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Lifestyle Behaviors and Ethnic Identity among Diverse Women at High Risk for Type 2 Diabetes

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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 1,463 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 < .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 ≤ .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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Keywords

ethnic identity; ethnicity; race; diet; physical activity; gestational diabetes; type 2 diabetes; women's health

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, Casagrande, Geiss, & Cowie, 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 & Schoenborn, 2006; Albright, Steffen, Wilkens, Henderson, & Kolonel, 2008; Flegal, Carroll, Ogden, & Curtin, 2010), physical inactivity (Adams & Schoenborn, 2006), and poor diet (August & 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, Casas, Hingorani, & Williams, 2009). Ethnic and racial minority groups suffer disproportionately from GDM (Ferrara, Kahn, Quesenberry, Riley, & Hedderson, 2004; Hedderson, Darbinian, & Ferrara, 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 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, Oken, & Gillman, 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 (Hedderson et al., 2006; Rosenberg, Garbers, Lipkind, & Chiasson, 2005; Siega-Riz et al., 2009; Stotland, Hopkins, & Caughey, 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 & 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, Fuller-Rowell, & Phinney, 2010; Phinney, 1992; Phinney & 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, Royal, Ampy, & Headings, 2006) and more healthful eating patterns and greater leisure-time physical activity (Siegel, Yancey, & McCarthy, 2000). As an "internal structure" (Phinney & Ong, 2007) that exists regardless of one's immigration status, ethnic identity is related to but distinct from the construct of acculturation (Cuéllar, Nyberg, Maldonado, & Roberts, 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 & Cunningham, 2010; Perez-Escamilla) and deteriorations in lifestyle behaviors (Allen et al., 2014; Ayala, Baquero, & Klinger, 2008; Montez & Eschbach, 2008; Patil, Hadley, & Nahayo, 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.

Materials and Methods

This cross-sectional study was nested within "Gestational Diabetes' Effects on Moms" (GEM), a pragmatic cluster randomized clinical trial conducted from 2011–2013 to compare postpartum type 2 diabetes prevention strategies among women with recent GDM (Ferrara et al., 2014; Ferrara et al., 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).

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 = 1,706 of 2,320 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 = 1,463 of 1,706 [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.).

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 & Ong, 2007). Prior research in the present sample has demonstrated good psychometric properties, including good internal consistency reliability (Cronbach's α ranging from .79 to .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 hour per week, 2 to almost 3 hours 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, Fragala, Pober, Chasan-Taber, & Freedson, 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 minutes 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).

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.

Results

Within the present sample (N = 1,463), 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 ≤ .01), with the exception of income (p = .78).

Valid dietary and physical activity data were obtained from 1,403 and 1,352 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 < .05), with the following exceptions: ethnicity/race and nativity/length of residence in the US were not associated with fitness activity (p values ≥ .12); educational level was not associated with total calories, total activity, or walking (p values ≥ .23); income was not associated with total calories, total activity, fitness activity, or walking (p values ≥ .23); preferred language was not associated with fiber intake, total calories, or fitness activity (p values ≥ .19); and pre-pregnancy BMI was not associated with any outcome (p values ≥ .19) except for fitness activity (p = .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 = .02); higher fiber intake among Filipina women (p = .01); higher fruit/vegetable intake among Latina women (p = .03); and lower total caloric intake among non-Hispanic White women (p = .04). With regard to physical activity, ethnic identity was significantly associated with greater fitness activity in the overall sample (p = .02) and among South Asian women (p = .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 = .004) and 4% greater fruit/vegetable intake (p = .007) in the overall sample; 17% greater fiber intake among Filipina women (p < .0001); 8% greater total caloric intake among Latina women (p = .02); and 5% lower total caloric intake among non-Hispanic White women (p = .03). With regard to physical activity, a one-unit increase in ethnic identity score was significantly associated with 11% greater total activity (p = .008) and 11% greater walking (p = .007) in the overall sample; and 40% greater total activity (p = .001) and 35% greater walking (p = .003) among Latina women.

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, Quinn, Butler, Fryer, & Garza, 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, Sorensen, Subramanian, & Kawachi, 2012), compelling experimental research suggests an "identity-based psychological explanation" for differences in health behaviors within minority groups (Guendelman, Cheryan, & Monin, 2011). For example, Asian Americans challenged to "prove" their American-ness 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 & Klonoff, 2004); and less saturated fat and more complex carbohydrates, which have been associated with lower levels of acculturation among older Latinos (Bermudez, Falcon, & Tucker, 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, Quan, Kanaya, & Fernandez, 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 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, Brunsma, & Delgado, 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, Sucher, & Nelms, 2012), research which to date remains limited in the context of pregnancy (Institute of Medicine & 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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References

Adams PF, Schoenborn CA. Health behaviors of adults: United States, 2002–04. Vital and Health Statistics. 2006; (230):1–140. Series 10: Data from the National Health Survey.

Ainsworth BE, Haskell WL, Whitt MC, Irwin ML, Swartz AM, Strath SJ, … Leon AS. Compendium of physical activities: An update of activity codes and MET intensities. Medicine and Science in Sports and Exercise. 2000; 32(9 Suppl):S498–S504. [PubMed: 10993420]

Albright CL, Steffen AD, Wilkens LR, Henderson BE, Kolonel LN. The prevalence of obesity in ethnic admixture adults. Obesity. 2008; 16(5):1138–1143. DOI: 10.1038/oby.2008.31 [PubMed: 18356848]

Allen JD, Caspi C, Yang M, Leyva B, Stoddard AM, Tamers S, … Sorensen GC. Pathways between acculturation and health behaviors among residents of low-income housing: the mediating role of social and contextual factors. Social Science and Medicine. 2014; 123:26–36. DOI: 10.1016/j.socscimed.2014.10.034 [PubMed: 25462602]

American College of Obstetricians and Gynecologists. Exercise during pregnancy and the postpartum period. ACOG Committee Opinion No. 267. Obstetrics and Gynecology. 2002; 99:171–173. Reaffirmed 2009. [PubMed: 11777528]

American College of Obstetricians and Gynecologists. Committee opinion no. 504: Screening and diagnosis of gestational diabetes mellitus. Obstetrics and Gynecology. 2011; 118:751–753. DOI: 10.1097/AOG.0b013e3182310cc3 [PubMed: 21860317]

August KJ, Sorkin DH. Racial/ethnic disparities in exercise and dietary behaviors of middle-aged and older adults. Journal of General Internal Medicine. 2011; 26(3):245–250. DOI: 10.1007/s11606-010-1514-7 [PubMed: 20865342]

Ayala GX, Baquero B, Klinger S. A systematic review of the relationship between acculturation and diet among Latinos in the United States: implications for future research. Journal of the American Dietetic Association. 2008; 108(8):1330–1344. DOI: 10.1016/j.jada.2008.05.009 [PubMed: 18656573]

Bao W, Tobias DK, Bowers K, Chavarro J, Vaag A, Grunnet LG, … Zhang C. Physical activity and sedentary behaviors associated with risk of progression from gestational diabetes mellitus to type 2 diabetes mellitus: A prospective cohort study. JAMA Intern Med. 2014; 174(7):1047–1055. DOI: 10.1001/jamainternmed.2014.1795 [PubMed: 24841449]

Bellamy L, Casas JP, Hingorani AD, Williams D. Type 2 diabetes mellitus after gestational diabetes: A systematic review and meta-analysis. Lancet. 2009; 373:1773–1779. DOI: 10.1016/s0140-6736(09)60731-5 [PubMed: 19465232]

Bermudez OI, Falcon LM, Tucker KL. Intake and food sources of macronutrients among older Hispanic adults: association with ethnicity, acculturation, and length of residence in the United States. Journal of the American Dietetic Association. 2000; 100(6):665–673. [PubMed: 10863569]

Boucher B, Cotterchio M, Kreiger N, Nadalin V, Block T, Block G. Validity and reliability of the Block98 food-frequency questionnaire in a sample of Canadian women. Public Health Nutrition. 2006; 9(1):84–93. [PubMed: 16480538]

Bradby H. Race, ethnicity and health: the costs and benefits of conceptualising racism and ethnicity. Social Science and Medicine. 2012; 75:955–958. DOI: 10.1016/j.socscimed.2012.03.008 [PubMed: 22521333]

Brezo J, Royal C, Ampy F, Headings V. Ethnic identity and type 2 diabetes health attitudes in Americans of African ancestry. Ethnicity and Disease. 2006; 16(3):624–632. [PubMed: 16937597]

Brown SD, Unger Hu KA, Mevi AA, Hedderson MM, Shan J, Quesenberry CP, Ferrara A. The Multigroup Ethnic Identity Measure-Revised: Measurement invariance across racial and ethnic groups. Journal of Counseling Psychology. 2014; 61(1):154–161. DOI: 10.1037/a0034749 [PubMed: 24188656]

Caspi CE, Sorensen G, Subramanian SV, Kawachi I. The local food environment and diet: A systematic review. Health and Place. 2012; 18(5):1172–1187. DOI: 10.1016/j.healthplace.2012.05.006 [PubMed: 22717379]

Centers for Disease Control and Prevention. National Diabetes Statistics Report: Estimates of Diabetes and Its Burden in the United States, 2014. Atlanta, GA: U.S. Department of Health and Human Services; 2014.

Centers for Disease Control and Prevention. PreventT2 curriculum. 2016 Mar 21. Retrieved from http://www.cdc.gov/diabetes/prevention/lifestyle-program/curriculum.html

Chasan-Taber L, Schmidt MD, Roberts DE, Hosmer D, Markenson G, Freedson PS. Development and validation of a Pregnancy Physical Activity Questionnaire. Medicine and Science in Sports and Exercise. 2004; 36(10):1750–1760. [PubMed: 15595297]

Cuéllar I, Nyberg B, Maldonado RE, Roberts RE. Ethnic identity and acculturation in a young adult Mexican-origin population. Journal of Community Psychology. 1997; 25(6):535–549. DOI: 10.1002/(sici)1520-6629(199711)25:6<535::aid-jcop4>3.0.co;2-o

Ferrara A, Hedderson MM, Albright CL, Brown SD, Ehrlich SF, Caan BJ, … Quesenberry CP Jr. A pragmatic cluster randomized clinical trial of diabetes prevention strategies for women with gestational diabetes: Design and rationale of the Gestational Diabetes' Effects on Moms (GEM) study. BMC Pregnancy Childbirth. 2014; 14(1):21.doi: 10.1186/1471-2393-14-21 [PubMed: 24423410]

Ferrara A, Hedderson MM, Brown SD, Albright CL, Ehrlich SF, Tsai AL, … Quesenberry CP Jr. The comparative effectiveness of diabetes prevention strategies to reduce postpartum weight retention in women with gestational diabetes: The Gestational Diabetes' Effects on Moms (GEM) cluster randomized controlled trial. Diabetes Care. 2016; 39:65–74. DOI: 10.2337/dc15-1254 [PubMed: 26657945]

Ferrara A, Kahn HS, Quesenberry CP, Riley C, Hedderson MM. An increase in the incidence of gestational diabetes mellitus: Northern California, 1991–2000. Obstetrics and Gynecology. 2004; 103:526–533. DOI: 10.1097/01.aog.0000113623.18286.20 [PubMed: 14990417]

Flegal KM, Carroll MD, Ogden CL, Curtin LR. Prevalence and trends in obesity among US adults, 1999–2008. JAMA. 2010; 303(3):235–241. DOI: 10.1001/jama.2009.2014 [PubMed: 20071471]

Geiss LS, Wang J, Cheng YJ, Thompson TJ, Barker L, Li Y, … Gregg EW. Prevalence and incidence trends for diagnosed diabetes among adults aged 20 to 79 years, United States, 1980–2012. JAMA. 2014; 312(12):1218–1226. DOI: 10.1001/jama.2014.11494 [PubMed: 25247518]

Gordon, NP. Similarity of the Adult Kaiser Permanente Membership in Northern California to the Insured and General Population in Northern California: Statistics from the 2011–12 California Health Interview Survey. 2015 Jun. Retrieved from http://www.dor.kaiser.org/external/chis_non_kp_2011/

Guendelman MD, Cheryan S, Monin B. Fitting in but getting fat: Identity threat and dietary choices among U.S. immigrant groups. Psychological Science. 2011; 22(7):959–967. DOI: 10.1177/0956797611411585 [PubMed: 21653909]

Hedderson MM, Darbinian JA, Ferrara A. Disparities in the risk of gestational diabetes by race-ethnicity and country of birth. Paediatric and Perinatal Epidemiology. 2010; 24(5):441–448. DOI: 10.1111/j.1365-3016.2010.01140.x [PubMed: 20670225]

Hedderson MM, Weiss NS, Sacks DA, Pettitt DJ, Selby JV, Quesenberry CP, Ferrara A. Pregnancy weight gain and risk of neonatal complications: Macrosomia, hypoglycemia, and hyperbilirubinemia. Obstetrics and Gynecology. 2006; 108(5):1153–1161. DOI: 10.1097/01.aog.0000242568.75785.68 [PubMed: 17077237]

Institute of Medicine. Race, Ethnicity, and Language Data: Standardization for Health Care Quality Improvement. Washington, DC: The National Academies Press; 2009.

Institute of Medicine. How Far Have We Come in Reducing Health Disparities?: Progress Since 2000: Workshop Summary. Washington, DC: The National Academies Press; 2012.

Institute of Medicine, & National Research Council. Weight gain during pregnancy: Reexamining the guidelines. Washington DC: The National Academic Press; 2009.

Kim C. Maternal outcomes and follow-up after gestational diabetes mellitus. Diabetic Medicine. 2014; 31(3):292–301. DOI: 10.1111/dme.12382 [PubMed: 24341443]

Kittler, PG.; Sucher, KP.; Nelms, MN. Food and Culture. 6. Belmont, CA: Wadsworth Publishing; 2012.

Knowler WC, Barrett-Connor E, Fowler SE, Hamman RF, Lachin JM, Walker EA. … Diabetes Prevention Program Research Group. Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. New England Journal of Medicine. 2002; (6):393–403. DOI: 10.1056/NEJMoa012512 [PubMed: 11832527]

Landrine H, Klonoff EA. Culture change and ethnic-minority health behavior: An operant theory of acculturation. Journal of Behavioral Medicine. 2004; 27(6):527–555. [PubMed: 15669443]

Lopez, A. The population of two or more races in California (Report No. 4). Stanford, CA: 2001. Retrieved fromhttp://ccsre.stanford.edu/reports/report_4.pdf

Menke A, Casagrande S, Geiss L, Cowie CC. Prevalence of and trends in diabetes among adults in the United States, 1988–2012. JAMA. 2015; 314(10):1021–1029. DOI: 10.1001/jama.2015.10029 [PubMed: 26348752]

Metzger BE. Summary and recommendations of the Third International Workshop-Conference on Gestational Diabetes Mellitus. Diabetes. 1991; 40(Suppl 2):197–201. [PubMed: 1748259]

Montez JK, Eschbach K. Country of birth and language are uniquely associated with intakes of fat, fiber, and fruits and vegetables among Mexican-American women in the United States. Journal of the American Dietetic Association. 2008; 108(3):473–480. DOI: 10.1016/j.jada.2007.12.008 [PubMed: 18313430]

Ong AD, Fuller-Rowell TE, Phinney JS. Measurement of ethnic identity: Recurrent and emergent issues. Identity: An International Journal of Theory and Research. 2010; 10:39–49. DOI: 10.1080/15283481003676226

Oza-Frank R, Cunningham SA. The weight of US residence among immigrants: A systematic review. Obesity Reviews. 2010; 11(4):271–280. DOI: 10.1111/j.1467-789X.2009.00610.x [PubMed: 19538440]

Patil CL, Hadley C, Nahayo PD. Unpacking dietary acculturation among new Americans: Results from formative research with African refugees. Journal of Immigrant and Minority Health. 2009; 11(5): 342–358. DOI: 10.1007/s10903-008-9120-z [PubMed: 18253832]

Perez-Escamilla R. Acculturation, nutrition, and health disparities in Latinos. American Journal of Clinical Nutrition. 2011; 93(5):1163S–167S. DOI: 10.3945/ajcn.110.003467 [PubMed: 21367946]

Phinney JS. The Multigroup Ethnic Identity Measure: A new scale for use with diverse groups. Journal of Adolescent Research. 1992; 7:156–176. DOI: 10.1177/074355489272003

Phinney JS, Ong AD. Conceptualization and measurement of ethnic identity: Current status and future directions. Journal of Counseling Psychology. 2007; 54:271–281. DOI: 10.1037/0022-0167.54.3.271

Physical Activity Guidelines Advisory Committee. Physical Activity Guidelines Advisory Committee Report, 2008. Washington, DC: U.S. Department of Health and Human Services; 2008.

Ponterotto JG, Mallinckrodt B. Introduction to the special section on racial and ethnic identity in counseling psychology: Conceptual and methodological challenges and proposed solutions. Journal of Counseling Psychology. 2007; 54:219–223. DOI: 10.1037/0022-0167.54.3.219

Ratner RE, Christophi CA, Metzger BE, Dabelea D, Bennett PH, Pi-Sunyer X, … Kahn SE. Prevention of diabetes in women with a history of gestational diabetes: Effects of metformin and lifestyle interventions. Journal of Clinical Endocrinology and Metabolism. 2008; 93(12):4774–4779. DOI: 10.1210/jc.2008-0772 [PubMed: 18826999]

Roberts DE, Fragala MS, Pober D, Chasan-Taber L, Freedson PS. Energy cost of physical activities during pregnancy. Medicine and Science in Sports and Exercise. 2002; 34:S124.

Rockquemore KA, Brunsma DL, Delgado DJ. Racing to theory or retheorizing race? Understanding the struggle to build a multiracial identity theory. Journal of Social Issues. 2009; 65:13–34. DOI: 10.1111/j.1540-4560.2008.01585.x

Rosenberg TJ, Garbers S, Lipkind H, Chiasson MA. Maternal obesity and diabetes as risk factors for adverse pregnancy outcomes: differences among 4 racial/ethnic groups. American Journal of Public Health. 2005; 95(9):1545–1551. DOI: 10.2105/ajph.2005.065680 [PubMed: 16118366]

Rothman KJ. No adjustments are needed for multiple comparisons. Epidemiology. 1990; 1(1):43–46. [PubMed: 2081237]

Rothman, KJ.; Greenland, S. Modern Epidemiology. 2. Boston: Little, Brown & Co; 1998.

Savitz, DA. Interpreting epidemiologic evidence: Strategies for study design and analysis. New York: Oxford University Press; 2003.

Siega-Riz AM, Viswanathan M, Moos MK, Deierlein A, Mumford S, Knaack J, … Lohr KN. A systematic review of outcomes of maternal weight gain according to the Institute of Medicine recommendations: birthweight, fetal growth, and postpartum weight retention. American Journal of Obstetrics and Gynecology. 2009; 201(4):339 e331–314. DOI: 10.1016/j.ajog.2009.07.002 [PubMed: 19788965]

Siegel JM, Yancey AK, McCarthy WJ. Overweight and depressive symptoms among African-American women. Preventive Medicine: An International Journal Devoted to Practice and Theory. 2000; 31:232–240. DOI: 10.1006/pmed.2000.0712

Stotland NE, Hopkins LM, Caughey AB. Gestational weight gain, macrosomia, and risk of cesarean birth in nondiabetic nulliparas. Obstetrics and Gynecology. 2004; 104(4):671–677. DOI: 10.1097/01.AOG.0000139515.97799.f6 [PubMed: 15458884]

Stuebe AM, Oken E, Gillman MW. Associations of diet and physical activity during pregnancy with risk for excessive gestational weight gain. American Journal of Obstetrics and Gynecology. 2009; 201(1):58, e51–58. DOI: 10.1016/j.ajog.2009.02.025 [PubMed: 19467640]

Subar AF, Thompson FE, Kipnis V, Midthune D, Hurwitz P, McNutt S, … Rosenfeld S. Comparative validation of the Block, Willett, and National Cancer Institute Food Frequency Questionnaires: The Eating at America's Table study. American Journal of Epidemiology. 2001; 154:1089–1099. [PubMed: 11744511]

Thomas SB, Quinn SC, Butler J, Fryer CS, Garza MA. Toward a fourth generation of disparities research to achieve health equity. Annual Review of Public Health. 2011; 32:399–416. DOI: 10.1146/annurev-publhealth-031210-101136

Tobias DK, Hu FB, Chavarro J, Rosner B, Mozaffarian D, Zhang C. Healthful dietary patterns and type 2 diabetes mellitus risk among women with a history of gestational diabetes mellitus. Archives of Internal Medicine. 2012; 172(20):1566–1572. DOI: 10.1001/archinternmed.2012.3747 [PubMed: 22987062]

Wang S, Quan J, Kanaya AM, Fernandez A. Asian Americans and obesity in California: A protective effect of biculturalism. Journal of Immigrant and Minority Health. 2011; 13(2):276–283. DOI: 10.1007/s10903-010-9426-5 [PubMed: 21153765]

Xiang AH, Li BH, Black MH, Sacks DA, Buchanan TA, Jacobsen SJ, Lawrence JM. Racial and ethnic disparities in diabetes risk after gestational diabetes mellitus. Diabetologia. 2011; 54(12):3016–3021. DOI: 10.1007/s00125-011-2330-2 [PubMed: 22016046]

Highlights

- Gestational diabetes is common and confers high risk for type 2 diabetes.
- Diet and physical activity are modifiable diabetes risk factors shaped by culture.
- Ethnic identity was associated with some diet and activity lifestyle behaviors.
- Associations varied across diverse ethnic/racial groups.
- Research should explore causal links among ethnic identity and lifestyle behaviors.

Table 1

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

	n (%)
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	
≤ High school	187 (12.8)
Some college, 2-year college, or technical school	495 (33.8)
≥ 4-year college	779 (53.3)
Missing	2 (0.1)
Income	
< $50,000	383 (26.2)
$50,000 to $99,999	527 (36.0)
≥ $100,000	479 (32.7)
Missing	74 (5.1)
Preferred language	
English	1,358 (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.

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)	.03	**2.6 (2.0)**	**.06** *	42.3 (6.9)	−.04	1,663.9 (871.1)	−.02
Black/African American	17.8 (11.0)	−.07	3.1 (2.3)	.02	40.4 (6.5)	−.19	1,881.0 (968.7)	.01
Chinese	19.6 (11.4)	.08	3.2 (2.4)	.09	44.8 (7.3)	.10	1,715.2 (731.6)	.11
Filipina	**16.8 (11.3)**	**.23** †	2.2 (1.9)	.15	42.4 (6.0)	−.11	1,595.1 (969.2)	.05
South Asian	23.0 (11.8)	.08	3.2 (2.0)	.11	40.4 (7.2)	−.02	1,776.3 (808.0)	−.02
Asian, other	16.1 (10.7)	.08	2.5 (2.0)	.14	41.6 (6.8)	.01	1,458.7 (792.8)	.07
Latina	17.6 (10.7)	.12	**2.4 (1.8)**	**.15** *	41.4 (6.8)	.01	1,466.1 (763.2)	.11
Non-Hispanic White	19.9 (11.1)	.00	2.6 (1.8)	.00	43.0 (7.0)	−.06	**1,732.5 (864.2)**	**−.11** *
Multiethnic	17.8 (13.1)	−.06	2.6 (2.0)	.01	42.2 (6.2)	−.01	1,708.6 (915.0)	−.15

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

* $p < .05$

† $p \leq .01$

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*)	***r***	**Median (*IQR*)**	***r***	**Median (*IQR*)**	***r***
Overall sample	23.6 (27.0)	.05	**135.0 (195.0)**	**.07** *	6.3 (7.8)	.04
Black/African American	24.8 (25.5)	−.10	90.0 (180.0)	.02	6.0 (8.5)	−.11
Chinese	18.1 (23.6)	.10	105.0 (210.0)	.03	5.1 (5.0)	.09
Filipina	28.5 (29.6)	.14	150.0 (180.0)	.04	8.0 (8.5)	.15
South Asian	20.3 (24.0)	.14	**180.0 (270.0)**	**.25** †	4.5 (5.8)	.05
Asian, other	21.8 (26.6)	.05	120.0 (180.0)	.10	6.3 (7.0)	.05
Latina	24.0 (28.4)	.11	135.0 (195.0)	.07	6.3 (7.3)	.11
Non-Hispanic White	26.1 (27.6)	.02	135.0 (180.0)	.03	7.3 (7.8)	.02
Multiethnic	27.0 (36.3)	.01	135.0 (225.0)	.05	7.5 (9.0)	.00

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

* $p < .05$

† $p \leq .01$

Table 4

Mixed linear regression[a] of ethnic identity and lifestyle behaviors[b]: The Gestational Diabetes' Effects on Moms (GEM) trial

	Fiber, g	Fruit/vegetables, c	from % Calories fat	Total calories, kcal/day	Total activity, MET hours/week	Fitness activity, minutes/week	Walking, hours/week
	Difference (95% *CI*)	Difference (95% *CI*)	(95% *CI*)	Difference (95% *CI*)	Difference (95% *CI*)	Difference (95% *CI*)	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%)
Multiethnic	+ 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%)

[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.

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

* $p < .05$

† $p \leq .01$

‡ $p \leq .001$