Published in final edited form as:

Ethn Health. 2020 February ; 25(2): 243–254. doi:10.1080/13557858.2017.1414156.

Women's beliefs about what causes obesity: variation by race/ethnicity and acculturation in a Washington State sample

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Abstract

Objective: Individuals' beliefs about the causes of multifactorial health conditions (causal attributions) shape how they conceptualize and respond to health threats and are therefore important for health promotion. Studies of racial/ethnic and cultural variation in obesity causal beliefs, however, are scarce. To address this gap, this study described beliefs about the underlying causes of obesity (genetic inheritance, diet, and physical activity) in Hispanic and non-Hispanic White women participating in a longitudinal cohort study in South King County, Washington State (n=1,002).

Design: Analysis of baseline survey data. Self-reported obesity causal beliefs were compared by race/ethnicity and acculturation indicators (survey language and nativity) using marginal effect estimates generated from multinomial logistic regression models.

Results: Hispanic women had a higher probability of not believing 'at all' in inheritance and physical activity as causes of obesity—an absolute increase of 33% and 5% over non-Hispanic White women, respectively. Both acculturation indicators were also associated with a higher probability of not believing 'at all' in inheritance as a cause of obesity, though Hispanic women who completed the survey in English and were born in the United States had genetic causal beliefs similar to non-Hispanic White women. Behavioral attributions did not vary by acculturation indicators in Hispanic women.

Conclusions: Differences in obesity causal beliefs, particularly genetic attributions, exist and may be important for developing and delivering effective obesity-related health promotion interventions. Identifying the determinants and public health consequences of cultural variation in obesity attributions should be the focus of future research.

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Conflict of Interest: None.

Keywords

USA; obesity causal beliefs; acculturation; Hispanic; genetic attributions; health promotion

INTRODUCTION

The underlying causes of obesity are complex—multiple genetic, environmental, and behavioral factors interact to determine weight status (Hofker and Wijmenga 2009). Theories of behavioral self-regulation and illness predict that individuals' beliefs about the causes of multifactorial health conditions (causal attributions), including obesity, are a key determinant of how they conceptualize and respond to health threats (Leventhal, Brissett, and Leventhal 2003). Causal attributions influence cognitive and emotional processes that shape coping behavior, including perceptions of treatment effectiveness, i.e., that genetically influenced diseases are best treated with medical interventions, while those caused by behaviors can be addressed through lifestyle modification (Marteau and Weinman 2006). Understanding obesity causal beliefs is therefore important for developing effective obesity prevention and treatment approaches (Hagger and Orbell 2003). This may be particularly true for 'precision' interventions that require engaging with individuals about their unique biological and behavioral risk factors. Creating precision clinical and public health interventions, including genetic and genomic tests for obesity risk, is an area of active interest and currently the focus of a number of large research initiatives, e.g., the *All of Us* Research Program (White House 2015).

Efforts to address the obesity epidemic in the United States (US) have highlighted obesity's disproportionate burden in Hispanic individuals, whom the US census defines as persons of Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish culture or origin regardless of race (Humes, Jones, and Ramirez 2011; NHCSL 2010). Complementarity research examining racial/ethnic variation in obesity attributions, however, is limited. A recent structured interview study found no differences in obesity causal beliefs between Hispanic and non-Hispanic individuals of any race (Sanderson et al. 2013). Similarly, the belief that obesity is inherited, i.e., genetic causal attributions, did not vary by race/ethnicity in the 2007 Health Information National Trends Survey (HINTS), though Hispanic respondents were more likely to believe that obesity is caused by overeating and not exercising than non-Hispanic White respondents (Wang and Coups 2010). Importantly, neither of these analyses accounted for acculturation, defined as the convergence of heritage and receiving cultural practices, values, and identifications (Schwartz et al. 2010). Reconciling findings from prior studies and clarifying how race/ethnicity and acculturation interact to influence obesity causal attributions is essential for developing obesity prevention and control interventions, including those that integrate genetic, environmental, and lifestyle risk information, that are meaningful to diverse subpopulations.

Specifically, racial/ethnic identity does not directly cause variation in obesity causal beliefs (Kaufman and Cooper, 2001). Instead, self-identified race/ethnicity is associated with factors that shape disease attributions that also track with acculturation, including health status, access to and understanding of health information, social norms, and cultural/folk beliefs

(Shiloh 2006). Whether Hispanic individuals with various degrees of US acculturation hold different beliefs about what causes obesity is largely unknown, yet increasingly relevant as the US Hispanic population continues to grow and experience high rates of obesity (Flegal et al. 2012; US Census Bureau 2012). Given the striking gap in obesity prevalence between Hispanic and non-Hispanic White women (41.4% vs. 32.2%, respectively) exploring variation in women's beliefs about the causes of obesity and considering the possible public health consequences is particularly important (Flegal et al. 2012). Relationships between time in the US—a proxy for acculturation—and body mass index (BMI) also appear to differ between Hispanic men and women (Ro and Bostean 2015).

The objective of the present study was therefore to describe beliefs about the causes of obesity in Hispanic and non-Hispanic White women using data collected through a large longitudinal cohort study conducted in Washington State. Additionally, we investigated acculturation's role in shaping obesity attributions. Based on prior studies of acculturation and obesity-related health beliefs we hypothesized that genetic and behavioral causal attributions would vary by race/ethnicity, but that more acculturated Hispanic women would have obesity causal beliefs similar to non-Hispanic Whites (New, Xiao, and Ma 2013).

METHODS

Participants

Data used in this analysis came from the baseline visit of the Socioeconomic Status and Obesity Study (SESO)—a longitudinal cohort study of Hispanic and non-Hispanic White women living in South King County, Washington State. SESO was designed to explore differences in Hispanic and non-Hispanic White women's weight gain trajectories during middle age and conducted from 2010–2014. Eligible women needed to identify as Hispanic of any race or non-Hispanic White, be between ages 30–50 years, and speak either English or Spanish. Women who agreed to participate provided written informed consent, completed a baseline survey, had their height and weight measured, and received a monetary incentive. A total of 1,018 women (515 Hispanic, 506 non-Hispanic White) were confirmed eligible and enrolled (final response rate of 34.1%) (AAPOR 2008). The present analysis focused specifically on obesity causal attributions and was restricted to women who were not currently pregnant (n=1,002). The University of Washington Institutional Review Board approved all study procedures.

Measures

All variables, with the exception of BMI, were self-reported in the SESO baseline pen and paper survey.

Obesity causal beliefs—Obesity causal beliefs were assessed using single questions modeled on those used in the HINTS 2007 study, but measuring behavioral attributions separately (Cantor et al. 2009). Specifically, to measure genetic causal beliefs individuals were asked, 'To what extent do you believe that obesity is inherited?' with response options falling on a four-point Likert-type scale ('don't believe at all', 'believe a little', 'believe quite a bit', and 'believe a lot'). Attributions for lifestyle behaviors were assessed similarly,

asking: ‘To what extent do you believe that obesity is caused by not eating a healthy diet?’ and ‘To what extent do you believe that obesity is caused by not exercising regularly?’ A healthy diet was defined as eating plenty of fruits and vegetables and not too much sugar or fatty foods. Exercising regularly was defined as planned physical activity done to increase physical fitness at least three times a week.

Acculturation indicators—Acculturation was conceptualized as the adoption of US cultural practices, values, and identifications (Schwartz et al 2010). Nativity (born in the US or abroad) and the language participants chose to complete the survey (English or Spanish) were chosen as proxies of acculturation based on their availability in our data and use in prior studies (Vadaparampil et al 2006).

Demographic and psychosocial covariates—Participants provided their date of birth and highest level of education from one (‘no schooling completed’) to 16 (‘doctoral degree’). Age was dichotomized (30 to <40 vs. 40 to 51) and education was defined as: high school degree or less; some college/associate degree; or Bachelor’s/advanced degree. Employment status was measured by asking, ‘What is your current job status?’ Responses were dichotomized (not working vs. working full- or part-time). Women reported whether they currently had health insurance of any type (yes or no). Measured height and weight at baseline were used to categorize women as underweight/normal weight; overweight; or obese/severely obese (NHLBI 1998).

Questions reflecting social norms of weight, diet, and physical activity were developed based on research investigating the spread of obesity in social networks (Christakis and Fowler 2007). Participants were asked how many of their five closest friends and how many of their five closest family members ‘...are overweight?’ Responses could range from zero to five and were averaged to provide a single social norms score. Norms for diet and physical activity were assessed by asking how many of their five closest friends and family members ‘...eat a healthy diet?’ and ‘...exercise regularly?’

Efficacy and outcome expectations for weight control, diet, and physical activity were measured using single questions (Grembowski et al 1993). Efficacy expectations for weight control were assessed by asking: ‘How sure are you that you will control your weight over the next year?’ Response options fell on a zero to 10 scale from ‘not sure’ to ‘very sure’. Outcome expectations were measured by asking: ‘Do you believe being overweight is harmful to your health?’ Response options were on a zero to 10 scale from ‘not at all harmful’ to ‘very harmful’. Expectancies for diet and physical activity asked about perceived ability to ‘eat less sugar and fat’ and ‘exercise regularly’ over the next year and the perceived harm of not doing so.

Statistical analysis

Summary statistics were calculated for all variables overall and by race/ethnicity. Differences in obesity causal beliefs by race/ethnicity and by nativity and survey language in Hispanic women were examined in bivariate analyses.

We used marginal effect estimates obtained from multinomial logistic regression models to assess the relationship between race/ethnicity and obesity causal beliefs. Multinomial logistic regression was used instead of ordered logistic regression because the proportional odds assumption of equivalent relationships between increasing causal belief categories was violated. To generate marginal effects, the probability of endorsing a particular causal belief category was estimated for each woman in the sample, treating them first as if they were Hispanic and then as if they were non-Hispanic White. The difference between these two predicted probabilities was calculated for each individual—giving the marginal effect of race/ethnicity for that individual—and differences were averaged across the sample to give the marginal effect of race/ethnicity overall (Williams 2012). Marginal effect estimates were multiplied by 100 to give percentages and can be interpreted as comparisons of the probability of endorsing particular causal beliefs categories between hypothetical populations of Hispanic and non-Hispanic White women with identical values of all other variables included in the model used to generate the predictions (i.e. between otherwise comparable populations). To see how differences in casual beliefs changed after accounting for potential intermediate variables, marginal effects were computed from unadjusted models and models adjusted in a step-wise fashion for demographic factors, psychosocial factors, and competing causal beliefs.

Similar procedures were used to calculate marginal effects for nativity (comparing those born abroad with those born in the US) and survey language (comparing those who completed the survey in Spanish with those who completed it in English) in Hispanic women. All analyses were conducted in 2015 using Stata version 13 software (StataCorp, 2013). Marginal effects were calculated with the margins post-estimation command using the delta method to compute standard errors and excluding women with missing data (Williams 2012). A two-sided p-value of 0.05 was considered statistically significant.

RESULTS

Descriptive results

Sample descriptive characteristics are provided in Table 1. More Hispanic women were in the younger age group, high school graduates or less, not working, uninsured, and obese/severely obese, relative to non-Hispanic White women. On average, Hispanic women had more family and friends who they perceived as overweight and fewer who they perceived as eating a healthy diet and exercising regularly. Hispanic women had lower mean efficacy for weight control, but higher mean outcome expectations. Mean efficacy and outcome expectancies for diet were higher in Hispanic women compared to non-Hispanic White women, but mean physical activity expectancies were lower. Eighty three percent of Hispanic women were born outside of the US, mainly in Mexico, compared to 5% of non-Hispanic White women. Nineteen percent of Hispanic women and all non-Hispanic White women chose to complete the baseline survey in English.

Table 2 describes obesity causal beliefs in the study sample. Behavioral causal beliefs were moderately positively correlated ($r=0.40$). Genetic attributions were uncorrelated with both diet and physical activity causal beliefs ($r=0.03$ and $r=0.05$). Genetic and physical activity causal beliefs differed between Hispanic and non-Hispanic White women based on chi-

squared tests of independence ($p = 0.001$ for both comparisons), but diet causal beliefs did not ($p = 0.15$). Within Hispanic women, only genetic causal beliefs differed by nativity and survey language ($p = 0.001$ for both comparisons).

Race/ethnicity marginal effects

Table 3 provides the marginal effect of race/ethnicity on genetic and physical activity causal beliefs about obesity. Diet causal beliefs did not vary by race/ethnicity in multinomial models and marginal effects were non-significant. Hispanic race/ethnicity was consistently associated with a higher probability of not believing ‘at all’ and a lower probability of believing ‘a little’ and ‘quite a bit’ in the role of inheritance in causing obesity. Racial/ethnic differences in genetic causal beliefs narrowed after adjusting for demographic factors, psychosocial factors, and competing causal beliefs. Hispanic race/ethnicity was also consistently associated with a higher probability of not believing ‘at all’ and a lower probability of believing ‘quite a bit’ in physical activity’s role in causing obesity. Adjusting for demographic factors slightly increased the marginal effect of race/ethnicity on physical activity causal beliefs, which was unchanged in subsequent models.

Acculturation marginal effects

Figure 1 provides the predicted probability of not believing ‘at all’ in inheritance as a cause of obesity stratified by race/ethnicity and acculturation indicators. Compared to those who were born in the US and completed the baseline survey in English, Hispanic women who were born abroad and completed the baseline survey in Spanish had a 34.2% and 36.4% higher probability, respectively, of not believing ‘at all’ in inheritance as a cause of obesity (95% CI: 25.5%, 42.0%; $p = 0.001$ & 95% CI: 27.2%, 45.6%; $p = 0.001$). Completing the baseline survey in Spanish was also consistently associated with a 20–30% lower probability of believing ‘quite a bit’ in inheritance’s role in causing obesity ($p = 0.001$ in all models). Adjustment for demographic factors, psychosocial factors, and competing causal beliefs did not dramatically change the marginal effect of either acculturation indicator on genetic causal beliefs (see Table 4 for marginal effect estimates for all models). Behavioral attributions did not vary by acculturation indicators in multinomial models and marginal effects were non-significant.

DISCUSSION

Hispanic and non-Hispanic White women in this sample held different beliefs about the role that genetic inheritance and physical activity, but not diet, play in causing obesity. Racial/ethnic differences in genetic causal beliefs were more pronounced than differences in physical activity attributions. Furthermore, genetic, but not diet or physical activity attributions, were associated with acculturation indicators in Hispanic women and contributed to variation in obesity causal beliefs by race/ethnicity.

These results have important implications for the development and delivery of obesity-related interventions. First, messages highlighting behavioral causes of obesity will likely be similarly relevant to Hispanic and non-Hispanic White women. This finding diverges from our initial hypotheses, but is supported by a growing body of research suggesting that most

Hispanic individuals, including recent immigrants, recognize the importance of diet and exercise for preventing obesity (Greenhalgh and Carney 2014; Agne et al 2012). For some Hispanic women additional education about the significance of regular physical activity for weight-regulation will be necessary, though interventions should primarily focus on facilitating healthy behaviors in the US environment rather than re-emphasizing their importance. Future work, including qualitative analysis, is necessary to understand the underlying causes of the small, but potential meaningful racial/ethnic differences in physical activity attributions we observed in this sample.

Second, Hispanic women with different degrees of acculturation will likely perceive interventions that highlight genetic determinants of obesity or provide personalized obesity risk estimates based on family health history or genetic variation differently. We found that less acculturated Hispanic women were much more likely to see no role for genetics in causing obesity, suggesting that interventions that involve communicating inherited risk information may be less effective for this subgroup. The low perceived relevance of genetic factors to less acculturated women may pose a challenge for widespread implementation of personalized or 'precision' approaches to obesity prevention and control, though access barriers for some Hispanic women are perhaps of greater concern (Tuckson, Newcomer, and De Sa 2013). The language women use for completing paperwork (or another proxy for English language proficiency) may help identify those in need of additional attention during conversations about inherited risk of obesity, including discussions of personal genetic and genomic risk factors, which are becoming increasingly common.

The substantial difference in genetic causal beliefs we observed between Hispanic women with different degrees of acculturation is novel. It also suggests that prior studies reporting small or non-significant racial/ethnic differences in genetic causal beliefs may have included more acculturated Hispanic individuals. To this point, participants in the recent structured interview study that found no racial/ethnic variability in obesity causal beliefs were recruited from a single inner-city clinic and all spoke English (Sanderson et al. 2013). Hispanic participants in HINTS 2007 were largely born in the US or had immigrated more than 10 years ago (Wang and Coups 2010; Cantor et al 2009; Kobetz et al 2012).

Identifying whether differences in genetic causal beliefs by acculturation level exist for other conditions (e.g. mental illness, cancer) and in other immigrant groups should be the focus of future research. Genetic attributions did not differ by nativity in non-Hispanic White women in this sample, though this is a less meaningful indicator of acculturation in this group. Identifying causal factors explaining observed associations between acculturation and genetic attributions is also important. These relationships are likely to be complex and context-dependent. Finally, whether increasing recognition of obesity's genetic component accompanies adoption of US cultural practices and values and whether this process leads women to perceive racial/ethnic differences in obesity rates as 'natural' or 'pre-determined' are both questions that warrant attention (Phelan, Link, and Feldman 2013; Condit and Bates 2005).

This sample had limited diversity beyond ethnicity and acculturation, minimizing the generalizability of our results. Specifically, findings should be confirmed in men and

Hispanic individuals with different socio-demographic profiles and countries of origin. Analyses were cross-sectional and should be interpreted as descriptive and not causal. Only crude proxy measures of acculturation were available in our data (Alegria 2009). Additionally, primarily single-item measures were used, leading to incalculable alphas. It is also possible that women interpreted ‘inheritance’ in different ways and that this question did not reflect beliefs about that role that genetic factors play in causing obesity. This measure of genetic attributions has been used in prior studies, most notable HINTS, and was piloted in both English and Spanish-speaking individuals, helping to minimize this concern.

Despite their limitations, these results highlight the importance of considering variation in obesity causal beliefs when undertaking obesity prevention and control efforts in diverse populations. Providing accurate and culturally appropriate education about obesity’s multifactorial causes should help ensure that future public health efforts are equally effective for all groups.

Acknowledgements:

The authors would like to acknowledge Denise Albano for her coordination of the SESO study.

Financial Support: This work was supported by the National Institute of Diabetes and Digestive and Kidney Diseases under grant number RO1 DK079042.

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Figure 1.

Predicted probability of not believing 'at all' in inheritance as a cause of obesity from multinomial logistic regression models, by race/ethnicity and acculturation indicators.

Notes: US=United States; NHW=non-Hispanic White. Data collected in South King County, Washington from 2010–2011.

^a Unadjusted (included only nativity) in Hispanics only, n=479

^b Unadjusted (included only survey language) in Hispanics only, n=502

^c Unadjusted (included only ethnicity), n=993

Table 1.

Participant demographic, psychosocial, and acculturation characteristics, by race/ethnicity.

	Overall (n=1,002)	NHW (n=493)	Hispanic (n=509)
Demographic Factors, n (%)			
Age			
30 – <40 years	566 (56.5)	259 (52.5)	307 (60.3)
40 – 51 years	406 (40.5)	228 (46.3)	178 (35.0)
Missing	30 (3.0)	6 (1.2)	24 (4.7)
Education			
High school graduate or less	492 (49.1)	103 (20.9)	389 (76.4)
Some college/associate degree	216 (21.6)	147 (29.8)	69 (13.6)
Bachelor's/advanced degree	294 (29.3)	243 (49.3)	51 (10.0)
Employment status			
Working full-time or part-time	568 (56.7)	326 (66.1)	242 (47.5)
Not working	428 (42.7)	165 (33.5)	263 (51.7)
Missing	6 (0.6)	2 (0.4)	4 (0.8)
Health insurance status			
Insured	539 (53.8)	406 (82.4)	133 (26.1)
Uninsured	437 (43.6)	84 (17.0)	353 (69.4)
Missing	26 (2.6)	3 (0.6)	23 (4.5)
Body mass index			
<25.0 kg/m ² (underweight/normal weight)	259 (25.9)	186 (37.7)	73 (14.3)
25 – <30.0 kg/m ² (overweight)	306 (30.5)	109 (22.1)	197 (38.7)
30.0 kg/m ² (obese/severely obese)	437 (43.6)	198 (40.2)	239 (47.0)
Psychosocial Factors, n (%)			
Social norms for weight			
(Mean ± SD)	2.1 ± 1.2	2.0 ± 1.2	2.2 ± 1.3
Missing	43 (4.3)	9 (1.8)	34 (6.7)
Social norms for diet			
(Mean ± SD)	2.3 ± 1.5	2.9 ± 1.3	1.7 ± 1.5
Missing	53 (5.3)	11 (2.2)	42 (8.3)
Social norms for physical activity			
(Mean ± SD)	2.3 ± 1.3	2.7 ± 1.2	1.9 ± 1.4
Missing	59 (5.9)	11 (2.2)	48 (9.4)
Weight control efficacy expectations			
(Mean ± SD)	6.0 ± 2.6	6.1 ± 2.4	5.9 ± 2.7
Missing	3 (0.3)	1 (0.2)	2 (0.4)
Weight control outcome expectations			
(Mean ± SD)	7.6 ± 1.9	7.4 ± 1.7	7.7 ± 2.0

	Overall (n=1,002)	NHW (n=493)	Hispanic (n=509)
Missing	4 (0.4)	0 (0)	4 (0.8)
Diet efficacy expectations			
(Mean $\pm$ SD)	5.7 $\pm$ 2.9	5.6 $\pm$ 3.0	5.9 $\pm$ 2.9
Missing	6 (0.6)	3 (0.6)	3 (0.6)
Diet outcome expectations			
(Mean $\pm$ SD)	8.9 $\pm$ 1.7	8.7 $\pm$ 1.6	9.2 $\pm$ 1.7
Missing	4 (0.4)	2 (0.4)	2 (0.4)
Physical activity efficacy expectations			
(Mean $\pm$ SD)	6.7 $\pm$ 3.0	7.1 $\pm$ 2.7	6.4 $\pm$ 3.1
Missing	7 (0.7)	0 (0)	7 (1.4)
Physical activity outcome expectations			
(Mean $\pm$ SD)	7.5 $\pm$ 3.0	7.8 $\pm$ 2.4	7.2 $\pm$ 3.4
Missing	6 (0.6)	0 (0)	6 (1.2)
Acculturation Indicators, n (%)			
Survey language			
English	590 (58.9)	493 (100.0)	97 (19.1)
Spanish	412 (41.1)	0 (0)	412 (80.9)
Nativity			
Born in US	530 (52.9)	467 (94.7)	63 (12.4)
Born abroad	446 (44.5)	24 (4.9)	422 (82.9)
Missing	26 (2.6)	2 (0.4)	24 (4.7)

Notes: NHW=non-Hispanic White; SD=standard deviation; US=United States. Data collected in South King County, Washington from 2010–2011.

Table 2.

Obesity causal beliefs, by race/ethnicity.

Obesity Causal Beliefs, n (%)	Overall (n=1,002)	NHW (n=493)	Hispanic (n=509)
Diet attributions			
Don't believe at all	27 (2.7)	10 (2.0)	17 (3.3)
Believe a little	94 (9.4)	43 (8.7)	51 (10.0)
Believe quite a bit	378 (37.7)	202 (41.0)	176 (34.6)
Believe a lot	497 (49.6)	236 (47.9)	261 (51.3)
Missing	6 (0.6)	2 (0.4)	4 (0.8)
Physical activity attributions			
Don't believe at all	36 (3.6)	6 (1.2)	30 (5.9)
Believe a little	121 (12.1)	55 (11.2)	66 (13.0)
Believe quite a bit	355 (35.4)	201 (40.8)	154 (30.3)
Believe a lot	483 (48.2)	230 (46.7)	253 (49.7)
Missing	7 (0.7)	1 (0.2)	6 (1.2)
Genetic attributions			
Don't believe at all	224 (22.4)	29 (5.9)	195 (38.3)
Believe a little	377 (37.6)	237 (48.1)	140 (27.5)
Believe quite a bit	297 (29.6)	180 (36.5)	117 (23.0)
Believe a lot	95 (9.5)	45 (9.1)	50 (9.8)
Missing	9 (0.9)	2 (0.4)	7 (1.4)

Notes: NHW=non-Hispanic White; SD=standard deviation; US=United States. Data collected in South King County, Washington from 2010–2011.

Table 3.

Race/ethnicity marginal effects for genetic and physical activity causal beliefs about obesity.

	Race/ethnicity marginal effect estimate ^a							
	Genetic causal beliefs				Physical activity causal beliefs			
	Model 1 ^b (n=993)	Model 2 ^c (n=937)	Model 3 ^d (n=869)	Model 4 ^e (n=869)	Model 1 ^b (n=995)	Model 2 ^c (n=939)	Model 3 ^d (n=869)	Model 4 ^e (n=869)
Don't believe at all, %	32.9***	25.6***	24.3***	24.1***	4.7***	6.6***	6.6***	6.2**
(SE)	(0.02)	(0.03)	(0.04)	(0.04)	(0.01)	(0.02)	(0.02)	(0.02)
Believe a little, %	-20.4***	-15.3***	-14.1***	-13.6**	1.9	-0.2	2.3	2.2
(SE)	(0.03)	(0.04)	(0.04)	(0.04)	(0.02)	(0.03)	(0.03)	(0.03)
Believe quite a bit, %	-13.4***	-11.8**	-11.0**	-11.7**	-10.2***	-17.2***	-9.9*	-10.3*
(SE)	(0.03)	(0.04)	(0.04)	(0.06)	(0.03)	(0.04)	(0.04)	(0.04)
Believe a lot, %	0.8	1.4	0.9	1.2	3.6	10.8*	1.1	2.0
(SE)	(0.02)	(0.02)	(0.03)	(0.04)	(0.03)	(0.04)	(0.04)	(0.04)

Notes: Results bolded when p < 0.05. BMI=body mass index. Data collected in South King County, Washington from 2010–2011.

^a Difference in predicted probability of endorsing specific causal belief category. Reference group=non-Hispanic White.

^b Unadjusted (included only race/ethnicity).

^c Adjusted for demographic factors (age, education, employment, health insurance, BMI).

^d Adjusted for demographic psychosocial factors (social norms, outcome expectations, efficacy expectations).

^e Adjusted for demographic and psychosocial factors and competing causal beliefs.

* p < 0.05

** p < 0.01

*** p < 0.001

Table 4.

Acculturation marginal effects for genetic causal beliefs about obesity in Hispanic women.

Genetic causal beliefs	Nativity marginal effect estimate ^a				Survey language marginal effect estimate ^b			
	Model 1 ^c (n=479)	Model 2 ^d (n=441)	Model 3 ^e (n=393)	Model 4 ^f (n=392)	Model 1 ^c (n=502)	Model 2 ^d (n=456)	Model 3 ^e (n=407)	Model 4 ^f (n=406)
Don't believe at all, %	34.2***	30.1***	31.6***	31.0***	36.4***	34.8***	35.8***	35.4***
(SE)	(0.04)	(0.05)	(0.06)	(0.13)	(0.04)	(0.05)	(0.05)	(0.07)
Believe a little, %	-16.5*	-10.2	-15.2	-15.6*	-11.9*	-3.4	-3.9	-4.2
(SE)	(0.07)	(0.07)	(0.08)	(0.08)	(0.05)	(0.06)	(0.07)	(0.07)
Believe quite a bit, %	-11.2	-15.3*	-13.4	-12.9	-20.1***	-28.7***	-30.7***	-30.0***
(SE)	(0.06)	(0.08)	(0.08)	(0.08)	(0.05)	(0.07)	(0.07)	(0.08)

Notes: Estimates bolded when $p < 0.05$. Marginal effects for 'believe a lot' were all non-significant and are not shown. US=United States; BMI=body mass index. Data collected in South King County, Washington from 2010–2011.

^a Difference in predicted probability of endorsing specific causal belief category. Reference group=US born.

^b Difference in predicted probability of endorsing specific causal belief category. Reference group=English.

^c Unadjusted (included only survey language or nativity).

^d Adjusted for demographic factors (age, education, employment, health insurance, BMI).

^e Adjusted for demographic factors and psychosocial factors (social norms, outcome expectations, efficacy expectations).

^f Adjusted for demographic, psychosocial, and competing causal beliefs.

* $p < 0.05$

** $p < 0.01$

*** $p < 0.001$