



Lifestyle behaviors and ethnic identity among diverse women at high risk for type 2 diabetes



Susan D. Brown^{*}, Samantha F. Ehrlich, Ai Kubo, Ai-Lin Tsai, Monique M. Hedderson, Charles P. Quesenberry Jr., Assiamira Ferrara

Division of Research, Kaiser Permanente Northern California, Oakland, CA, United States

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ABSTRACT

Background: Diet and physical activity lifestyle behaviors are modifiable risk factors for type 2 diabetes and are shaped by culture, potentially influencing diabetes health disparities.

Objectives: We examined whether ethnic identity—the strength of attachment to one's ethnic group, and a long-standing focus of psychological research—could help account for variations in lifestyle behaviors within a diverse population at high risk for chronic disease.

Methods: Using data from the Gestational Diabetes' Effects on Moms trial, this US-based cross-sectional study included 1463 pregnant women (74% from minority ethnic/racial groups; 46% born outside the US) with gestational diabetes (GDM), a common pregnancy complication conferring high risk for type 2 diabetes after delivery. Mixed linear regression models examined whether ethnic identity is associated with lifestyle behaviors after adjusting for demographic, clinical, and acculturative characteristics (e.g., nativity and length of residence in the US).

Results: In the overall sample, a one-unit increase in ethnic identity score was significantly associated with 3% greater fiber intake, 4% greater fruit/vegetable intake, 11% greater total activity, and 11% greater walking (p values < 0.01). Within ethnic/racial groups, a one-unit increase in ethnic identity score was significantly associated with 17% greater fiber intake among Filipina women; 5% lower total caloric intake among non-Hispanic White women; and 40% greater total activity, 35% greater walking, and 8% greater total caloric intake among Latina women (p values ≤ 0.03).

Conclusion: Results from this large study suggest that ethnic group attachment is associated with some lifestyle behaviors, independent of acculturation indicators, among young women with GDM who are at high risk for type 2 diabetes. Stronger ethnic identity may promote certain choices known to be associated with reduced risk of type 2 diabetes. Prospective research is needed to clarify the temporal nature of associations between ethnic identity and modifiable diabetes risk factors.

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Diabetes health disparities persist in the US, with greater diabetes prevalence among African American, Latino, Native American, and Asian as compared to non-Hispanic White adults (Centers for Disease Control and Prevention, 2014; Menke et al., 2015). Indeed, incidence continues to climb among African American and Latino adults despite plateauing in the total population (Geiss et al., 2014). Many minority groups suffer disproportionately from diabetes risk factors including obesity (Adams and Schoenborn, 2006; Albright et al., 2008; Flegal et al., 2010), physical inactivity (Adams

and Schoenborn, 2006), and poor diet (August and Sorkin, 2011).

At particularly high risk are women with a history of gestational diabetes (GDM), or hyperglycemia first recognized during pregnancy (Metzger, 1991). Women with GDM are seven times more likely to develop type 2 diabetes than parous women without GDM (Bellamy et al., 2009). Ethnic and racial minority groups suffer disproportionately from GDM (Ferrara et al., 2004; Hedderson et al., 2010) and are more likely to develop type 2 diabetes after a pregnancy complicated by GDM (Xiang et al., 2011). Similarly, women from certain ethnic/racial groups born outside the US suffer disproportionately from GDM as compared to their US-born counterparts (Hedderson et al., 2010).

Diet and physical activity are key modifiable risk factors for diabetes which play an important role during pregnancy. In the

^{*} Corresponding author. Division of Research, Kaiser Permanente Northern California, 2000 Broadway, Oakland, CA 94612, United States.

E-mail address: susan.d.brown@kp.org (S.D. Brown).

Diabetes Prevention Program (Knowler et al., 2002), a lifestyle intervention focused on weight loss and improved diet and activity reduced type 2 diabetes risk by 53% among women with a history of GDM (Ratner et al., 2008). Building on this evidence base, the National Diabetes Prevention Program's weight management curriculum emphasizes physical activity and nutrient-dense diets that are high in fiber and lower in total fat and calories for the general population of at-risk adults (Centers for Disease Control and Prevention, 2016). Observational research has also identified diet and physical activity as important predictors of progression to type 2 diabetes after a pregnancy complicated by GDM (Bao et al., 2014; Kim, 2014). In the Nurses Health Study II, greater physical activity (Bao et al., 2014) and dietary patterns characterized by greater fiber, whole grain, fruit, and vegetable intake and lower saturated fat intake (Tobias et al., 2012) were associated with significantly lower risk for disease progression. Finally, diet and activity are implicated in the risk of excess weight gain during pregnancy (Stuebe et al., 2009), which in turn is associated with adverse pregnancy outcomes such as preeclampsia, delivery by cesarean section, hyperbilirubinemia, and having a large-for-gestational age infant (Hedderston et al., 2006; Rosenberg et al., 2005; Siega-Riz et al., 2009; Stotland et al., 2004). Clear opportunities exist to reduce ethnic/racial health disparities in type 2 diabetes by addressing modifiable lifestyle behaviors.

Health disparities across ethnic/racial groups are well-documented (Institute of Medicine, 2009), and there is recognition that it is through individuals' lived experience of ethnicity/race that disparities emerge (Institute of Medicine, 2012). Yet our understanding of how this occurs remains incomplete. The construct of *ethnic identity* could serve to contextualize associations between health behaviors—and in turn, disease outcomes—and often routine ethnic/racial categorizations. An active focus of research in psychology for decades (Ponterotto and Mallinckrodt, 2007), ethnic identity is conceptualized as a multi-dimensional reflection of the strength and quality of one's attachment to a social group (Ong et al., 2010; Phinney, 1992; Phinney and Ong, 2007). As a developmental process, ethnic identity varies intra-personally across the lifecourse as well as inter-personally within groups, with members differing in the degree to which their ethnic group membership is personally salient and valued. While research on ethnic identity and lifestyle behaviors is limited, among African Americans higher levels of ethnic identity have been associated with greater knowledge of diabetes risk factors (Brezo et al., 2006) and more healthful eating patterns and greater leisure-time physical activity (Siegel et al., 2000). As an "internal structure" (Phinney and Ong, 2007) that exists regardless of one's immigration status, ethnic identity is related to but distinct from the construct of acculturation (Cuéllar et al., 1997), or the process by which individuals such as immigrants and indigenous peoples learn about and adopt a new society's cultural norms. While acculturation has been associated among US immigrant groups with obesity (Oza-Frank and Cunningham, 2010; Perez-Escamilla) and deteriorations in lifestyle behaviors (Allen et al., 2014; Ayala et al., 2008; Montez and Eschbach, 2008; Patil et al., 2009; Perez-Escamilla, 2011), limited research has examined the interplay between ethnic identity and acculturation on lifestyle behaviors in both immigrant and non-immigrant groups.

Within a young and well-defined population at high risk for type 2 diabetes, i.e., women with GDM, we investigated whether ethnic identity was associated with diet and physical activity lifestyle behaviors, and whether these associations varied across ethnic/racial groups. We hypothesized that higher levels of ethnic identity would be associated with healthful lifestyle behaviors, beyond related factors such as indicators of acculturation.

1. Materials and methods

This cross-sectional study was nested within "Gestational Diabetes' Effects on Moms" (GEM), a pragmatic cluster randomized clinical trial conducted from 2011 to 2013 to compare postpartum type 2 diabetes prevention strategies among women with recent GDM (Ferrara et al., 2014, 2016). The present study was set in Kaiser Permanente Northern California (KPNC)—a large integrated US healthcare delivery system whose membership is demographically similar to the underlying population except at the extremes of income and education (Gordon, 2015). The study was approved by the KPNC institutional review board; GEM was registered at ClinicalTrials.gov (identifier NCT01344278).

1.1. Participants and procedure

In KPNC nearly all pregnant women are screened for GDM as part of standard care (Ferrara et al., 2004). Using the electronic health record (EHR) system, women across all 44 KPNC facilities were identified as being eligible for GEM on the basis of being ≥ 18 years old and diagnosed with GDM using the Carpenter and Coustan criteria (Ferrara et al., 2014), as recommended by the American College of Obstetricians and Gynecologists during the study period (2011).

This study utilized data from the GEM baseline survey administered during pregnancy, soon after diagnosis with GDM (Ferrara et al., 2014). The two-part survey was administered in English or Spanish as 1) a computer-assisted telephone interview yielding demographic and acculturative data ($N = 1706$ of 2320 eligible women [73.5%] provided verbal consent and responded), followed by 2) a mailed questionnaire yielding data on ethnic identity, diet, and physical activity ($N = 1463$ of 1706 [92.6%] responded). Survey responders did not differ from non-responders on characteristics such as age or pre-pregnancy body mass index (BMI), but were slightly more likely to be White (Ferrara et al.).

1.2. Measures

Self-identified ethnic/racial origin was assessed using a 16-category checklist inclusive of multiple Asian and Latina groups, informed by recommendations from the Institute of Medicine (2009). Education, pre-tax household income, and nativity (i.e., country of birth) and years of residence in the US were assessed via single-item questions. Age, preferred language, height, and pre-pregnancy weight to calculate pre-pregnancy BMI (kg/m^2) were assessed via EHR.

Ethnic identity was assessed using the Multigroup Ethnic Identity Measure-Revised (MEIM-R), a 6-item self-report instrument assessing affiliation with one's ethnic group (Phinney and Ong, 2007). Prior research in the present sample has demonstrated good psychometric properties, including good internal consistency reliability (Cronbach's α ranging from 0.79 to 0.91) and evidence of measurement invariance across multiple diverse ethnic/racial groups, supporting its broad utility (Brown et al., 2014). Items address dimensions of exploration (e.g., "I have often talked to other people in order to learn more about my ethnic group") and commitment (e.g., "I feel a strong attachment towards my own ethnic group") on a 5-point scale ranging from 1 (strongly disagree) to 5 (strongly agree). MEIM-R scores were calculated by averaging item values, with higher scores corresponding to higher levels of ethnic identity.

Dietary intake in the prior three months was assessed with a 130-item version of the Block 2005 validated food frequency questionnaire (FFQ; Boucher et al., 2006; Subar et al., 2001). The FFQ was modified to reflect diverse dietary habits of women in the

target population (e.g., by adding categories for edamame and winter squash). Dietary outcome variables for the present study included average daily fiber intake (grams), fruit/vegetable intake (cups), percent of calories from fat, and total caloric intake (kcal). Dietary data were treated as missing if deemed potentially implausible (total caloric intake <600 or >4000 kcal/day).

Physical activity in the prior three months was assessed with a 37-item version of the Pregnancy Physical Activity Questionnaire (PPAQ; Chasan-Taber et al., 2004). The PPAQ was modified to include activities such as yoga/Pilates, aerobic exercise machines and classes, resistance training, and team sports. Participants selected a range of time spent in each activity on 6-point scales (e.g., ranging from never, ½ to almost 1 h per week, 2 to almost 3 h per week, etc.). The mid-point of the selected time spent in each activity (i.e., duration) was multiplied by the activity's metabolic equivalent of task (MET value, i.e., intensity), using either Compendium-based (Ainsworth et al., 2000) or field-based measurements for pregnant women (Roberts et al., 2002). Results were summed to calculate total activity (MET hours per week), a proxy for energy expenditure comparable across adults differing in body weight. We also examined “fitness activity” (minutes per week), i.e., intentional moderate- to vigorous-intensity activity performed to increase fitness or improve health and wellness, resulting in energy expenditure beyond the demands of everyday living; this outcome is consistent with national recommendations for healthy pregnant women to engage in at least 30 min per day of moderate-intensity physical activity, most days of the week (American College of Obstetricians and Gynecologists, 2002, Reaffirmed, 2009; Physical Activity Guidelines Advisory Committee, 2008). Finally we examined walking (hours per week), a commonly reported form of physical activity; similar to the definition of “fitness activity” we included only intentional forms, i.e., walking for fun, exercise, or transportation (walking while at work or playing with children were excluded). Physical activity data were treated as missing if deemed potentially implausible (>20 total hours per day or > 9 moderate-intensity hours per day).

1.3. Statistical analyses

Preliminary analyses included examining associations between ethnic identity and a) demographic, acculturative, and clinical factors in the overall sample using Pearson correlations and ANOVA (excluding missing categories); and b) dietary and physical activity behaviors in the overall sample and within ethnic/racial groups using Pearson correlations. Primary analyses consisted of mixed linear regression models to examine associations between ethnic identity (modeled as a continuous variable) and dietary and physical activity behaviors. We examined associations in the overall sample and within ethnic/racial groups to explore potential effect modification by ethnicity/race and subgroup differences that could be obscured by analyzing the overall sample alone. Multivariate models included covariates that were associated with either ethnic identity or the outcome of interest (or both). All models were adjusted for age, education, nativity/length of residence in the US, preferred language, pre-pregnancy BMI, and medical facility (random intercept, to account for clustering of women in geographically-based medical facilities). Additionally, ethnicity/race (for models in the overall sample) and total caloric intake (for models examining fiber and fruit/vegetable intake) were included where relevant. Income was included in models for fiber intake, fruit/vegetable intake, and percent of calories from fat given significant bivariate associations. Regression models for normally-distributed outcome variables (percent of calories from fat) yielded absolute differences in adjusted mean outcomes per unit increase in ethnic identity score. Non-normally-distributed outcome

variables (all others) were log transformed, such that regression models yielded relative differences in adjusted mean outcomes per unit increase in ethnic identity. Models were not developed among Black/African American women due to restricted sample size.

2. Results

Within the present sample ($N = 1463$), women were diagnosed with GDM at a mean (SD) of 25.2 (6.4) weeks and completed the baseline survey at 29.5 (6.0) weeks of gestation. The mean age at delivery was 32.6 (5.0) years. More than 75% of women identified as ethnic/racial minorities, and nearly two-thirds were overweight or obese prior to the index pregnancy (Table 1). Mean level of ethnic identity in the overall sample was 3.41 (0.83). Ethnic identity was significantly associated with age and each of the characteristics listed in Table 1 (p values ≤ 0.01), with the exception of income ($p = 0.78$).

Valid dietary and physical activity data were obtained from 1403 to 1352 women, respectively. Each of the participant characteristics listed in Table 1 was significantly associated with each of the seven diet and physical activity outcomes (p values < 0.05), with the following exceptions: ethnicity/race and nativity/length of residence in the US were not associated with fitness activity (p values ≥ 0.12); educational level was not associated with total calories, total activity, or walking (p values ≥ 0.23); income was not associated with total calories, total activity, fitness activity, or walking (p values ≥ 0.23); preferred language was not associated with fiber intake, total calories, or fitness activity (p values ≥ 0.19); and pre-pregnancy BMI was not associated with any outcome (p

Table 1
Participant characteristics: The Gestational Diabetes' Effects on Moms (GEM) trial.

	<i>n</i> (%)
Ethnic/racial origin	
Black/African American	58 (3.4)
Chinese	168 (11.5)
Filipina	165 (11.3)
South Asian	144 (9.8)
Asian, other ^a	153 (10.5)
Latina	240 (16.4)
Non-Hispanic White	375 (25.6)
Multiethnic	160 (10.9)
Nativity/length of residence in US	
Born outside the US, in residence 0–4 years	95 (6.5)
Born outside the US, in residence 5–9 years	138 (9.4)
Born outside the US, in residence 10–19 years	197 (13)
Born outside the US, in residence ≥ 20 years	247 (16.95)
US-born	770 (52.6)
Missing	16 (1.1)
Educational level	
\leq High school	187 (12.8)
Some college, 2-year college, or technical school	495 (33.8)
\geq 4-year college	779 (53.3)
Missing	2 (0.1)
Income	
< \$50,000	383 (26.2)
\$50,000 to \$99,999	527 (36.0)
\geq \$100,000	479 (32.7)
Missing	74 (5.1)
Preferred language	
English	1358 (92.8)
Other than English	105 (7.2)
Pre-pregnancy body mass index, kg/m ²	
< 25	513 (35.1)
25 to < 30	418 (28.57)
≥ 30	529 (36.2)
Missing	3 (0.2)

^a Primary identifications included Vietnamese, multiple Asian origins, and Korean.

values ≥ 0.19) except for fitness activity ($p = 0.03$).

Bivariate associations between ethnic identity and diet and physical activity outcomes are shown in Tables 2 and 3, respectively. With regard to diet, ethnic identity was significantly associated with higher fruit/vegetable intake in the overall sample ($p = 0.02$); higher fiber intake among Filipina women ($p = 0.01$); higher fruit/vegetable intake among Latina women ($p = 0.03$); and lower total caloric intake among non-Hispanic White women ($p = 0.04$). With regard to physical activity, ethnic identity was significantly associated with greater fitness activity in the overall sample ($p = 0.02$) and among South Asian women ($p = 0.003$).

Results from mixed linear regression models estimating associations between ethnic identity and lifestyle behaviors after adjustment for demographic, acculturative, and clinical factors are shown in Table 4. A one-unit increase in ethnic identity score was significantly associated with 3% greater fiber ($p = 0.004$) and 4% greater fruit/vegetable intake ($p = 0.007$) in the overall sample; 17% greater fiber intake among Filipina women ($p < 0.0001$); 8% greater total caloric intake among Latina women ($p = 0.02$); and 5% lower total caloric intake among non-Hispanic White women ($p = 0.03$). With regard to physical activity, a one-unit increase in ethnic identity score was significantly associated with 11% greater total activity ($p = 0.008$) and 11% greater walking ($p = 0.007$) in the overall sample; and 40% greater total activity ($p = 0.001$) and 35% greater walking ($p = 0.003$) among Latina women.

3. Discussion

Understanding the correlates of healthy eating and physical activity are important in the context of pregnancy, and GDM in particular, given the impact of these behaviors on maternal, fetal, and child health. Results of the present study partially supported our hypothesis that ethnic identity, or strength of attachment to one's ethnic group, is associated with healthful diet and physical activity lifestyle behaviors in a diverse population of pregnant women at high risk for type 2 diabetes. After adjusting for demographic, acculturative, and clinical characteristics, higher ethnic identity was associated with slightly higher fiber and fruit/vegetable intake and modestly greater total physical activity and walking in the overall sample of pregnant women with GDM. Within ethnic/racial groups, ethnic identity was associated with modestly greater fiber intake among Filipina women; slightly lower total caloric intake among non-Hispanic White women; and considerably greater total activity and walking coupled with slightly higher total caloric intake among Latina women. Taken together, we observed few significant associations relative to the total number examined and the clinical significance of most observed differences appears modest, although some effects were

more pronounced in certain groups. For example, for an individual who reported walking at median levels, each unit increase in ethnic identity score was associated with 42 more minutes of walking per week in the overall sample and 2.2 more hours of walking among Latina women (with the latter accompanied by a modest increase of approximately 117 calories per day, in analyses adjusted for BMI). The study's novel results must be interpreted cautiously pending future research. For example, additional work would be needed to clarify net effects on energy balance and obesity, a key diabetes risk factor which individuals control indirectly via diet and activity.

Advancing health equity requires first-generation research to detect and second-generation research to understand disparities, making it possible to conduct third- and fourth-generation research to provide solutions and take action (Thomas et al., 2011). The present study is situated within second-generation efforts to expand our understanding of individual-level, psychosocial determinants of behavioral risk factors for type 2 diabetes. In concert with structural explanations such as equitable access to health care, healthy foods, and health-promoting neighborhood characteristics (e.g., the built and local food environments; Caspi et al., 2012), compelling experimental research suggests an "identity-based psychological explanation" for differences in health behaviors within minority groups (Guendelman et al., 2011). For example, Asian Americans challenged to "prove" their Americanness chose more prototypically American, less healthy foods—higher in fat and calories—than Asian Americans who were not faced with a challenge to their American identity (Guendelman et al., 2011). A strong sense of belonging to one's ethnic group may mitigate such psychological threats, buffering individuals from adopting unhealthy behaviors that have become dominant in US society. It might also promote more traditional, potentially healthier choices such as higher fruit and vegetable intake which is normative in many Latino and Asian cultures (Landrine and Klonoff, 2004); and less saturated fat and more complex carbohydrates, which have been associated with lower levels of acculturation among older Latinos (Bermudez et al., 2000). Observational research in a population-based sample of Asian Americans in California further supports the notion that retaining cultural connections, even with increasing acculturation, may protect against obesity (Wang et al., 2011). Prospective research is needed to determine causal links and disentangle relationships among ethnicity, ethnic identity, acculturation, and lifestyle behaviors, with particular attention to variability across diverse groups.

Limitations. The present study has a number of limitations. First, the cross-sectional design precludes interpretations regarding causality or temporality of observed associations. Second, level of acculturation was assessed only indirectly via indicators such as nativity and years of residence in the US. Third, we examined

Table 2
Dietary behaviors and bivariate correlations with ethnic identity: The Gestational Diabetes' Effects on Moms (GEM) trial.

	Fiber, g		Fruit/vegetables, c		% Calories from fat		Total calories, kcal/day	
	Median (IQR)	r	Median (IQR)	r	Mean (SD)	r	Median (IQR)	r
Overall sample	18.9 (11.6)	0.03	2.6 (2.0)	0.06*	42.3 (6.9)	−0.04	1663.9 (871.1)	−0.02
Black/African American	17.8 (11.0)	−0.07	3.1 (2.3)	0.02	40.4 (6.5)	−0.19	1881.0 (968.7)	0.01
Chinese	19.6 (11.4)	0.08	3.2 (2.4)	0.09	44.8 (7.3)	0.10	1715.2 (731.6)	0.11
Filipina	16.8 (11.3)	0.23†	2.2 (1.9)	0.15	42.4 (6.0)	−0.11	1595.1 (969.2)	0.05
South Asian	23.0 (11.8)	0.08	3.2 (2.0)	0.11	40.4 (7.2)	−0.02	1776.3 (808.0)	−0.02
Asian, other	16.1 (10.7)	0.08	2.5 (2.0)	0.14	41.6 (6.8)	0.01	1458.7 (792.8)	0.07
Latina	17.6 (10.7)	0.12	2.4 (1.8)	0.15*	41.4 (6.8)	0.01	1466.1 (763.2)	0.11
Non-Hispanic White	19.9 (11.1)	0.00	2.6 (1.8)	0.00	43.0 (7.0)	−0.06	1732.5 (864.2)	−0.11*
Multiethnic	17.8 (13.1)	−0.06	2.6 (2.0)	0.01	42.2 (6.2)	−0.01	1708.6 (915.0)	−0.15

Estimates in bold were significant at $p < 0.05$.

* $p < 0.05$.

† $p \leq 0.01$.

Table 3

Physical activity behaviors and bivariate correlations with ethnic identity: The Gestational Diabetes' Effects on Moms (GEM) trial.

	Total activity, MET hours/week		Fitness activity, minutes/week		Walking, hours/week	
	Median (IQR)	<i>r</i>	Median (IQR)	<i>r</i>	Median (IQR)	<i>r</i>
Overall sample	23.6 (27.0)	0.05	135.0 (195.0)	0.07*	6.3 (7.8)	0.04
Black/African American	24.8 (25.5)	−0.10	90.0 (180.0)	0.02	6.0 (8.5)	−0.11
Chinese	18.1 (23.6)	0.10	105.0 (210.0)	0.03	5.1 (5.0)	0.09
Filipina	28.5 (29.6)	0.14	150.0 (180.0)	0.04	8.0 (8.5)	0.15
South Asian	20.3 (24.0)	0.14	180.0 (270.0)	0.25†	4.5 (5.8)	0.05
Asian, other	21.8 (26.6)	0.05	120.0 (180.0)	0.10	6.3 (7.0)	0.05
Latina	24.0 (28.4)	0.11	135.0 (195.0)	0.07	6.3 (7.3)	0.11
Non-Hispanic White	26.1 (27.6)	0.02	135.0 (180.0)	0.03	7.3 (7.8)	0.02
Multietnic	27.0 (36.3)	0.01	135.0 (225.0)	0.05	7.5 (9.0)	0.00

Estimates in bold were significant at $p < 0.05$.* $p < 0.05$.† $p \leq 0.01$.**Table 4**Mixed linear regression^a of ethnic identity and lifestyle behaviors^b: The Gestational Diabetes' Effects on Moms (GEM) trial.

	Fiber, g difference (95% CI)	Fruit/vegetables, c Difference (95% CI)	% Calories from fat Difference (95% CI)	Total calories, kcal/day Difference (95% CI)	Total activity, MET hours/week Difference (95% CI)	Fitness activity, minutes/week Difference (95% CI)	Walking, hours/week Difference (95% CI)
Overall sample	+ 3%† (1 to 5%)	+ 4%† (1 to 8%)	−0.12 (−0.57 to 0.34)	0% (−3 to 2%)	+ 11%† (3 to 21%)	+10% (−1 to 21%)	+ 11%† (3 to 20%)
Chinese	+1% (−4 to 8%)	+2% (−8 to 13%)	0.69 (−0.96 to 2.34)	+6% (−1 to 14%)	+25% (−5 to 63%)	+8% (−20 to 46%)	+23% (−4 to 58%)
Filipina	+ 17%‡ (9 to 25%)	+11% (−3 to 26%)	−0.92 (−2.53 to 0.69)	0% (−10 to 11%)	+23% (−1 to 54%)	+14% (−13 to 49%)	+24% (−4 to 61%)
South Asian	+5% (−2 to 12%)	+8% (−2 to 20%)	−0.82 (−2.59 to 0.96)	−2% (−9 to 7%)	1% (−24 to 35%)	+28% (−8 to 77%)	−2% (−25 to 28%)
Asian, other	−1% (−8 to 7%)	+4% (−8 to 17%)	0.84 (−0.82 to 2.50)	+10% (0 to 22%)	+16% (−10 to 48%)	+30% (−8 to 82%)	+13% (−13 to 45%)
Latina	−1% (−5 to 3%)	+2% (−6 to 10%)	0.12 (−0.97 to 1.21)	+ 8%* (1 to 14%)	+ 40%† (14 to 71%)	+27% (−2 to 66%)	+ 35%† (11 to 64%)
Non-Hispanic White	+3% (0 to 6%)	+1% (−5 to 7%)	−0.36 (−1.25 to 0.52)	− 5%* (−9 to −1%)	+2% (−13 to 18%)	4% (−14 to 26%)	+6% (−9 to 23%)
Multietnic	+3% (−2 to 9%)	+8% (0 to 17%)	−0.09 (−1.26 to 1.07)	−6% (−13 to 1%)	+18% (−6 to 49%)	−1% (−28 to 36%)	+19% (−4 to 48%)

Estimates in bold were significant at $p < 0.05$.* $p < 0.05$.† $p \leq 0.01$.‡ $p \leq 0.001$.^a Mixed linear regression models adjusted for age, education, income (for fiber intake, fruit/vegetable intake, and % of calories from fat only), pre-pregnancy body mass index, nativity/length of residence in US, preferred language, ethnicity/race (in the overall sample only), and total caloric intake (for fiber and fruit/vegetable intake only); medical facility included as random effect.^b Fiber, fruit/vegetables, total calories, total activity, fitness activity, and walking were log transformed, with data shown as relative differences; % calories from fat was non-transformed, with data shown as absolute differences.

ethnic/racial groups separately where possible; restricted sample sizes precluded analyses in certain groups, e.g., Black/African American, Vietnamese, and Native American. In addition, self-identification on the study survey conformed to what are commonly referred to in the US as ethnic (e.g., Latina) and racial groups (e.g., Black/African American). This mode of self-categorization, while informed by institutional recommendations (Institute of Medicine, 2009), may differ from those used in contexts outside the US and is far from unproblematic (Bradby, 2012). Indeed, it is difficult to interpret the findings among non-Hispanic White and multiethnic women without more specific information about their cultural affiliations. As the multiethnic US population continues to expand (Lopez, 2001), and with it the emergent literature on their social and cultural experiences (for a discussion see Rockquemore et al., 2009), larger sample sizes are needed to examine specific ethnic/racial subgroups. Finally, of note, the present study included 104 preliminary and 49 primary comparisons, and some findings may be due to chance. We did not adjust p values for multiple comparisons given in part that the primary hypotheses

were pre-specified; and on the rationale outlined by Rothman and Greenland (1998), Rothman (1990), and Savitz (2003) who observe for example that adjustment, while decreasing type I error, would increase the risk of type II error for associations that are not null (Rothman, 1990).

Strengths. Limitations notwithstanding, study strengths include the large and highly diverse sample, which permitted a number of ethnic-specific analyses and supports generalizability to varied populations of pregnant women with GDM. Access to rich survey and EHR data allowed us to adjust for a range of relevant demographic, acculturative, and clinical factors, and validated survey instruments allowed us to assess a wide range of population-specific lifestyle behaviors. This work expands the empirical research literature on the potential influences of culture and ethnicity/race on lifestyle behaviors (Kittler et al., 2012), research which to date remains limited in the context of pregnancy (Institute of Medicine and National Research Council, 2009).

Conclusions. In sum, stronger ethnic identity is associated with certain healthier dietary and physical activity lifestyle behaviors

among diverse pregnant women at high risk for type 2 diabetes. The present study adds to literature exploring the lived experience of ethnicity/race within a critical segment of the population at high risk for chronic disease, and suggests that a stronger sense of belonging to one's ethnic group may promote certain healthier, more traditional choices within some groups of women with GDM. Prospective research is needed to clarify the temporal nature of these associations and their causal links.

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