest growing demographic group in the U.S., and comprise approximately 5.6% of the current U.S. population^[1]. By 2050 Non-Hispanic Asians are projected to make up almost 8% of the total U.S. population^[1]. Non-Hispanic Asians have become the largest stream of immigrants to the U.S., comprising 36% of all new immigrants, surpassing the total number of Hispanic immigrants^[2].

Type 2 diabetes is the fifth leading cause of death among Non-Hispanic Asians, after cancer, heart disease, stroke and unintentional injuries^[3]. Type 2 diabetes is a debilitating condition that can lead to comorbid health complications such as heart disease and premature death^[4]. Metabolic dysfunctions associated with type 2 diabetes include high levels of blood glucose and dyslipidemia^[5,6].

Besides the rapid growth of the Non-Hispanic Asian population in the U.S., the urgent need of assessing metabolic dysfunction in this population also lies in the observation that Non-Hispanic Asian populations around the world are at increased risk for metabolic symptoms that may contribute to the

development of type 2 diabetes^[7,8]. Cross-sectional studies that compare Non-Hispanic Asian populations to other racial/ethnic groups in North America suggest that Non-Hispanic Asians experience an elevated prevalence of metabolic risk relative to other racial/ethnic groups^[9-11].

Nativity to the U.S. has important effects on the development of metabolic dysfunction and type 2 diabetes among Non-Hispanic Asians. Previous research on minority immigrant health indicates exposure to U.S. lifestyle and the Western diet is associated with a decline in overall health. Hispanic immigrants demonstrate increased body mass index^[12-14], hypertension^[15], and high blood pressure^[15] after living in the U.S. for a period of time. Comparable research on Non-Hispanic Asian populations is limited. However, there is evidence to show that Asian immigrants are in better health upon arrival to the U.S. For example, immigrant Korean and Chinese females experience an overall decline in health and in the nutritional quality of their diets over time^[16,17]. As Non-Hispanic Asians acculturate to U.S. lifestyle and culture, an increase in chronic disease prevalence is observed^[18].

Previous studies examining metabolic dysfunction

and type 2 diabetes have not utilized a nationally representative sample of Non-Hispanic Asians with objective measures. Using the most recent wave (2011-2012) of the National Health and Nutrition Examination Survey, where Non-Hispanic Asians were oversampled for the first time, this study 1) compared the risk of metabolic dysfunction and type 2 diabetes of Non-Hispanic Asians and Non-Hispanic white adults in the U.S.; and 2) compared the risk of metabolic dysfunction and type 2 diabetes between U.S vs foreign-born Non-Hispanic Asian adults.

Materials and Methods

The source of data for this study is the 2011-2012 National Health and Nutrition Examination Survey (NHANES), a cross-sectional, nationally representative surveillance system designed to assess the current health status of the non-institutionalized population of residents in the U.S. The 2011-2012 wave of NHANES over-sampled Non-Hispanic Asians for the first time, allowing for a robust analysis of Non-Hispanic Asian health outcomes. Each survey used a complex, stratified, multi-staged probability clustering sampling design. NHANES 2011-2012 was approved by the National Center for Health Statistics (NCHS) and Centers for Disease Control (CDC) Institutional Review Board, which included written and informed consent from the participants. The data collection methods are described in detail elsewhere^[19].

Study Sample

From an original sample size of 9,756 participants, only self-identified Non-Hispanic Asian and Non-Hispanic white adult participants were included in the present analysis (n=2,935). Non-Hispanic Asian adults comprised 28.2 % (n=827) of the total study sample. Data were available in sub-samples only for low-density lipoprotein (LDL, n=1,309) and for 2-hour oral glucose tolerance test (OGTT, n=1,024).

Measures

Race was self-reported in NHANES 2011-12. Height and weight were measured by trained health professionals in a mobile examination center using standardized equipment. Body mass index (BMI) was calculated as weight (kg) divided by height squared (m²). Serum cotinine exposure was used as a proxy for tobacco use, where levels ≥ 1 ng/mL were coded as "current smokers"^[20]. Age was self-reported at the time of interview, where 'adult' was defined to be 18 years and older for this study. Other covariates included were marital status (ever married vs. never married), education level (less than high school vs high school or above) and nativity (born in the U.S vs born outside the U.S). Metabolic indicators were defined according to American Diabetes Association guidelines. High blood pressure was defined as systolic blood pressure (SBP) ≥ 130 mmHg and/or diastolic blood pressure (DBP) ≥ 85 mmHg. Dyslipidemia was defined as high density lipoprotein (HDL) ≤ 40 mg/dL (male) or ≤ 50 mg/dL (female), low density lipoprotein (LDL) ≥ 100 mg/dL, triglycerides ≥ 150 mg/dL, and total cholesterol ≥ 200 mg/dL. Prediabetes was assessed by impaired fasting glucose (IFG) ≥ 100 mg/dL, oral glucose tolerance test (OGTT) ≥ 140 mg/dL or HbA1c ≥ 5.6 %. Type 2 diabetes was indicated as

IFG ≥ 126 mg/dL, OGTT ≥ 200 mg/dL or HbA1c $\geq 6.5\%$ ^[21].

Statistical Analysis

Standard sampling weights, strata, and primary sampling units provided by the NCHS/CDC were applied to adjust for unequal probabilities and non-response data in the survey. Multivariate logistic regression analysis was used to calculate odds ratios for metabolic risk factors and type 2 diabetes; adjusting for age, sex, marital status, BMI, education, nativity, serum cotinine exposure (for smoking), and race as appropriate. Statistical analyses were carried out using STATA 11.0 for Windows^[22].

Results

Characteristics of the sample are presented in Table 1. Compared to Non-Hispanic Asians, Non-Hispanic Whites were slightly older (means \pm SD = 50.3 \pm 0.4 vs. 44.3 \pm 0.5 years, p<0.05) and had higher BMI (means \pm SD = 28.3 \pm 0.15 vs 24.4 \pm 0.15 kg/m², p<0.05). In addition, a higher proportion of Non-Hispanic Whites compared to Non-Hispanic Asians were born in the U.S (96.6% vs 16.3%, p<0.05) and had higher serum cotinine exposure (38.0% vs 24.7 %, p<0.05). In terms of proportion of population at risk for metabolic dysfunction, Non-Hispanic Whites were more likely than Non-Hispanic Asians to have high SBP (28.7% vs 19.3%, p<0.05) and low HDL (30.8% vs 26.5%, p<0.05). However, Non-Hispanic Asians were more likely than Non-Hispanic Whites to be pre-diabetic as indicated by: HbA1c $\geq 5.6\%$ (50.7% vs 46.7%, p=0.05), and have type 2 diabetes as indicated by HbA1c $\geq 6.5\%$ (21.2 % vs 15.2%, p<0.001).

Table 1: Sample characteristics of Non-Hispanic Asian and Non-Hispanic white adults (18 years and older)^a

Total	Non-Hispanic Asian	Non-Hispanic White
(N=2,935)	(N=827)	(N=2,108)
Age \bar{x} (years)	44.3(0.5)*	50.3(0.4)
Edu Level %		
Less than HS	8.6**	2.4
College graduate	50.8**	35.9
Gender %		
Female	53.6	51.1
Current Marital Status, married %	62.5*	52.2
Serum Cotinine % ≥ 1 ng/mL	24.6*	38
Metabolic Risk Profile		
BMI \bar{x} (m/kg ²)	24.4 (0.1)*	28.3 (0.1)
SBP ≥ 130 mmHg	19.3**	28.7
DBP ≥ 85 mmHg	9	8.6
HDL ≤ 40 mg/dL (male) & ≤ 50 mg/dL (female)	26.5*	30.8
LDL ≥ 100 mg/dL	82.1	83.1
Triglycerides ≥ 150 mg/dL	33.8	37.6
Total Cholesterol ≥ 200 mg/dL	47.4	46.7
Diabetes Risk		
OGTT ≥ 200 mg/dL	69.2	66.98
OGTT ≥ 140 mg/dL	73.9	72.2

IFG ≥ 126 mg/dL	60.2	58.3
IFG ≥ 100 mg/dL	64.8	64.4
HbA1c $\geq 6.5\%$	21.2**	15.2
HbA1c $\geq 5.6\%$	50.7***	46.7
Born in the US %	16.2**	96.6

*National Health and Nutrition Examination and Survey 2011-2012

Data are % values unless otherwise indicated as means \pm SD.***p=0.05.,*P<0.05, **P \leq 0.001

Adjusted Analysis Comparing Non-Hispanic Asians vs Non-Hispanic Whites

Table 2 shows the odds of metabolic dysfunction among Non-Hispanic Asians relative to Non-Hispanic Whites after adjusting for age, sex, education, smoking, nativity, marital status and BMI. Non-Hispanic Asians were significantly more at risk than Non-Hispanic Whites for low HDL (OR=1.78, 95% CI=1.02-3.11), pre-diabetes by HbA1c $\geq 5.6\%$ (OR=3.25, 95% CI=1.79-5.90) and type 2 diabetes by HbA1c $\geq 6.5\%$ (OR=3.32, 95% CI=1.58-6.98). IFG and OGTT indicators did not discriminate significantly between Non-Hispanic Asian and Non-Hispanic White adults.

Table 2: Adjusted metabolic risks for Non-Hispanic Asian vs. Non-Hispanic White Adults in the U.S.

Diabetes Risk	Odds Ratio	95 % CI
OGTT ≥ 140 mg/dL	2	0.48-8.21
OGTT ≥ 200 mg/dL	2.63	0.87-7.95
HbA1c $\geq 5.6\%$	3.25*	1.79-5.90
HbA1c $\geq 6.5\%$	3.32*	1.58-6.98
IFG ≥ 100 mg/dL	0.97	0.63-1.49
IFG ≥ 126 mg/dL	0.9	0.59-1.37
Metabolic Risk Factors		
SBP ≥ 130 mmHg	1.14	0.73-1.79
DBP ≥ 85 mmHg	1.1	1.11-1.33
LDL ≥ 100 mg/dL	0.63	0.33-1.18
Triglycerides ≥ 150 mg/dL	1.42	0.98-2.06
HDL ≤ 40 mg/dL (male) & HDL ≤ 50 mg/dL (female)	1.78*	1.02-3.11
Total Cholesterol ≥ 200 mg/dL	0.78	0.58-1.06

Model adjusted for age, sex, education level, marital status, BMI, serum cotinine exposure (for smoking), and nativity. Non-Hispanic Whites serve as the referent. *p<0.05.

Adjusted Analysis Comparing U.S vs Foreign-Born Non-Hispanic Asians

In Table 3, foreign-born Non-Hispanic Asians showed increased risk for elevated LDL (OR=1.79, 95% CI=1.23-2.59), high levels of elevated cholesterol (OR=1.77, 95% CI = 1.31-2.39) and type 2 diabetes by HbA1c $\geq 6.5\%$ (OR=1.94, 95% CI=1.24-3.02), relative to U.S. born Non-Hispanic Asian adults after adjusting for covariates.

Table 3: Adjusted metabolic risks for foreign-born vs. U.S.-born Non-Hispanic Asian adults in the U.S.

Diabetes Risk	Odds Ratio	95 % CI
OGTT ≥ 140 mg/dL	1.91	0.55-6.65
OGTT ≥ 200 mg/dL	2.53***	1.00-7.95
HbA1c $\geq 5.6\%$	0.92	0.52-1.64
HbA1c $\geq 6.5\%$	1.94*	1.24-3.02
IFG ≥ 100 mg/dL	1.35	0.90-2.02
IFG ≥ 126 mg/dL	1.39	0.89-2.17
Metabolic Risk Factors		
SBP ≥ 130 mmHg	0.85	0.57-1.25
DBP ≥ 85 mmHg	1.48	0.85-2.57
LDL ≥ 100 mg/dL	1.79*	1.23-2.59
Triglycerides ≥ 150 mg/dL	1.27	0.91-1.77
HDL ≤ 40 mg/dL (male) ≤ 50 mg/dL (female)	1.37	0.96-1.95
Total Cholesterol ≥ 200 mg/dL	1.77*	1.31-2.39

Odds ratios are adjusted for age, sex, education, marital status, serum cotinine, and BMI. U.S.-born Non-Hispanic Asians serve as the referent. ***=0.05.,*p<0.05

Discussion

The purpose of this study was to examine the metabolic profile and type 2 diabetes between Non-Hispanic Asian and Non-Hispanic white adults in the U.S., and to compare metabolic dysfunction between U.S born and foreign born Non-Hispanic Asian adults. Overall, Non-Hispanic Asians were at increased risk for type 2 diabetes compared to Non-Hispanic Whites. Non-Hispanic Asians born outside the U.S. had significantly higher risk of type 2 diabetes compared to U.S-born Non-Hispanic Asians.

The finding of elevated risk of type 2 diabetes, and decreased HDL, corroborates with previous literature among Non-Hispanic Asians compared to Non-Hispanic Whites in the U.S.^[23]. This may be due in part to the traditional Asian diet which is primarily composed of refined grains and simple carbohydrates^[24].

It may seem paradoxical that Non-Hispanic Asians born outside of the U.S. are in worse overall metabolic health compared to Non-Hispanic Asian adults born in the U.S. given the literature on the negative effects of acculturation and exposure to Western lifestyles. This may attest to the need for considering socio cultural factors such as a lack of knowledge and understanding about healthy and unhealthy foods readily available in a new host environment for immigrants. Other than diet, chronic stress – which may be experienced by immigrants as they adapt to their new environments – may also play a role in increased risk of metabolic dysfunction^[25-29]. Research has shown that chronic stress may lead to energy dysregulation and disruption of brain networks that control eating behavior^[30]. In particular, stress-induced hyper activation of the hypothalamic-pituitary-adrenal axis may play an important role in the accumulation of visceral adipose tissue^[31], a risk factor for type 2 diabetes. There is research showing the lack of dietary moderation among Asian immigrants^[25] and this may be due to both a lack of nutrition knowledge as well as to emotional eating behaviors.

It is also plausible that Western lifestyles are most incompatible with the metabolic programming of Non-Hispanic

Asians born *outside* rather than within the U.S. There is evidence from at least one other study to suggest that among young Asian American women who are overweight, those who had lived in the U.S. for fewer than 12 years had higher percent body fat than those who had lived in the U.S. for longer^[13].

This study highlights the heightened burden of metabolic dysfunction and type 2 diabetes among Non-Hispanic Asians relative to Non-Hispanic Whites, especially among foreign-born Non-Hispanic Asian living in the U.S. Although our study has several strengths, it is not without limitations. The cross-sectional nature prohibits the ability to make causal inferences related to metabolic dysfunction and type 2 diabetes. While NHANES is a large population based dataset, it does not delineate specific country of origin nor allow for the identification of specific Asian ethnic subgroups. Therefore, we were unable to discern different ethnic groups within the Non-Hispanic Asian population, among whom metabolic risk and type 2 diabetes may vary by country of origin or Non-Hispanic Asian ethnicity.

Despite some limitations, to our knowledge, this is the first study to examine the metabolic profile and type 2 diabetes risk among Non-Hispanic Asian adults in the U.S. using a large and nationally representative sample. Clinical implications from our study include the need for clinicians who serve Non-Hispanic Asian patients to be cognizant of the elevated risk among this minority group. Interventions tailored specifically to Non-Hispanic Asians are warranted. Moreover, future surveillance data should consider variations among Non-Hispanic Asian subgroups that may be important to health outcomes and disparities. Future research should also explore differences in psychosocial and behavioral risk factors between U.S. and foreign-born Non-Hispanic Asians.

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References

- Asians Fastest-Growing Race or Ethnic Group in 2012. (2013) US Census Bureau Reports.
- The Asian Population: 2010. (2012) US Census Bureau.
- An Older and More Diverse Nation by Mid Century. (2008) US Census Bureau.
- Emerging Risk Factors Collaboration, Seshasai, S.R., Kaptoge, S., Thompson, A., et al. Diabetes mellitus, fasting glucose, and risk of cause-specific death. (2011) *N Engl J Med* 364(9): 829-841.
- American Diabetes Association. Diagnosis and classification of diabetes mellitus. (2010) *Diabetes Care* 33(Suppl 1): S62-S69.
- Grundy, S.M., Brewer, H.B., Jr., Cleeman, J.I., et al. Definition of metabolic syndrome: Report of the National Heart, Lung, and Blood Institute/American Heart Association conference on scientific issues related to definition. (2004) *Circulation* 109(3): 433-438.
- Shabbir, S., Kwan, D., Wang, M.C., et al. Asians and Pacific Islanders and the growing childhood obesity epidemic. (2010) *Ethn Dis* 20(2):129-135.
- Ye, J., Rust, G., Baltrus, P., et al. Cardiovascular risk factors among Asian Americans: results from a National Health Survey. (2009) *Ann Epidemiol* 19(10):718-723.
- Razak, F., Anand, S., Vuksan, V., et al. Ethnic differences in the relationships between obesity and glucose-metabolic abnormalities: a cross-sectional population-based study. (2005) *Int J Obes* 29(6):656-667.
- Lear, S.A., Kohli, S., Bondy, G.P., et al. Ethnic variation in fat and lean body mass and the association with insulin resistance. (2009) *J Clin Endocrinol Metab* 94(12): 4696-4702.
- Weber, M.B., Oza-Frank, R., Staimez, L.R., et al. Type 2 diabetes in Asians: prevalence, risk factors, and effectiveness of behavioral intervention at individual and population levels. (2012) *Annu Rev Nutr* 32: 417-439.
- Bates, L.M., Acevedo-Garcia, D., Alegria, M., et al. Immigration and generational trends in body mass index and obesity in the United States: results of the National Latino and Asian American Survey, 2002-2003. (2008) *Am J Public Health* 98(1):70-77.
- Wang, M.C., Crespi, C.M. The influence of childhood and adolescent environmental exposure to a westernized environment on the relation between body mass index and adiposity in young Asian American women. (2011) *Am J Clin Nutr* 93(5):1168S-1174S.
- Kaplan, M.S., Huguette, N., Newsom, J.T., et al. The association between length of residence and obesity among Hispanic immigrants. (2004) *Am J Prev Med* 27(4): 323-326.
- Steffen, P.R., Smith, T.B., Larson, M., et al. Acculturation to Western society as a risk factor for high blood pressure: a meta-analytic review. (2006) *Psychosom Med* 68(3): 386-397.
- Kim, J., Chan, M.M. Acculturation and dietary habits of Korean Americans. (2004) *Br J Nutr* 91(3): 469-478.
- Liu, A., Berhane, Z., Tseng, M. Improved dietary variety and adequacy but lower dietary moderation with acculturation in Chinese women in the United States. (2010) *J Am Diet Assoc* 110(3): 457-462.
- Yoo, G.J., Le, M., Oda, A.Y. *Handbook of Asian American Health*. (2013) Springer 16: 449.
- Centers for Disease Control (CDC), National Center for Health Statistics (NCHS). National Health and Nutrition Examination Survey Questionnaire (or Examination Protocol, or Laboratory Protocol). (2013)
- Benowitz, N.L., Bernert, J.T., Caraballo, R.S., et al. Optimal serum cotinine levels for distinguishing cigarette smokers and nonsmokers within different racial/ethnic groups in the United States between 1999 and 2004. (2009) *Am J Epidemiol* 169(2): 236-248.
- American Diabetes Association. Diagnosis and classification of diabetes mellitus. (2014) *Diabetes Care* 37(Suppl 1): S81-S90.
- Stata Statistical Software. (2011) STATA Corp 11.0.
- McNeely, M.J., Boyko, E.J. Type 2 diabetes prevalence in Asian Americans: results of a national health survey. (2004) *Diabetes Care* 27(1): 66-69.
- Dixit, A.A., Azar, K.M., Gardner, C.D., et al. Incorporation of whole, ancient grains into a modern Asian Indian diet to reduce the burden of chronic disease. (2011) *Nutr Rev* 69(8): 479-488.
- Franzen-Castle, L., Smith, C. Environmental, Personal, and Behavioral Influences on BMI and Acculturation of Second Generation Hmong Children. (2014) *Matern Child Health J* 18(1): 73-89.
- Batis, C., Hernandez-Barrera, L., Barquera, S., et al. Food acculturation drives dietary differences among Mexicans, Mexican Americans, and Non-Hispanic Whites. (2011) *J Nutr* 141(10):1898-1906.
- Arbona, C., Olvera, N., Rodriguez, N., et al. Acculturative stress among documented and undocumented Latino immigrants in the United States. (2010) *Hisp J Behav Sci* 32(3): 362-384.
- Lueck, K., Wilson, M. Acculturative stress in Asian immigrants: The impact of social and linguistic factors. (2010) *Int J Intercultural Relations* 34(1): 47-57.
- Tseng, M., Fang, C.Y. Socio-economic position and lower dietary moderation among Chinese immigrant women in the USA. (2012) *Public Health Nutr* 15(3): 415-423.
- Dallman, M.F. Stress-induced obesity and the emotional nervous system. (2010) *Trends Endocrinol Metab* 21(3):159-165.
- Kyrou, I., Chrousos, G.P., Tsigos, C. Stress, visceral obesity, and metabolic complications. (2006) *Ann N Y Acad Sci* 1083(1): 77-110.