

A PRELIMINARY ASSESSMENT OF ACCULTURATION AND ITS RELATIONSHIP TO BODY SIZE AND GLUCOSE INTOLERANCE AMONG BLACKS IN THE US VIRGIN ISLANDS

Objectives: This study is a preliminary investigation of the relationship of acculturation to body size and glucose intolerance among African Caribbeans living in the United States Virgin Islands (USVI).

Methods: Focus groups were used to identify items for measuring acculturation, and validity and reliability procedures were performed on the items. The acculturation items were administered to a population-based sample of 740 individuals aged 20 years and older. Anthropometric measurements and blood pressure were taken and a fasting blood sample was also drawn.

Results: Factor analysis showed that the acculturation items clustered as 3 factors that appeared to represent: 1) the 'adoption' of USVI-American values; 2) 'integration' and practice of USVI customs; and 3) allegiance to 'traditional' African-Caribbean values and customs. Each factor exhibited relationships to demographic variables that were characteristic of acculturation, with the mean adoption (AD) score being significantly ($P=.0002$) higher for USVI-born persons than for African-Caribbean immigrants [AD=11.3 (95% CI=11.0–11.6) vs AD=10.6 (95% CI=10.4–10.8), respectively], while African-Caribbean immigrants had a higher ($P=.0001$) traditional score (TS) compared to USVI-born persons [TS=9.0 (95% CI=8.8–9.2) vs TS=7.0 (95% CI=6.7–7.2), respectively]. In regression analyses adjusting for age, education, income, smoking, and alcohol consumption, the 'adoption' factor was independently and positively related to BMI ($P=.02$) among USVI-born African Caribbeans, and to fasting glucose ($P=.005$) among African-Caribbean immigrants.

Conclusions: Acculturation is associated with increased body size and diabetes risk in African Caribbeans in the USVI and appears to bear a differential impact according to place of birth. (*Ethn Dis.* 2003;13:15–21)

Key Words: Acculturation, Body Size, Glucose Intolerance, African-American, Caribbean

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INTRODUCTION

African-Caribbean populations are experiencing epidemic rates of obesity and an increasing prevalence of related chronic diseases, such as diabetes mellitus.^{1,2} In general, these changes have been attributed to increased economic development and the adoption of sedentary lifestyles, characteristics of developed countries.³ However, to develop effective national programs to stem the tide of increasing obesity and related chronic diseases, more definitive information is needed about the factors influencing lifestyle changes. Perhaps a better understanding of the social pressures contributing to weight gain in these populations might be obtained from an assessment of the factors associated with the development of obesity among African-Caribbean populations that immigrate to more developed countries, like the United Kingdom and the United States. However, in a recent study in the United Kingdom, behavioral factors important in the development of obesity in South Asian and European women, including social class, education and transport, smoking, alcohol intake, and physical activity, could not account for the higher rates of obesity in African-Caribbean women,⁴ and there have been no published findings of obesity-related factors among African-Caribbean immigrants to the United States.

One factor that has not been examined as a possible contributor to obesity rates in African-Caribbean popula-

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tions is acculturation. Acculturation is the process through which migrants adopt the values, attitudes, and behavioral norms of the host society.⁵ Prior studies have demonstrated the importance of acculturation to changing rates of obesity and diabetes in Mexican and Japanese immigrants to the United States.^{6,7} However, nothing is known about how acculturation relates to measures of body size and glucose intolerance in African Caribbeans who migrate to the United States. Some insight into this process might be gained by assessing the impact of acculturation on anthropometric measures of body size and glucose tolerance among Black Caribbean-born immigrants to the United States Virgin Islands (USVI).

The USVI, a group of 100 small islands and cays located approximately 70 miles east of the island of Puerto Rico, was purchased by the United States from Denmark in 1917 and has been influenced by the culture of the mainland United States since that time. As a consequence of the communist revolution in Cuba in the 1950s, the USVI became an alternative and popular destination for tourists from the United States mainland. To accommodate the burgeoning tourist industry, the pace of economic development in the USVI was increased to a greater degree than that seen in the neighboring British controlled islands of the eastern Caribbean. Improving economic conditions in the territory led to a large migration of Black people into the USVI from neighboring English-speaking islands (eg, Dominica, Antigua, St. Kitts). These African-Caribbean immigrants, together with native-born African Americans, represent the majority of the population of the USVI (~80%). In conjunction

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with a larger population-based study of the prevalence of diabetes,⁸ the current study was conducted to assess the relationship of acculturation to anthropometric measures of body size and glucose tolerance in the USVI.

METHODS

To achieve the objective of this study, it was necessary to find a way of measuring acculturation among African-Caribbean individuals in the USVI. Most instruments for measuring acculturation have used language as a central component of assessing the acculturative process in immigrants. However, language could not be used in the current study since African-Caribbean persons primarily speak English. Therefore, we conducted a preliminary study to identify factors that could assess the extent to which African-Caribbean individuals in the USVI were at variance from traditional value systems and practices. These factors would then be related to anthropometric indices and fasting blood glucose.

Three focus groups consisting of 5 to 8 individuals were conducted on the island of St. Croix to identify issues for which questionnaire items could be constructed to assess acculturation. Input was obtained from both sexes of immigrant and USVI-born African Carib-

beans. The discussions of the focus groups identified 6 general areas where African Caribbeans in the USVI might be influenced by United States cultural values and practices. Twenty-three questionnaire items were subsequently constructed based on these 6 areas. The areas and number of items included: government responsibility (4 items); holiday celebrations (5 items); economic principles (4 items); child rearing practices (5 items); social customs (4 items); and sporting (for which only one item was suggested). Each item was graded on a 5-point Likert scale. The content validity of the items was evaluated by giving the list to a panel of judges, 4 men and 4 women, with graduate degrees, who represented a cross-section of both the immigrant and native-born Black populations. The judges were asked to examine the items to determine if the response to each item by the traditional African-Caribbean person was likely to be different from a USVI Americanized resident. For each judge, an item was rated (+) if the USVI Americanized person would be more likely to agree and (-) if the traditional African-Caribbean person would be more likely to agree. An item was selected for use in the larger study if at least 5 judges rated it (+) or at least 5 judges rated it (-). The judges selected 15 items. Upon review, 2 items were thought to reflect socioeconomic status and were discarded.

The test-retest reliability of the remaining items was evaluated using a convenience sample of 25 students from the University of the Virgin Islands, to whom each item was administered on 2 occasions during a 2-month period. Pearson's reliability coefficient was $>.80$ for each of the items.

The list of acculturation items was then administered to a population-based sample of 659 Caribbean-born Black persons aged 20 or older residing on the island of St. Croix. Study participants were recruited between February 1995 and February 1998 from households

that were randomly selected from a list of customers (which included approximately 98% of all households on the island of St. Croix), of the Virgin Islands Water and Power Authority. One individual from each household was randomly selected for participation in the study. The participation rate was 79.0%. Prior to data collection, participants signed a consent form approved by the Biomedical Institutional Review Board of the University of Pittsburgh.

Anthropometric measurements and interviews were conducted at the study clinic. Anthropometric measurements included weight, height, and waist circumference. Fasting blood samples were collected and measured for serum glucose at the Juan F. Louis Hospital and Medical Center on St. Croix, using a Kodak Ektachem 700 Analyzer (Eastman Kodak Company, Rochester, NY) and employing a glucose oxidase colorimetric method. Body mass index (BMI), a measure of overall obesity, was calculated as weight in kilograms (kg) divided by height in meters squared (kg/m^2). Individuals with fasting blood glucose values ≥ 7.0 mmol/L (126 mg/dL) were considered to have diabetes, in accordance with ADA criteria.⁹

Statistical Analysis

The distribution of each acculturation item was examined and items with skewed distributions were discarded. Factor analysis with varimax rotation was used to examine the factor loading of the remaining items. Univariate associations were examined with correlation coefficients. Multiple regression analysis was used to assess the independent relationships between study variables. Odds ratios (OR) with 95% confidence intervals (CI) from logistic regression models were used to estimate the risk for diabetes and obesity associated with levels of acculturation. All statistical procedures were conducted using Statistical Analysis System (SAS) software.¹⁰

Table 1. Questionnaire items representing the 3 factors assessing acculturation

Factor 1 variables	Questionnaire items: "Adoption by USVI-American values"
TEENRENT	A nineteen-year-old should rent an apartment rather than live in his/her parent's home
ONECARD	A working adult should have at least one credit card
CABLETVS	For me, cable TV is a must
DAYCARE	Parents should place a three-year-old in a day-care center rather than at a relative
Factor 2 variables	Questionnaire Items: "Integration and practice of USVI-American customs"
TGVPCMAS	In my home, Thanksgiving is a bigger celebration than Christmas
SPANKING	Spanking a child is a form of child abuse
EATINOUT	I prefer eating out to cooking at home
Factor 3 variables	Questionnaire items: "Allegiance to traditional Caribbean customs/values"
SOMWISH	Sometimes I wish I could live in another Caribbean Island, other than the Virgin Islands
THROWAWAY	Paying house rent is throwing away money
CRICKET	I prefer cricket to baseball

RESULTS

Of the entire sample, 413 (62.7%) were African-Caribbean immigrants, and 246 (37.3%) were USVI-born individuals. Women represented 69% of the cohort, and 36.6% of all individuals were obese. The mean age of the entire group was 47.6 ± 15.2 yr. In comparisons of the demographic profile of the 2 groups, African-Caribbean immigrants were older than USVI-born individuals (49.6 ± 13.4 years vs 44.1 ± 17.4 years, respectively) and included a

higher proportion ($P < .0001$) of individuals who did not complete high school (45.8% vs 24.3%, respectively; $P < .001$).

Measurement of Acculturation

Of the original 13 items administered to participants, 3 were discarded because of skewed distributions in the responses. Factor analysis showed that the remaining 10 items loaded on 3 significant factors. A list of items that grouped together for each factor is shown in Table 1. Table 2 shows the

factor patterns and eigenvalues for each acculturation item. The items for Factor 1 were from 3 categories suggested by the focus groups: child rearing, economic principles, and social customs. The items for Factor 2 represented the categories of holiday celebration, child rearing, and social customs. Factor 3 items were from the categories of social customs, economic principles, and sport. Given the diversity of issues addressed by each of the 3 factors, low Cronbach alphas of .44, .34, and .30 were observed for Factor 1, Factor 2, and Factor 3, respectively. The items clustering together under each factor appear to represent different aspects of acculturation: Factor 1 appears to represent an adoption of USVI-American values; Factor 2 items suggest integration and practice of USVI-American customs; and Factor 3 items suggest an allegiance to traditional African-Caribbean customs and values. To facilitate ease of identification in subsequent analyses, Factors 1, 2, and 3 were renamed as "adoption," "integration," and "tradition," respectively, according to the apparent categories of acculturation they represent.

The relationships between the acculturation factors and demographic variables (age, gender, income, education, and length of residence in the USVI) were examined separately in immigrants and USVI-born African Caribbeans, due to anticipated differences based on place of birth. Among the immigrants, adoption was not significantly correlated with any demographic variable; integration was inversely correlated ($P < .05$) with education ($r = -.10$) and income ($r = -.16$); and tradition was inversely correlated with education ($r = -.11$), gender ($r = -.13$), and, as expected, with length of residence in the USVI ($r = -.16$). For those born in the USVI, adoption was positively correlated with age ($r = .12$); integration was not correlated with any demographic variable; and tradition was inversely correlated with age ($r = -.12$), education ($r = -.12$), and income ($r = -.21$), and positively with gender ($r = .13$).

Table 2. Results of factor analysis showing rotated factor patterns for 3 significant factors among acculturation items

Variables	Factor 1	Factor 2	Factor 3
SOMWISH	-0.14317	0.25642	0.58959
TGVPCMAS	0.04797	0.53985	0.06733
SPANKING	0.08950	0.67383	0.10220
TEENRENT	0.50311	0.13914	0.13367
THROWAWAY	0.31907	-0.20897	0.58206
ONECARD	0.65670	0.00652	0.08276
CABLETVS	0.62010	0.06726	-0.20226
DAYCARE	0.49263	0.16546	-0.10463
CRICKET	0.08222	0.01947	0.70932
EATINOUT	0.21801	0.63141	-0.12880
Eigenvalues	1.498498	1.305251	1.297680

SOMWISH=Sometimes I wish I could live in another Caribbean Island, other than the Virgin Islands; TGVPCMAS=In my home, Thanksgiving is a bigger celebration than Christmas; SPANKING=Spanking a child is a form of child abuse; TEENRENT=A nineteen-year-old should rent an apartment rather than live in his/her parent's home; THROWAWAY=Paying house rent is throwing away money; ONECARD=A working adult should have at least one credit card; CABLETVS=For me, cable TV is a must; DAYCARE=Parents should place a three-year-old in a day-care center rather than at a relative; CRICKET=I prefer cricket to baseball; EATINOUT=I prefer eating out to cooking at home.

A test of the validity of the acculturation factors would be their ability to distinguish between immigrants and USVI-born persons. Consistent with what would be expected, the mean adoption (AD) score, adjusted for age, gender, education, and income, was significantly higher ($P=.0002$) for USVI-born persons than for African-Caribbean immigrants [AD=11.3 (95% CI=11.0–11.6) for USVI-born vs AD=10.6 (95% CI=10.4–10.8) for immigrants], while African-Caribbean immigrants had a higher ($P=.0001$) traditional score (TS) than did USVI-born persons [TS=9.0 (95% CI=8.8–9.2) vs TS=7.0 (95% CI=6.7–7.2), respectively]. The mean integration (IN) score did not differ significantly between the groups.

Acculturation and Body Size

Each of the acculturation factors was examined in relation to anthropometric variables (BMI and waist circumference) among USVI-born individuals ($N=214$) and African-Caribbean immigrants ($N=362$) without a history of diabetes.

In univariate analyses, only the AD score showed a significant relationship to anthropometric measurements. The AD score was positively correlated with waist circumference ($r=.14$, $P=.039$) and BMI ($r=.17$, $P=.015$) among USVI-born persons, and showed a marginally significant correlation to waist circumference ($r=.10$, $P=.052$) among African-Caribbean immigrants.

Multivariate analyses were conducted by constructing partial models (data not shown) in which only the adoption factor and a possible confounding factor (age, income, education, gender, smoking, and alcohol consumption) were included, followed by the examination of a full model (See Table 3) that included all possible confounding factors. In partial and full model analyses, none of the possible confounders could account for the observed relationship of AD score to BMI among USVI-born persons. However, the significant relationship of AD

Table 3. Regression coefficients for BMI and waist circumference by adoption score adjusting for study variables, among Caribbean-born Blacks living in the US Virgin Islands

	USVI-born β (P Value)	Immigrants β (P Value)
BMI		
Adoption	.5851 (.0207)*	.0695 (.6307)
Age	.0169 (.6614)	.0096 (.6946)
Gender	1.024 (.4628)	2.439 (.0008)*
Education	-.0173 (.9573)	-.5280 (.0099)*
Income	.2606 (.4416)	-.0789 (.6853)
Smoking	-3.646 (.2297)	-1.130 (.4375)
Alcohol	2.220 (.0839)	-.0922 (.8934)
Waist circumference		
Adoption	1.230 (.1043)	.5052 (.1797)
Age	.2514 (.0352)*	.0906 (.1575)
Gender	-7.489 (.0703)	-2.987 (.1151)
Education	.0885 (.9268)	-1.016 (.0604)
Income	-.2937 (.7742)	-.2183 (.6707)
Smoking	-6.573 (.4299)	-2.977 (.4264)
Alcohol	4.067 (.2873)	-2.325 (.1979)

* $P<.05$.

score to waist circumference in USVI-born individuals disappeared in the partial models when adjusted for age, male gender, or alcohol consumption, but not when adjusted for education or income. The AD score was not significantly related to waist in the multivariate regression models for African-Caribbean immigrants. In logistic regression analyses, USVI-persons with a high AD score (based on the upper level scores from a median split of the distribution) had a 75% increased risk [age and sex-adjusted odds ratio=1.75 (95% CI=1.01–2.08)] of being obese compared to those with a low AD score.

Acculturation and Glucose Tolerance

The relationship of the acculturation factors to fasting glucose was examined among individuals who had not been diagnosed with diabetes prior to entry into the study. Correlation analyses revealed that, for African-Caribbean immigrants, there was a significant relationship of the AD score ($r=.19$, $P=.0003$) and the IN score ($r=.14$, $P=.0075$) to fasting glucose. However, among USVI-born persons, none of the

acculturation factors were significantly related to fasting glucose. In Figure 1, a plot of the relationship of fasting glucose to AD score shows that mean fasting glucose levels increase with higher AD score among immigrants, while among USVI-born individuals, fasting glucose levels rise, then plateau and decline slightly at AD scores of 11 or greater.

In multiple regression models (Table 4) that included age, gender, education, and alcohol consumption, in which the AD score and IN scores were included separately, both factors remained independently related to fasting glucose [($\beta=2.42$; $P=.0051$ for AD score) and ($\beta=2.53$; $P=.0205$ for IN score)] among African-Caribbean immigrants. However, when both variables were entered into the model, only the AD score remained significant. The data in Table 5 demonstrate that in multiple regression models, neither BMI or waist circumference could account for the relationship of adoption score to fasting glucose among immigrants.

Multiple logistic regression analysis was used to assess the risk among African-Caribbean immigrants of having

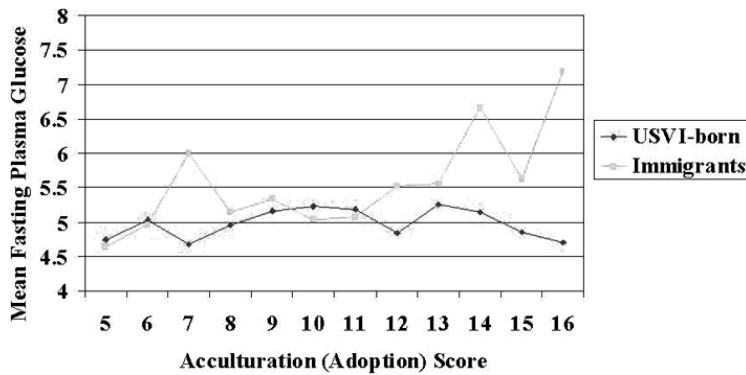


Fig 1. Mean fasting plasma glucose value by level of acculturation (adoption score) among USVI-born and immigrant African Caribbeans in the US Virgin Islands

newly diagnosed diabetes associated with AD score, while adjusting for age, gender, education, and alcohol consumption. The results show that a high AD score (based on a median split of the distribution) is associated with a 3-fold increased risk of having newly diagnosed diabetes mellitus. [OR=3.77 (95% CI=1.19–9.56)]. The risk of having newly diagnosed diabetes associated with high AD scores remained significant after adjusting for waist circumference and BMI in separate logistic models (data not shown).

Individual Components of the Adoption Factor in Relation to BMI and Fasting Glucose

Multiple regression analyses were used to determine if any one of the 4 items that compose the adoption factor was solely responsible for the observed relationship of AD score to BMI and fasting glucose. Each of the 4 items was entered separately into regression models in which BMI and fasting glucose were the dependent variables. The results revealed that in models including age, gender, education, income, smoking, and alcohol consumption, only the DAYCARE ($\beta=1.32, P=.0204$) variable was independently related to BMI among USVI-born individuals (see Table 1 for definitions of abbreviations). In models including age, gender, education, income, and alcohol consump-

tion, significant relationships to fasting glucose were found only for the CABLETVS ($\beta=7.60, P=.0006$) and ONECARD ($\beta=4.65, P=.0261$) variables.

DISCUSSION

The current study described an attempt to evaluate the relationship of acculturation to body size and glucose tolerance among African Caribbeans in the USVI. Because there was no available measure of acculturation for use among African Caribbeans, a preliminary investigation was conducted to identify factors that might be used to assess the acculturative process in African Caribbeans in the USVI. Three acculturation factors were identified in the current study, including adoption of USVI-

American values, integration and practice of USVI-American customs, and allegiance to traditional African-Caribbean values and customs. This multidimensionality is consistent with the general view of acculturation as being a multidimensional construct.¹¹ The content validity of the items used for measuring acculturation in the USVI were established, reliability was acceptable, and the relationships of the acculturation factors to demographic characteristics were consistent with the expected behavior of a measure of acculturation. Although the Chronbach alpha for the 3 factors were low, this psychometric shortcoming was not unexpected, since the objective of the study was not necessarily the development of an acculturation questionnaire, but rather the identification of a factor or factors which could be used as a surrogate for changing cultural values. A potentially valuable aim of future public health research might be the development of a questionnaire with high internal consistency that incorporates all 3 factors identified in the current study to measure acculturation among African Caribbeans in the United States, Caribbean, and elsewhere.

In the current study, acculturation was independently associated with BMI only among USVI-born persons. A possible explanation for this finding is that the lifestyle behaviors, associated with acculturation, which predispose to obesity, are disproportionately distributed

Table 4. Regression coefficients for fasting glucose by adoption score and integration score adjusting for study variables, among Caribbean-born Black immigrants living in the US Virgin Islands

	Model 1 β (P Value)	Model 2 β (P Value)	Model 3 β (P Value)
Adoption	2.422 (.0051)*		2.064 (.0202)*
Integration		2.530 (.0205)*	1.907 (.0873)
Age	.5333 (.0003)*	.5207 (.0004)*	.5372 (.0002)*
Gender	.2080 (.9601)	1.285 (.7596)	.9082 (.8280)
Education	-1.309 (.2251)	-1.275 (.2423)	-1.092 (.3149)
Alcohol	-5.803 (.1622)	-6.681 (.1088)	-5.626 (.1771)

* $P < .05$.

Table 5. Regression coefficients for fasting blood glucose by adoption score adjusting for waist circumference, BMI, and study variables, among Caribbean-born Blacks living in the US Virgin Islands

	USVI-born β (P Value)	Immigrants β (P Value)	USVI-born β (P Value)	Immigrants β (P Value)
Adoption	.1213 (.8467)	2.333 (.0071)	.0716 (.9104)	2.070 (.0171)*
Waist	.2381 (.0012)*	.3561 (.0114)*	—	—
BMI	—	—	.6547 (.0028)*	.7556 (.0393)*
Age	.2135 (.0345)*	.5452 (.003)*	.2275 (.0214)*	.5565 (.0003)*
Gender	-7.404 (.0293)*	.6659 (.8740)	-9.927 (.0040)*	-2.607 (.5464)
Education	-1.172 (.1107)	-.8994 (.4100)	-1.160 (.1200)	-1.013 (.3553)
Alcohol	2.068 (.5104)	-4.367 (.2972)	1.773 (.5782)	-3.918 (.3498)

* P<.05.

in USVI-born persons. For example, reduced levels of physical activity and excess caloric intake, behavioral factors associated with obesity and acculturation,⁸ may be higher in USVI-born persons than in immigrants. Another possible explanation is that no measure of acculturation was identified by this study as being associated with BMI among African-Caribbean immigrants. While this cannot be entirely discounted, univariate analyses demonstrated a significant relationship between waist circumference and AD score for both USVI and immigrants (though less significant for immigrants), suggesting that the AD score might have been significantly related to BMI in the immigrant group if the relationship existed.

An intriguing study finding was that fasting glucose and diabetes risk were

Acculturative stress and other psychosocial stressors are thought to adversely influence hormones of the central nervous system and hypothalamic-pituitary-adrenal axis that are involved in lipid and glucose homeostasis.¹³

significantly correlated with acculturation only among African-Caribbean immigrants. A possible explanation for this observation is suggested by the plot in Figure 1, which shows that at higher levels of AD score, fasting glucose plateaus and falls in the USVI group, but continues to rise in the immigrant group. This pattern is consistent with the hypothesis that the relationship of acculturation to diabetes risk follows a biphasic curve where rising affluence increases diabetes prevalence to a zenith, at which point rates begin to decline with increasing affluence in the population.³ Therefore, African-Caribbean immigrants to the USVI may still be on the ascending limb of the curve, while for USVI-born individuals, the acculturation–diabetes relationship may have reached a plateau and begun its descent on the other side of the curve. It is interesting that when adjusted for both BMI and waist circumference, AD score remained significantly and independently related to increased diabetes risk, suggesting that adiposity alone cannot account for the relationship of acculturation to glucose intolerance among African-Caribbean immigrants in the USVI. Acculturative stress is another factor associated with acculturation¹² that might influence diabetes risk among African-Caribbean immigrants in the USVI, though not necessarily among USVI-born persons. Acculturative stress and other psychosocial stressors are thought to adversely influence

hormones of the central nervous system and hypothalamic-pituitary-adrenal axis that are involved in lipid and glucose homeostasis.¹³ Thus, higher levels of acculturative and psychosocial stress have been associated with larger waist circumference and elevated HbA_{1c}.^{13,14}

In summary, the current study shows that acculturation, as assessed by the adoption of USVI-American-oriented cultural values, differentially influences the risk of obesity and diabetes in native-born and immigrant African Caribbeans in the USVI. It is unlikely that acculturation influences obesity and diabetes risk directly, but rather may mediate behavioral patterns that result in increased frequency of these disorders. Additional study in the USVI is required to determine what those behavioral patterns might be and how they vary according to place of birth. Limitations of the study are that the data are cross-sectional and the measure used to assess acculturation is imprecise. Despite these limitations, the results provide useful insight with regard to the importance of addressing acculturation in public health efforts to reduce obesity and diabetes risk among Blacks in the USVI and, perhaps, the continental United States.

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Manuscript draft: Tull, Chambers
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Acquisition of funding: Tull
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Supervision: Tull