

Association Between Level of Acculturation and Cardiovascular Risk Factors in Asian Indian Adults in the United States: A Cross-Sectional Analysis of NHIS 2014–2018

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Abstract. Background: Acculturation is assumed to raise cardiometabolic risk uniformly with time in the U.S. Despite sustained attention to South Asian susceptibility to cardiovascular risk, less is known about how acculturation shapes that risk within the growing Asian Indian population of the United States, the only South Asian group the National Health Interview Survey identifies separately.

Methods: This cross-sectional analysis utilizes a nationally representative survey (2014–2018 NHIS) of 8,114 non-Hispanic Asian adults identified and placed into subgroups of Chinese, Filipino, Asian Indian, and Other Asian. We examined the association of acculturation status (proxy measured as years living in the US) and cardiovascular risk such as diabetes, hypertension, high cholesterol, and obesity (defined as BMI ≥ 25). Logistic regression was used to adjust for potential confounders.

Results: The acculturation–obesity gradient reverses among Asian Indians: U.S.-born Asian Indians had lower obesity than recent immigrants (adjusted OR 0.56, 95% CI 0.35–0.90), whereas across all Asian Americans overall it rose (1.36, 95% CI 1.15–1.62). Relative to Chinese adults, the Asian Indian diabetes excess was attenuated but survived adjustment for adiposity (2.87 $\rightarrow$ 2.36, 95% CI 1.63–3.41), while the same adjustment fully accounted for their excess hypertension (1.27, 95% CI 1.00–1.63) and high cholesterol (1.14, 95% CI 0.88–1.48).

Conclusion: Aggregate reporting and a White-calibrated BMI cutoff jointly mask a large obesity burden in Asian Indians, and the canonical assumption that acculturation uniformly worsens risk fails in this subgroup, where it runs backwards.

Keywords. Acculturation; Cardiovascular risk; Obesity; Asian Indians; Asian Americans

1. Introduction

South Asian adults in the United States carry a higher burden of atherosclerotic cardiovascular disease and type 2 diabetes than most other racial and ethnic groups, at lower body-mass index and younger ages.¹ Prior work in cohorts such as SABRE and MASALA has attributed this excess risk to ethnicity-specific metabolic characteristics, explaining why this isn't replicated within non-Hispanic White or other Asian populations.^{2,3} An additional factor thought to shape cardiovascular risk among immigrants is acculturation, defined broadly as the adoption of a host culture's customs and lifestyle behaviors.^{4,5} Longer residence within a host country is commonly used as a measurable proxy to determine degree of acculturation as they are typically associated^{4–6}; a higher degree of acculturation is also broadly associated with a higher prevalence of cardiometabolic risk factors, however this relationship varies by ethnic subgroup and by which risk factor is examined.^{4–8}

Despite the increasing necessity to understand the ever-growing South Asian diaspora, the impact of acculturation on cardiovascular risk among Asian Indian adults in the US — the only South Asian group identifiable in national survey data — remains poorly understood. There is a lack of analysis surrounding specific ethnic subgroups on a national level, as most South Asian-focused studies are typically regional cohorts and within national surveys, a generalized Asian American group masks the important differences in risk profiles among groups.^{6,7,9}

This study examined whether a higher level of acculturation, compared to a lower level, is associated with a higher prevalence of cardiovascular risk factors, primarily diabetes, hypertension, high cholesterol, and obesity, among Asian Indian adults in the US. We hypothesized that Asian Indian adults with higher levels of acculturation would show a higher prevalence of these risk factors in comparison to those with lower acculturation, independent of age, sex, education, and adiposity.

2. Methods

2.1. Data source and pooling

We analyzed the National Health Interview Survey (NHIS), an annual, nationally representative, cross-sectional household survey of the U.S. civilian non-institutionalized population conducted by the National Center for Health Statistics (NCHS).¹⁰ Public-use Sample Adult and Person files for 2014–2018 were obtained from the CDC/NCHS data portal and merged on household, family and person identifiers. Files are distributed as fixed-width ASCII with SAS input decks (2016–2018 additionally as CSV); variables were read by column position so that field widths and leading zeros are preserved. Reserved missing codes were recoded to missing per variable according to field width — 7/8/9 on one-digit items, 9999 on the four-digit BMI field — rather than by any global find-and-replace, because valid values never collide with reserved codes at the same field width. Variable names that changed across

cycles were harmonized (diabetes DIBEV→DIBEV1; stratum STRAT_P→PSTRAT; PSU PSU_P→PPSU).

Five independent annual samples were pooled, so the Sample Adult final weight was divided by the number of pooled years (pooled weight = WTFA_SA / 5). NHIS changed its sample design in 2016; the variance-estimation stratum was therefore defined as the interaction of design period (2006–2015 vs. 2016+) and NHIS stratum, so that pseudo-PSUs from the two designs are never combined within a stratum.¹¹

2.2. Analytic sample

The analytic sample was non-Hispanic single-race Asian adults ($n = 8,114$ pooled). Hispanic origin was taken from the NCHS-imputed ORIGIN_I variable, and multiple-race Asian respondents were excluded (Asian-alone definition), so that race/ethnicity categories are mutually exclusive. Within this sample, public-use NHIS separately identifies Chinese, Filipino and Asian Indian respondents; Korean, Vietnamese, Japanese and all remaining groups are released only as a residual “Other Asian” category and cannot be disaggregated without access to the NCHS Research Data Center. Asian Indian adults ($n = 1,809$) were the analytic focus. Acculturation status could not be assigned to 54 respondents (0.7%): 45 foreign-born adults whose length of U.S. residence was missing, and 9 whose birthplace was missing. Acculturation-stratified analyses are therefore based on 8,060 respondents (Asian Indian $n = 1,793$).

2.3. Exposures

Two exposures were examined.

Asian subgroup. Asian subgroup was the four-level variable described above (Chinese, Filipino, Asian Indian, Other Asian), with Chinese adults as the regression reference because they had the lowest adiposity of the four groups.

Acculturation status. Acculturation was operationalized primarily as a graded categorical variable combining nativity and length of U.S. residence: foreign-born with <15 years in the U.S. (recent immigrant, the regression reference), foreign-born with ≥15 years (long-resident), and U.S.-born. This construction follows the standard duration-of-residence approach used in the U.S. immigrant-obesity literature.¹² A 0–4 additive index summing four binary items (U.S.-born; ≥15 years of residence; U.S. citizenship; English spoken at home) was also constructed and analyzed complete-case as a sensitivity check; it reproduces the graded categorical results. Because the years-in-U.S. item (YRSINUS) is banded and top-coded at “15+ years,” age at immigration is only partially recoverable and is not used as an exposure here.

2.4. Outcomes

Four cardiovascular risk factors were examined: hypertension, diabetes, high cholesterol and obesity, with obesity reported under more than one threshold so that the tables enumerating those thresholds separately carry six rows: hypertension, diabetes, high cholesterol, obesity at BMI ≥30,

obesity at BMI ≥25 and mean BMI. Hypertension, diabetes and high cholesterol were self-reported physician diagnoses (“ever told by a doctor or other health professional”). Borderline/prediabetes responses were coded as non-diabetic for the diabetes outcome. Obesity was derived from self-reported height and weight (BMI, kg/m^2) and was classified under three thresholds: the standard WHO/CDC cutoff (BMI ≥30); ≥27.5, the point the WHO expert consultation identified as the “high risk” public-health action point for Asian populations, which that consultation proposed alongside rather than in place of the international classification;¹³ and the Asian Indian consensus cutoff for obesity (≥25).¹⁴ The ≥25 threshold is the pre-specified primary adiposity outcome for this population; the other two are reported alongside it so that the effect of the threshold choice is visible rather than assumed. A composite “any diagnosed cardiometabolic condition” variable (hypertension, diabetes or high cholesterol) was derived for the detection analysis.

2.5. Covariates

Covariates were entered in blocks: demographics (age, modeled as a natural cubic spline with 4 degrees of freedom to avoid imposing linearity on a strongly age-dependent set of outcomes; sex), socioeconomic position (college degree vs. not), and — for the three diagnosed outcomes only — adiposity (obesity by the Asian Indian ≥25 cutoff), entered last so that its role as a potential mediator of any acculturation effect can be read directly from the change in the estimate.

2.6. Statistical analysis

All estimates incorporated the NHIS complex design using Taylor-series linearization (R survey and srvyr packages)¹⁵, specified with the pooled weight, design-period × stratum as strata, and nested PSUs. Subpopulations were analyzed by domain estimation on the full-sample design rather than by subsetting the data before constructing the design, so that subgroup standard errors are correct. Confidence intervals for prevalences use the Korn–Graubard beta method, which is the NCHS standard and cannot produce intervals crossing 0% or 100%;¹⁶ cells with fewer than 30 unweighted observations are suppressed.

Table 1 reports characteristics of the analytic sample by acculturation status, with design-based Rao–Scott χ^2 tests for categorical characteristics¹⁷ and Wald F tests for means. Table 2 and Table 3 report survey-weighted bivariate prevalences of each cardiovascular risk factor across the two exposures — Asian subgroup and acculturation status — with Rao–Scott tests of association.

The primary inferential analysis (Table 4) was a sequentially adjusted (hierarchical) logistic regression, fit as design-weighted quasibinomial generalized linear models and reported as odds ratios with 95% confidence intervals. Model 1 is unadjusted; Model 2 adds demographics (age spline, sex); Model 3 adds socioeconomic position; and Model 4 adds adiposity for the three diagnosed outcomes in every panel, and is not

Table 1. Characteristics of non-Hispanic Asian adults, by acculturation status

Characteristic	Recent immigrant (<15 y in U.S.)	Long-resident (≥ 15 y in U.S.)	U.S.-born	p
Unweighted N	2,496	3,543	2,021	
Weighted % of Asian adults	31.0	47.6	21.4	
Age, mean years	37.5 (36.7-38.2)	52.5 (51.9-53.2)	39.2 (38.0-40.4)	<0.001
Age 18–44, %	77.5 (75.0-79.9)	31.7 (29.4-34.0)	67.7 (64.6-70.6)	<0.001
45–64, %	17.2 (15.1-19.6)	45.8 (43.6-48.1)	19.4 (17.2-21.7)	
65+, %	5.3 (4.2-6.5)	22.5 (20.7-24.3)	13.0 (11.0-15.2)	
Female, %	55.3 (52.7-57.9)	53.1 (51.0-55.2)	50.6 (47.6-53.6)	0.069
Education: $<$ high school, %	9.7 (8.0-11.6)	9.6 (8.4-10.9)	5.8 (4.3-7.6)	<0.001
High school/GED, %	13.9 (11.8-16.3)	16.6 (14.9-18.5)	15.4 (13.3-17.7)	
Some college, %	14.2 (12.5-16.1)	18.5 (16.8-20.2)	32.2 (29.1-35.4)	
College graduate+, %	62.2 (58.8-65.5)	55.3 (52.9-57.7)	46.7 (43.3-50.1)	
Asian subgroup: Chinese, %	22.8 (20.4-25.4)	20.6 (18.4-22.9)	20.2 (17.6-23.0)	<0.001
Filipino, %	14.2 (12.0-16.7)	19.5 (17.4-21.7)	30.9 (27.7-34.3)	
Asian Indian, %	38.1 (34.8-41.4)	24.1 (21.9-26.4)	10.0 (8.2-12.0)	
Other Asian, %	24.9 (22.4-27.5)	35.8 (33.4-38.3)	38.9 (35.3-42.7)	
U.S. citizen, %	25.8 (23.3-28.5)	84.5 (82.8-86.1)	100.0 (by definition)	<0.001
English spoken at home, %	44.2 (41.1-47.3)	57.1 (54.7-59.5)	95.5 (93.9-96.8)	<0.001
Years in U.S. (foreign-born), mean ^a	7.3 (7.1-7.5)	≥ 15 (top-coded)	—	—

NHIS 2014–2018 pooled, non-Hispanic single-race Asian adults. Values are survey-weighted % (95% CI) or weighted mean (95% CI) unless noted; N is unweighted. p-values are design-based Rao–Scott χ^2 tests for categorical characteristics and Wald F tests for means, and are shown once per characteristic. Confidence intervals for percentages use the Korn–Graubard beta method. ^a Years in the U.S. approximated from banded YRSINUS midpoints (0.5/3/7.5/12.5 y) for recent immigrants. No mean is reported for the long-resident stratum: that stratum is defined by ≥ 15 years of residence and YRSINUS is top-coded at “15+,” so any mean would restate the definition rather than estimate a quantity, and the corresponding test would be definitional. Not applicable to the U.S.-born.

Table 2. Cardiovascular risk factors by Asian subgroup

Cardiovascular risk factor	Chinese	Filipino	Asian Indian	Other Asian	p
Unweighted N	1,743	1,715	1,809	2,847	
Hypertension	17.7 (15.4-20.2)	35.0 (32.2-37.9)	18.4 (15.9-21.1)	24.6 (22.5-26.8)	<0.001
Diabetes	4.4 (3.4-5.5)	10.5 (8.6-12.5)	8.6 (7.1-10.4)	9.0 (7.7-10.5)	<0.001
High cholesterol	20.8 (18.5-23.2)	32.9 (30.0-35.9)	22.9 (20.1-25.9)	27.7 (25.4-30.0)	<0.001
Obesity, BMI ≥ 30	4.5 (3.3-6.0)	16.8 (14.5-19.2)	11.5 (9.8-13.4)	9.1 (7.6-10.7)	<0.001
Obesity, BMI ≥ 25 (Asian Indian cutoff)	23.9 (21.4-26.6)	52.7 (49.3-56.2)	52.5 (49.4-55.6)	36.5 (33.8-39.3)	<0.001
BMI, mean kg/m ²	23.1 (22.9-23.4)	25.9 (25.6-26.2)	25.4 (25.2-25.6)	24.1 (23.9-24.4)	<0.001

NHIS 2014–2018 pooled, non-Hispanic Asian adults. Survey-weighted % (95% CI), Korn–Graubard method; N unweighted. p from design-based Rao–Scott χ^2 (Wald F for mean BMI). Diagnosed conditions are self-reported “ever told by a health professional.” The two obesity rows apply two different thresholds to the same measurements: standard WHO/CDC (≥ 30) and the Asian Indian consensus cutoff (≥ 25 , Misra 2009)¹⁴; the intermediate ≥ 27.5 threshold is shown in Figure 1A. “Other Asian” = Korean, Vietnamese, Japanese and others not separable in public-use NHIS.

estimated where obesity is itself the outcome. To ensure that movement across models reflects adjustment rather than a changing sample, all models for a given outcome were fit on that outcome’s common complete-case sample.

Because the central question is whether acculturation operates uniformly across Asian subgroups, we pre-specified a formal test of effect modification: a design-based Wald test of the acculturation $\times$ subgroup interaction (6 df) for each outcome, fit on all non-Hispanic Asian adults with adjustment for age, sex and education. Where the interaction was significant, subgroup-stratified adjusted models were fit to display the direction of the association within each subgroup. Effect modification by education was tested the same way. Finally, to distinguish a true difference in risk burden from a difference in diagnosis, we estimated the prevalence of any diagnosed cardiometabolic condition among Asian Indians who were obese by the ≥ 25 cutoff, by acculturation status, both crude and

adjusted. Analyses used R 4.6; the full download-to-document pipeline is scripted and re-runs end to end from the raw CDC files.

This data is publicly available and de-identified and therefore exempt from IRB.

3. Results

Table 1 presents characteristics of the analytic sample examined. This study included 8,114 non-Hispanic Asian adults, of whom 31.0% were recent immigrants (<15 years in the U.S.), 47.6% were long-term residents (≥ 15 years), and 21.4% were U.S.-born (Table 1; all percentages survey-weighted, N unweighted). Mean age differed across groups (37.5, 52.5, and 39.2 years; $p<0.001$) as well as age distribution; long-term residents tended to be older with nearly half (45.8%) aged 45–64 whereas among recent immigrants the majority of the group (77.5%) was aged 18–44. Recent immigrants had the highest

Table 3. Cardiovascular risk factors by acculturation status

Cardiovascular risk factor	Recent immigrant (<15 y in U.S.)	Long-resident (≥ 15 y in U.S.)	U.S.-born	p
Panel A. All non-Hispanic Asian adults				
Unweighted N	2,496	3,543	2,021	
Hypertension	13.1 (11.2-15.1)	32.1 (30.1-34.1)	20.7 (18.5-23.1)	<0.001
Diabetes	4.2 (3.2-5.4)	12.4 (11.1-13.8)	4.7 (3.7-5.9)	<0.001
High cholesterol	14.3 (12.5-16.2)	35.7 (33.6-37.9)	22.2 (19.8-24.8)	<0.001
Obesity, BMI ≥ 30	7.5 (6.2-8.9)	9.0 (7.9-10.3)	17.5 (15.1-20.1)	<0.001
Obesity, BMI ≥ 25 (Asian Indian cutoff)	38.9 (36.2-41.7)	41.4 (39.0-43.9)	44.5 (41.7-47.4)	0.023
BMI, mean kg/m ²	24.1 (23.9-24.3)	24.6 (24.4-24.8)	25.3 (25.0-25.7)	<0.001
Panel B. Asian Indian adults				
Unweighted N	922	700	171	
Hypertension	10.6 (8.1-13.5)	29.2 (25.0-33.6)	4.2 (1.5-8.9)	<0.001
Diabetes	4.7 (3.0-6.8)	13.7 (11.0-16.7)	3.5 (1.3-7.4)	<0.001
High cholesterol	14.3 (11.4-17.7)	34.5 (29.8-39.4)	8.3 (4.1-14.6)	<0.001
Obesity, BMI ≥ 30	10.4 (8.2-12.9)	12.7 (9.9-15.9)	11.4 (5.6-20.0)	0.492
Obesity, BMI ≥ 25 (Asian Indian cutoff)	53.7 (49.5-57.9)	54.4 (49.2-59.5)	35.7 (26.1-46.3)	0.004
BMI, mean kg/m ²	25.3 (25.0-25.6)	25.8 (25.4-26.1)	24.1 (23.1-25.0)	0.003

NHIS 2014–2018 pooled. Survey-weighted % (95% CI), Korn–Graubard method; N unweighted. p from design-based Rao–Scott χ^2 (Wald F for mean BMI). Note the contrast between the two obesity rows in Panel B: under the standard ≥ 30 threshold there is no association with acculturation ($p = 0.49$), while under the Asian Indian consensus ≥ 25 threshold there is ($p = 0.004$), and its direction is the reverse of the conventional expectation.

Table 4. Hierarchical (sequentially adjusted) logistic regression models

Outcome	Contrast	Model 1 (unadjusted)	Model 2 (+ age, sex)	Model 3 (+ education)	Model 4 (+ adiposity)	N
Panel A. Acculturation as exposure — Asian Indian adults (reference: recent immigrant)						
Hypertension	Foreign-born ≥ 15 y	3.43 (2.46-4.79)	0.89 (0.59-1.35)	0.91 (0.60-1.39)	0.95 (0.63-1.43)	1760
	US-born	0.37 (0.16-0.86)	0.63 (0.24-1.67)	0.64 (0.24-1.70)	0.70 (0.27-1.83)	1760
Diabetes	Foreign-born ≥ 15 y	3.17 (2.01-5.00)	0.82 (0.46-1.47)	0.86 (0.48-1.55)	0.90 (0.50-1.60)	1760
	US-born	0.72 (0.29-1.77)	1.43 (0.50-4.08)	1.50 (0.53-4.24)	1.66 (0.59-4.66)	1760
High cholesterol	Foreign-born ≥ 15 y	3.20 (2.35-4.37)	1.28 (0.85-1.93)	1.27 (0.84-1.93)	1.38 (0.91-2.08)	1758
	US-born	0.55 (0.27-1.11)	0.84 (0.38-1.86)	0.84 (0.38-1.85)	0.94 (0.44-2.03)	1758
Obesity (BMI ≥ 25)	Foreign-born ≥ 15 y	1.03 (0.79-1.34)	0.68 (0.50-0.94)	0.68 (0.49-0.94)	—	1761
	US-born	0.47 (0.30-0.73)	0.57 (0.35-0.93)	0.56 (0.35-0.90)	—	1761
Panel B. Acculturation as exposure — all non-Hispanic Asian adults (reference: recent immigrant)						
Hypertension	Foreign-born ≥ 15 y	3.16 (2.61-3.82)	1.10 (0.88-1.37)	1.11 (0.89-1.38)	1.13 (0.90-1.41)	7839
	US-born	1.71 (1.37-2.15)	1.36 (1.05-1.77)	1.36 (1.05-1.76)	1.25 (0.96-1.64)	7839
Diabetes	Foreign-born ≥ 15 y	3.18 (2.39-4.25)	1.29 (0.95-1.75)	1.33 (0.98-1.80)	1.35 (1.00-1.83)	7843
	US-born	1.10 (0.77-1.57)	0.82 (0.56-1.21)	0.82 (0.55-1.21)	0.75 (0.51-1.11)	7843
High cholesterol	Foreign-born ≥ 15 y	3.36 (2.82-4.00)	1.50 (1.22-1.84)	1.50 (1.22-1.84)	1.53 (1.24-1.88)	7814
	US-born	1.71 (1.39-2.11)	1.54 (1.23-1.94)	1.55 (1.24-1.94)	1.48 (1.17-1.85)	7814
Obesity (BMI ≥ 25)	Foreign-born ≥ 15 y	1.11 (0.96-1.29)	0.91 (0.77-1.08)	0.91 (0.77-1.08)	—	7849
	US-born	1.26 (1.07-1.47)	1.38 (1.16-1.63)	1.36 (1.15-1.62)	—	7849
Panel C. Asian subgroup as exposure — all non-Hispanic Asian adults (reference: Chinese)						
Hypertension	Asian Indian	1.10 (0.88-1.38)	1.56 (1.23-1.98)	1.59 (1.26-2.02)	1.27 (1.00-1.63)	7876
	Filipino	2.60 (2.12-3.18)	2.68 (2.16-3.32)	2.65 (2.13-3.29)	2.18 (1.74-2.73)	7876
	Other Asian	1.59 (1.31-1.93)	1.63 (1.32-2.00)	1.60 (1.29-1.98)	1.48 (1.19-1.84)	7876
Diabetes	Asian Indian	2.04 (1.46-2.84)	2.73 (1.90-3.92)	2.87 (1.99-4.13)	2.36 (1.63-3.41)	7880
	Filipino	2.50 (1.79-3.49)	2.13 (1.48-3.06)	2.10 (1.45-3.02)	1.76 (1.21-2.57)	7880
	Other Asian	2.08 (1.52-2.85)	2.00 (1.43-2.80)	1.92 (1.37-2.71)	1.81 (1.28-2.55)	7880
High cholesterol	Asian Indian	1.13 (0.91-1.41)	1.36 (1.06-1.75)	1.34 (1.04-1.72)	1.14 (0.88-1.48)	7851
	Filipino	1.85 (1.54-2.22)	1.65 (1.33-2.05)	1.68 (1.35-2.07)	1.44 (1.14-1.81)	7851
	Other Asian	1.44 (1.19-1.74)	1.40 (1.12-1.73)	1.42 (1.15-1.76)	1.34 (1.07-1.67)	7851
Obesity (BMI ≥ 25)	Asian Indian	3.49 (2.88-4.23)	3.38 (2.76-4.13)	3.45 (2.83-4.22)	—	7886
	Filipino	3.51 (2.89-4.28)	3.51 (2.87-4.28)	3.41 (2.78-4.19)	—	7886
	Other Asian	1.81 (1.50-2.19)	1.80 (1.49-2.17)	1.74 (1.43-2.11)	—	7886

Odds ratios (95% CI) from design-weighted quasibinomial logistic regression on the pooled NHIS 2014–2018 design. Model 1 unadjusted; Model 2 adds age (natural cubic spline, 4 df) and sex; Model 3 adds college education; Model 4 adds adiposity (obesity, BMI ≥ 25) for the three diagnosed outcomes, in all three panels. Model 4 is not applicable where obesity is itself the outcome (—). For each outcome all models are fit on that outcome's common complete-case sample (N, unweighted), so movement across models reflects adjustment and not a changing denominator.

educational qualification (62.2% college graduates) while the U.S.-born had the lowest (46.7%; $p<0.001$). Asian subgroup composition (divided into Chinese, Filipino, Asian Indian, and Other Asian) varied substantially by acculturation status: Asian Indian adults made up 38.1% of recent immigrants but only 10.0% of the U.S.-born, while Filipino adults made up 30.9% of the U.S.-born but 14.2% of recent immigrants ($p<0.001$). U.S. citizenship (25.8%, 84.5%, 100.0%) and English use at home (44.2%, 57.1%, 95.5%) both increased steadily with acculturation status (both $p<0.001$).

Table 2 presents the weighted prevalence of all four cardiovascular risk factors differed by Asian subgroups (all $p<0.001$). The Chinese group had the lowest prevalence of cardiovascular risk across all measures (17.7%, 4.4%, 20.8%, and 23.9%), while the Filipino group had the highest prevalence of hypertension (35.0%), diabetes (10.5%), high cholesterol (32.9%), and obesity (BMI $\geq$ 25, 52.7%). Asian Indian adults had intermediate hypertension (18.4%), diabetes (8.6%), and cholesterol (22.9%) prevalence but an obesity prevalence comparable to Filipino adults (BMI $\geq$ 25, 52.5%).

Table 3 presents the association between cardiovascular risk factors (diabetes, hypertension, high cholesterol, obesity) with acculturation status among all Asian adults combined; all four risk factors were significantly associated with acculturation ($p<0.001$ for hypertension, diabetes and high cholesterol; $p=0.023$ for obesity). Prevalence of obesity (BMI $\geq$ 25) increased from 38.9% (recent immigrants) to 41.4% (long-resident) to 44.5% (U.S.-born; $p=0.023$). Among Asian Indian adults specifically, this pattern reversed: obesity prevalence was 53.7% (recent immigrants), 54.4% (long-resident), and 35.7% (U.S.-born; $p=0.004$). This reversal was threshold-dependent: under the conventional BMI $\geq$ 30 cutoff, obesity showed no association with acculturation among Asian Indians (10.4%, 12.7%, 11.4%; $p=0.492$), while under the Asian-specific BMI $\geq$ 25 cutoff the association was significant and reversed (Table 3; Figure 1, Panel A).

Table 4 presents a hierarchical logistic regression which confirms the patterns seen in Table 3 after sequential adjustment. Among Asian Indian adults (Panel A), fully adjusted odds of obesity (BMI $\geq$ 25) were significantly lower among foreign-born long-term residents (OR 0.68, 95% CI 0.49–0.94) and U.S.-born adults (OR 0.56, 95% CI 0.35–0.90) relative to recent immigrants, while hypertension, diabetes, and high cholesterol showed no significant association with acculturation after full adjustment (all CIs crossed 1.0). Among all non-Hispanic Asian adults (Panel B), U.S.-born status remained significantly associated with higher adjusted odds of obesity (OR 1.36, 95% CI 1.15–1.62) and high cholesterol (OR 1.48, 95% CI 1.17–1.85), while hypertension and diabetes associations became non-significant after adjustment. Using Chinese adults as the reference group (Panel C), Asian Indian and Filipino adults had notably higher fully adjusted odds of obesity (OR 3.45 and 3.41, respectively) and diabetes (OR

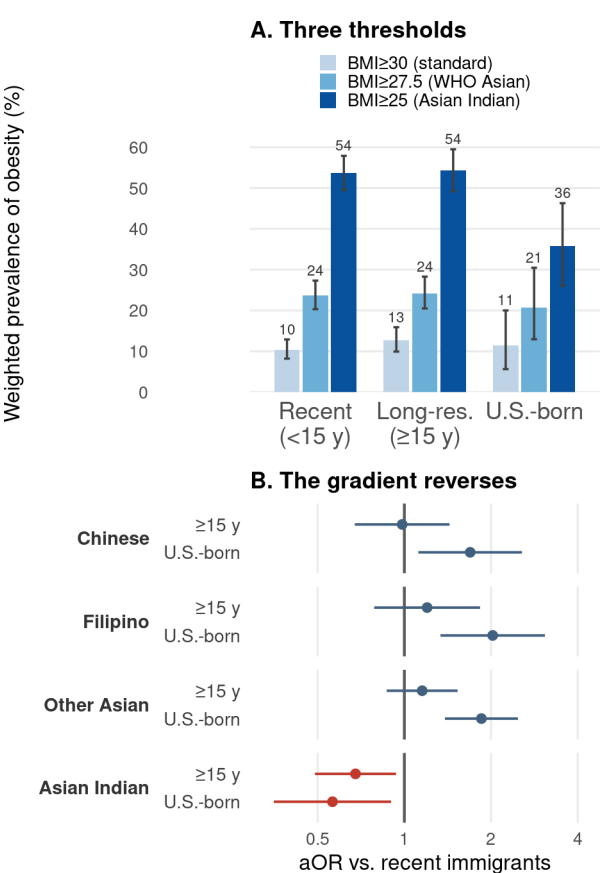


Figure 1. Obesity, acculturation and Asian subgroup
NHIS 2014–2018 pooled, non-Hispanic Asian adults ($n = 8,114$); Asian Indians $n = 1,809$. Panel A: survey-weighted prevalence of obesity among Asian Indian adults by acculturation status under three thresholds applied to the same measured BMI, with 95% Korn–Graubard confidence intervals; the number above each bar is the point estimate. Panel B: subgroup-stratified adjusted odds ratios for obesity (BMI $\geq$ 25) relative to recent immigrants, from models adjusted for age (spline), sex and education; horizontal lines are 95% CIs and the x-axis is on a log scale. The acculturation $\times$ subgroup interaction is significant (Wald $p < 0.001$, 6 df). Chinese, Filipino and Other Asian adults show the conventional positive acculturation–obesity gradient; Asian Indians show the reverse.

2.36 and 1.76), while high cholesterol was elevated among Filipino but not Asian Indian adults.

Figure 1 summarizes the obesity findings graphically. Panel A presents weighted obesity prevalence across three BMI thresholds ($\geq$ 30, $\geq$ 27.5, $\geq$ 25) by acculturation status, illustrating that Asian Indian adults’ obesity burden becomes progressively more apparent as the threshold is lowered toward the Asian-specific BMI $\geq$ 25 cutoff. Panel B presents subgroup-stratified adjusted odds ratios for obesity versus recent immigrants. Chinese, Filipino, and Other Asian adults each showed significantly elevated odds among U.S.-born adults (ORs 1.69, 2.03, and 1.85, respectively), while Asian Indian adults showed the opposite pattern, with significantly reduced odds among both long-residents (OR 0.68) and U.S.-born adults (OR 0.56). The interaction between Asian subgroups and acculturation was statistically significant ($p<0.001$).

4. Discussion

In this nationally representative sample of Asian Indian adults residing in the U.S., we found that higher acculturation was associated with significantly lower odds of obesity compared to lower acculturation, independent of age, sex, and education; the trend reversed among Chinese, Filipino and Other Asian subgroups. Associations between acculturation and hypertension, diabetes, and high cholesterol among Asian Indian adults were not statistically significant after full adjustment. Our results suggest that there are ethnicity-specific differences in the relation between acculturation status and obesity risk and emphasize the need to disaggregate generalized Asian groups when examining cardiometabolic risk.

Our findings diverge from prior work suggesting that longer U.S. residence is generally associated with a higher prevalence of cardiometabolic risk factors among immigrants.^{4–7} Interestingly, a recent analysis of immigrants of South Asian ancestry has suggested that cardiometabolic risk may not increase uniformly with acculturation, highlighting the need to reconsider traditional assumptions.¹⁸ However it remains consistent with more recent calls to separate Asian American populations into ethnicity-specific subgroups in cardiovascular research, given that baseline risk as well as effects of acculturation differ by subgroup.^{6,9} There are several factors that may explain this deviation. Prior literature focused on acculturation and CVD risk often pooled Asian ethnicities or focused on regional cohorts such as MASALA rather than nationally representative, subgroup-specific data; an Asian Indian-specific pattern could easily be masked in pooled analyses. Differences in study period may also be significant, as earlier waves of Indian immigration to the US varied regarding socioeconomic status, baseline health behaviors, and employment background in comparison to more recent arrivals. Structural changes in food and infrastructure may shift these associations long-term; our study's use of an Asian-specific obesity cutoff rather than the traditional threshold may also account for some divergence as the association under a traditional BMI $\geq$ 30 was not significant, suggesting that choice of threshold has a substantial effect.

A potential interpretation is that acculturation operates on obesity risk in Asian Indian adults through a pathway different from other Asian subgroups, such as through generational differences in socioeconomic resources, health literacy, or access to structured exercise and dietary support that improve with time in the U.S. among Asian Indian families specifically, even as broader Asian American populations move toward less favorable diet and activity patterns with acculturation. This interpretation is necessarily speculative, since the cross-sectional design cannot establish mechanism or direction. The finding is also narrow in scope: it applies specifically to obesity, defined using the Asian-specific BMI threshold, and did not extend to the other three cardiovascular risk factors examined. With that caveat, the finding is relevant to clinicians, public health practitioners, and community health organizations serving Asian Indian populations, in that it opposes a uniform

"acculturation raises risk" message across all Asian American subgroups, and suggests obesity screening priorities for Asian Indian patients may require different standards relative to other Asian American groups.

This study's primary strengths are its large, nationally representative sample; survey-weighted analysis accounting for the complex NHIS design; and subgroup-specific modeling that allowed the Asian Indian-specific pattern to be distinguished from the broader Asian American sample, which a pooled analysis would have obscured.

Several limitations warrant caution in interpreting these results. The cross-sectional design means exposure and outcome were measured simultaneously, so temporal ordering cannot be established and causation cannot be inferred. NHIS relies on self-reported diagnoses and, for some cycles, self-reported height and weight, introducing potential social desirability and recall bias. Residual confounding by unmeasured factors is also likely, most plausibly income, marital status, geographic region of residence, and access to and quality of food, none of which were available for adjustment in this analysis. Finally, the data span 2014–2018; given ongoing shifts in U.S. immigration patterns and the food environment, current associations may differ; more recent data was not analyzed because Asian subgroup data has not been publicly available in NHIS since a 2019 questionnaire redesign.

Longitudinal studies following Asian Indian adults over time would help distinguish true acculturation effects from cohort or selection effects and would allow examination of causal ordering. Future work should also incorporate income, marital status, region, and food access/quality as covariates, use multidimensional acculturation measures beyond length of residence (e.g., dietary pattern, language use, generational status), and disaggregate South Asian adults further into Indian, Pakistani, Bangladeshi, and Sri Lankan subgroups to determine whether the obesity pattern identified here is specific to Indian immigrants or reflects a broader South Asian trend.

Among Asian Indian adults in the U.S., higher acculturation was associated with lower obesity risk, a pattern opposite to that seen in other Asian American subgroups, stressing that approaches to cardiovascular risk messaging and prevention efforts for Asian American populations should not assume a uniform effect of acculturation across ethnic subgroups.

Declarations

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Conflicts of interest. None declared.

Data availability. Analyses used publicly available, de-identified survey data.

AI use. Claude (Anthropic) was used to assist in writing the R code for the survey-weighted analyses and in drafting and editing portions of this manuscript during pre-submission review. The authors reviewed and verified all AI-assisted output, including every statistical result reported here, and take full responsibility for the content of this manuscript. AI tools are not authors of this work.

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