SYMPOSIUM
Health Disparities in Early Nutrition: Where the Problem Begins?

Physical Activity and Dietary Behaviors Associated With Weight Gain and Impaired Glucose Tolerance Among Pregnant Latinas[1–3]

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ABSTRACT

Pregnancy has been proposed as a critical period for the development of subsequent maternal overweight and/or obesity. Excessive gestational weight gain is, in turn, associated with maternal complications such as cesarean delivery, hypertension, preeclampsia, impaired glucose tolerance, and gestational diabetes mellitus. Although there is substantial evidence that targeting at-risk groups for type 2 diabetes prevention is effective if lifestyle changes are made, relatively little attention has been paid to the prevention of excessive gestational weight gain and impaired glucose tolerance during pregnancy. Latinos are the largest minority group in the United States, with the highest birth and immigration rates of any minority group and are disproportionately affected by overweight and obesity. However, due to cultural factors, socioeconomic factors, and language barriers, Latinos have had limited access to public health interventions that promote healthy lifestyles. Therefore, the objective of this article is to review the scientific evidence regarding the association between physical activity, dietary behaviors, and gestational weight gain and impaired glucose tolerance among Latinas. A second objective is to discuss how lifestyle interventions including weight management through diet and exercise could be successful in reducing the risk of excessive gestational weight gain and gestational diabetes mellitus. Finally, recommendations are provided for future lifestyle intervention programs in this population with a focus on translation and dissemination of research findings. *Adv. Nutr. 3: 108–118, 2012.*

Introduction

Pregnancy has been proposed as a critical period for the development of subsequent maternal overweight and/or obesity (1,2). Excessive gestational weight gain is, in turn, associated with maternal complications such as cesarean delivery, hypertension, preeclampsia, impaired glucose tolerance, and gestational diabetes mellitus (3,4). Recent reports indicate a relationship between high gestational weight gain, an abnormal metabolic environment in utero, and increased risk of large-for-gestational-age infants, fetal and neonatal death (5), and subsequent childhood adiposity and morbidity (6).

Latinos are the largest minority group in the United States, with the highest birth and immigration rates of any minority group (7). It is estimated that by 2050, Latinas will comprise 24% of the female population in the United States (8). Latino children represent the largest minority group of U.S. children (11.6 million or 1 of every 6 children). Latinos are disproportionately affected by overweight and obesity (9,10). Latina mothers are more likely to begin their pregnancies overweight or obese (11,12) compared with non-Latina white mothers, with almost half entering pregnancy in these categories (13–15). Latino boys are the most overweight, and Latina girls are the second most overweight racial/ethnic group in the United States (16).

Latinos include people of different national origin, race, education, and health status. There are substantial health disparities between Latina subgroups, and these differ by health measure and national origin. For example, recent

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studies have observed better chronic disease profiles among Cubans and Mexicans, but discernible health disparities among Puerto Ricans (17) including higher rates of infant mortality and low birth weight compared with other Latina subgroups (18). Furthermore, distinct socioeconomic differences exist by subgroups reflecting important differences in access to health services. Therefore, combined analyses of all Latinas in national data sets can mask critical differences among Latina subgroups.

Studies have observed high rates of gestational weight gain both below and above the recommended guidelines among Latinas with, for example, 52% of overweight and 75% of obese Latina women exceeding Institute of Medicine (IOM) guidelines (19) and 19–29% failing to achieve guidelines (15,20–22). Recent studies suggest that the number of Latinas with both increased BMI and excessive gestational weight gain is increasing over time (22,23). This is critical because gestational diabetes and macrosomia are more likely to develop in obese Latinas than their obese African American and white counterparts (24). In addition, at each BMI level, Latinos have a higher prevalence of diabetes than non-Latino whites (9,25,26).

Although there is substantial evidence that targeting at-risk groups for type 2 diabetes prevention is effective if lifestyle changes are made, relatively little attention has been paid to the prevention of excessive gestational weight gain and impaired glucose tolerance during pregnancy. However, due to cultural factors, socioeconomic factors, and language barriers, Latinos have had limited access to public health interventions that promote healthy lifestyles. Therefore, the objective of this article is to review the scientific evidence regarding the association between physical activity, dietary behaviors, and gestational weight gain and impaired glucose tolerance among Latinas. A second objective is to discuss how lifestyle interventions including weight management through diet and exercise could be successful in reducing the risk of excessive gestational weight gain and gestational diabetes mellitus. Finally, recommendations are provided for future lifestyle intervention programs in this population with a focus on translation and dissemination of research findings.

Behavioral risk factors among pregnant Latinas

Latinos are the most physically inactive ethnic group in the United States (27,28). For example, based on data from the Behavioral Risk Factor Surveillance System, Latinas were ~40% less likely to meet the American College of Obstetricians and Gynecologists (ACOG) recommendation for moderate activity in pregnancy (29) compared non-Latina whites (30). Latino children have a higher prevalence of obesity-related risk factors prenatally, during infancy, and early childhood compared with non-Latino white children (12,31–33). Latino infants have lower rates of exclusive breastfeeding, are less likely to sleep >12 h/d, have more rapid weight gain, and are more likely to be fed solid foods at younger than 4 mo of age (12). Latino children have higher levels of TV viewing (34), consumption of sugar-sweetened beverages (31), and fast food (32) and lower levels of physical activity (33) than non-Latino white children.

Both behavioral risk factors and health status vary widely among Latino subgroups. Latinos from the Caribbean islands (i.e., Puerto Ricans and Dominicans) are the second largest group of Latinos living in the United States (7), the fastest growing subgroup, and the largest Latino subgroup in the northeast United States (35,36). Compared with other Latinos, Puerto Ricans and Dominicans have the greatest health disparities, the least education, and the lowest incomes (17) and exhibit more adverse behaviors such as poor nutrition (37). Latinas of Puerto Rican descent also have an increased risk of low birth weight and poor neonatal health outcomes compared with other Latina groups (38). In addition, exercise patterns vary markedly among U.S. Latina women by country of origin, with 56.7% of Puerto Rican women reporting no leisure time physical activity and rates ranging from 50.2% of Mexican-American women to 71.2% of Cuban women reporting no leisure time physical activity (39,40).

Therefore, promoting exercise, a healthy diet, and appropriate gestational weight gain among pregnant Latinas is particularly important.

Knowledge, attitudes, and beliefs regarding dietary behaviors and gestational weight gain among pregnant Latinas

Previous research has suggested that attitudes, beliefs, weight gain advice, and social support are associated with a risk of exceeding or not achieving recommended weight gain guidelines (41). However, few studies have assessed pregnancy weight gain–related attitudes, beliefs, practices, or knowledge about current weight gain recommendations among Latinas (42–44). A previous study among 46 Mexican adolescents found that important predictors of a healthy diet during pregnancy were maternal concern about the well-being of the baby, role of motherhood, and the family support system (44). In this study, Gutierrez et al. found that with acculturation, adolescents lost most of their traditional Mexican cultural beliefs related to pregnancy, and their attitudes about weight gain were more negative. There was no relationship between nutrition knowledge and adequacy of prenatal diet. Instead, pregnant Mexican adolescents in this sample reported choosing the traditional foods thought most nutritious by parents and family. Similarly, using in-depth interviews of 10 Mexican females and 10 people who influenced them, Thornton et al. (42) found that husbands and female relatives of women were primary sources of support for weight- and diet-related beliefs during pregnancy.

Tovar et al. (46) conducted 4 focus groups among Latina prenatal care patients (predominantly Puerto Rican) stratified by level of acculturation and BMI). Gestational weight gain advice varied widely and was not consistent with the 1990 IOM guidelines. For example, women reported receiving advice about gestational weight gain largely from nutritionists and family members rather than from physicians.

Women reported that family members supported increased gestational weight gain based on the belief that this would lead to a healthier baby. This differed by level of acculturation, with less acculturated women receiving more advice from family members than highly acculturated women. The majority of overweight/obese women reported not receiving any recommendations for weight gain during pregnancy from physicians. In general, women did not consider standard weight gain recommendations to be important and thought they should be individualized. Such findings in Latinas should inform behavior change strategies designed to achieve gestational weight gain guidelines.

Knowledge, attitudes, and beliefs regarding exercise among pregnant Latinas

Despite data indicating that Latinas are significantly less likely to meet ACOG recommendations for moderate activity in pregnancy compared with non-Latina whites (29), few studies have evaluated knowledge, attitudes, and beliefs regarding exercise among pregnant Latinas. These studies have consistently identified social isolation, safety concerns, and cultural norms as barriers to physical activity in this ethnic group.

In a focus group series among Mexican women in Detroit, Michigan, Kieffer et al. (43) found that barriers to exercise included lack of knowledge about how to exercise safely while pregnant, unsafe streets, and physical symptoms and concerns. Similarly, Mudd et al. (47) evaluated perceptions of safety among 296 pregnant women (20.6% Latina) recruited from 9 clinics in Grand Rapids, Michigan. In this sample, Latina ethnicity, low income, nonparticipation in moderate or vigorous physical activity in the past month, and not meeting ACOG recommendations were each associated with increased odds of feeling unsafe and unsure regarding exercise in pregnancy. Such concerns may be due to the failure of prenatal care providers to communicate information and current guidelines about the safety of moderate physical activity, or, alternatively, these concerns may stem from cultural influences.

The notion of a cultural norm encouraging sedentary behavior during pregnancy is also supported by findings in several other studies. For example, in focus groups conducted among Mexican women, women identified norms that emphasized the need for rest during pregnancy to protect the baby (42). In this study, social isolation, a lack of social support from husbands, a lack of friends with whom to exercise, and lack of child care were also identified as barriers to exercise (42). In a large cohort of predominantly Puerto Rican prenatal care patients, being born in a foreign country was inversely associated with physical activity during pregnancy, providing further support for the existence of culturally based norms regarding exercise during pregnancy (48).

In addition to identifying barriers to and facilitators of exercise, effective promotion of exercise among pregnant women also requires a sense of the relative importance of these factors. Marquez et al. (49) conducted 3 focus groups among 20 pregnant Puerto Rican and Dominican women and non-Latina white women. Both Latina and non-Latina white women identified physical limitations and restrictions, lack of resources, lack of energy, and lack of time as powerful barriers to exercise, whereas social support and access to resources were identified as powerful facilitators of exercise. Latinas additionally identified information and proper diet as powerful facilitators. In focus groups conducted among racially and ethnically diverse pregnant women in North Carolina, Evenson et al. (50) found that lack of social support was identified as the primary interpersonal barrier to exercise in all 4 Latina focus groups, but identified in only 1 of the 4 white groups and in only 2 of the 5 African-American groups.

In light of these findings, intervention programs designed for pregnant women should facilitate social support, provide information and resources, and promote the short- and long-term benefits of exercise during pregnancy.

Observational studies of physical activity, dietary behaviors, and gestational weight gain among pregnant Latinas

Previous studies found that women who were less physically active during pregnancy than before pregnancy were more likely to exceed IOM guidelines for gestational weight gain (15). Such findings have been consistent for both vigorous activity and walking (51,52). Walking has also been associated with reduced postpartum weight retention (53). In terms of dietary behaviors, observational studies have demonstrated a relationship among energy intake, high fat intake, high intake of sweets, and low fiber intake and excessive gestational weight gain (51,54–56), and some studies have shown that dietary intake of certain types of foods may also influence gestational weight gain, but evidence is conflicting (51). These findings suggest that targeting healthy eating and modest physical activity during pregnancy may help to improve compliance with gestational weight gain guidelines and reduce postpartum weight retention (57).

Intervention studies of physical activity, dietary behaviors, and gestational weight gain among pregnant Latinas

Walking is the most popular form of exercise in the prenatal and postpartum periods (58), and moderate intensity physical activity such as brisk walking between 150 and 250 min/wk has been found to improve weight loss in trials among nonpregnant populations who used moderate diet restriction (59). During pregnancy, a group of early small, nonrandomized, prospective studies among athletes who maintained aerobic exercise during pregnancy were consistent in reporting decreased mean gestational weight gain, ranging from 1.7 to 3.3 kg (60–62).

However, with few exceptions (63), more recent randomized and nonrandomized, controlled trials designed to decrease excessive gestational weight gain (42,63–74) have demonstrated minimal effectiveness and were limited to predominantly non-Latino white populations (75). One of

the few trials to yield statistically significant findings was limited to low-income women only (70). The content of the intervention in the majority of studies was dietetic counseling alone, whereas the majority of the trials that included exercise observed the suggestion of a protective effect but were often limited by the use of historical control groups or insufficient power (64,70,72). A meta-analysis of trials with physical activity as the intervention found less gestational weight gain in the intervention group compared with the control group (−0.61 kg; 95% CI: −1.17 to −0.06) (76).

In a recent large study, Phelan et al. (63) randomized 401 pregnant women (~20% Latina) to a low-intensity behavioral intervention or to standard care. The intervention included 1 face-to-face visit; weekly mailed materials that promoted appropriate weight gain, healthy eating, and exercise; individual graphs of weight gain; and telephone-based feedback. Normal weight women in the intervention arm were less likely to exceed IOM recommendations for gestational weight gain compared with women in the standard care group (40.2% vs. 52.1%, $P = 0.003$); however, the intervention did not have a significant impact on gestational weight gain among overweight/obese women.

Intervention studies of physical activity, dietary behaviors, and postpartum weight loss among Latinas

Weight loss interventions among nonpregnant adults have shown that multifaceted interventions compared with stand-alone dietary advice, exercise modification, or behavioral strategies yield significant improvements in health outcomes and weight loss (77–79). Similarly, weight loss interventions focused on the postpartum period (80–82) suggested positive effects of a lifestyle intervention on weight loss (83). However, these studies included few Latina women, and the format and intensity of lifestyle pregnancy interventions designed to target postpartum weight loss remain uncertain (84).

Observational studies of physical activity and impaired glucose tolerance among pregnant Latinas

Previous observational epidemiologic studies have suggested that prepregnancy physical activity may have a protective role in the development of impaired glucose tolerance or gestational diabetes mellitus (85–90). Studies examining activity during pregnancy found similar results, although somewhat less consistently, with several studies (89,91) observing a significant protective effect and others supporting this trend, but not significantly so (86,87,92). A recent meta-analysis indicated a 55% lower risk of gestational diabetes mellitus for women in the highest prepregnancy physical activity quantile compared with those in the lowest quantile (pooled OR = 0.45, 95% CI: 0.28–0.75; $P = 0.002$) (93). The same-meta analysis indicated a 24% lower risk of gestational diabetes mellitus for women in the highest activity group during pregnancy compared with those in the lowest activity group (pooled OR = 0.76, 95% CI: 0.70–0.83; $P < 0.0001$) (93). However, only 1 of these previous studies was conducted in a Latina population.

The Latina Gestational Diabetes Mellitus Study was a prospective cohort study of household/caregiving, occupational, sports/exercise, and active living habits and the risk of gestational diabetes mellitus among 1006 Latina (predominantly Puerto Rican) prenatal care patients in western Massachusetts conducted from 2000 to 2004 (86). Prepregnancy, early pregnancy, and mid-pregnancy physical activity was assessed using the Kaiser Physical Activity Survey (94). After controlling for age and prepregnancy BMI, women in the highest quartile of pre- (OR = 0.2, 95% CI: 0.1–0.8; $P_{trend} = 0.03$) and mid- (OR = 0.2, 95% CI: 0.1–0.8; $P_{trend} = 0.004$) pregnancy household/caregiving activities as well as mid-pregnancy sports/exercise (OR = 0.1, 95% CI: 0.0–0.7; $P_{trend} = 0.12$) had a reduced risk of gestational diabetes mellitus compared with women in the lowest quartile (86). These findings suggest that exercise, even at levels below recommended guidelines, may be associated with a decreased risk of gestational diabetes mellitus among Latinas.

Observational studies of dietary behaviors and impaired glucose tolerance among pregnant Latinas

Observational epidemiologic studies of dietary behaviors and risk of impaired glucose tolerance or gestational diabetes mellitus are relatively sparse. Early studies were often limited by cross-sectional or retrospective designs, failed to adjust for other components of the diet, and could not determine whether dietary composition was more important than prepregnancy BMI in terms of gestational diabetes mellitus risk (95). These studies suggested that macronutrients, such as higher intake of saturated fat and lower intake of polyunsaturated fat, were associated with increased incidence or recurrence of gestational diabetes mellitus, but not consistently so (96–99).

More recent prospective studies have suggested that higher intake of fat and lower intake of carbohydrates are associated with increased risk of gestational diabetes mellitus independent of prepregnancy BMI (95,98), but again findings have not been consistent (100). Inconsistent findings have also been observed for fiber (96,97,100–102) and glycemic load. For example, glycemic load before pregnancy was associated with increased risk of gestational diabetes mellitus (88), whereas glycemic load during early pregnancy was not associated with risk (100). High cholesterol intake both before and during pregnancy has been associated with increased risk of gestational diabetes mellitus (103).

In terms of micronutrients, lower plasma vitamin C (104) and vitamin D (105) in early pregnancy have been significantly associated with increased gestational diabetes mellitus risk. Some studies have shown that dietary intake of certain types of foods, such as sugar-sweetened cola and eggs, may also influence gestational diabetes mellitus risk, but evidence is sparse (103,106). A prepregnancy Western dietary pattern (i.e., high intake of red meat, processed meat, refined grain products, sweets, French fries, and pizza) has been associated with increased risk of

gestational diabetes mellitus compared with a prudent dietary pattern (107).

In one of the few studies conducted among Latinas, Tovar et al. (108) examined the association between dietary factors and abnormal glucose tolerance among women from the Latina Gestational Diabetes Mellitus Study, a prospective cohort of Latina prenatal care patients. The authors found that lower levels of saturated fatty acids and energy-dense snack foods and higher levels of fiber and polyunsaturated: saturated fat ratio were significantly associated with decreased risk of abnormal glucose tolerance, independent of gestational weight gain. Because beans, which are high in fiber, are the main source of complex carbohydrates in traditional Caribbean Latino diets, such findings could have important implications for intervention studies in Latinas (108). No significant associations were observed between total dietary fat, polyunsaturated fatty acids, monounsaturated fatty acids, glycemic load, or servings of fruits and vegetables and abnormal glucose tolerance. Differences in study findings could be due in part to differences in race/ethnicity between study samples.

Observational studies of gestational weight gain and impaired glucose tolerance among pregnant Latinas

Few studies have examined the relationship between gestational weight gain and impaired glucose tolerance among Latina women. However, recent studies in Latina as well as non-Latina white women suggest that excessive gestational weight gain in early pregnancy may be associated with increased risk of gestational diabetes mellitus as well as milder forms of abnormal glucose tolerance, particularly in overweight and obese women (3,4,108–113).

In a prospective cohort study among 813 Latina (predominantly Puerto Rican) prenatal care patients in Massachusetts, Tovar et al. (108) found that exceeding gestational weight gain guidelines based on the 1990 IOM recommendations was not associated with increased risk of abnormal glucose tolerance in the overall sample. However, among women with class II and III obesity (BMI $\geq$35 kg/m^2), in women with a high rate of weight gain (>0.30 kg/wk) or who exceeded target weight gain, abnormal glucose tolerance was more likely to develop compared with women who gained within IOM ranges (OR = 4.2, 95% CI: 1.1–16.0 and OR = 3.2, 95% CI: 1.0–10.5, respectively). Similarly, in a prospective cohort study of 952 pregnant black and white women, Saldana et al. (109) found that gestational weight gain was associated with impaired glucose tolerance among overweight women but not among women of other BMI categories. In this group, women who gained twice the recommended amount of weight had a 2-fold increased risk of impaired glucose tolerance compared with women who gained the recommended level.

In contrast, in a study among Latinas in the New Mexico Pregnancy Risk Assessment Monitoring System, Walker et al. (113) found that women diagnosed with gestational diabetes mellitus were 1.6 times more likely to report inadequate weight gain (95% CI: 1.05, 2.37) compared with those without gestational diabetes mellitus. Brawarsky et al. (114) observed similar findings among participants in a prospective cohort study in San Francisco (36% Latina women). In this study, factors associated with an increased risk of inadequate weight gain included chronic or gestational diabetes versus no diabetes (OR = 2.70, $p < 0.05$). Kieffer et al. (110) conducted a cross-sectional study among 552 Latinas (predominantly Mexican Americans) and found that gestational weight gain up to 28 wk was not associated with gestational diabetes mellitus (OR = 1.02, 95% CI: 0.985–1.061). The authors also did not observe significant interactions between prepregnancy BMI and weight gain and risk of gestational diabetes mellitus. Such findings could be attributable to reverse causation because gestational diabetes mellitus may be treated with dietary changes resulting in a lower weight gain in late pregnancy, as suggested by Catalano et al. (115). On the other hand, it is also possible that common factors such as weak insulin resistance present from the beginning of pregnancy may increase the risk of both gestational diabetes mellitus and low gestational weight gain (115).

Intervention studies of physical activity, dietary behaviors, and impaired glucose tolerance among pregnant Latinas

As demonstrated by the Diabetes Prevention Program, walking in combination with nutritional control in nonpregnant women can be effective in delaying or preventing subsequent type 2 diabetes (116,117) with a reduction in risk comparable to that with vigorous activity (118,119). However, few interventions have tested whether making a change in physical activity or dietary behaviors during pregnancy can prevent impaired glucose tolerance or gestational diabetes mellitus, and of these studies, few have included Latina women.

The Cochrane Review reviewed randomized and quasi-randomized, controlled trials of dietary strategies designed to prevent gestational diabetes mellitus in pregnant women including the effect of a high-fiber diet and the impact of high and low glycemic index diets, respectively (120). Studies were small and found no impact of a high-fiber diet on mean oral glucose tolerance test results at 35 wk (mean difference: −0.36, 95% CI: −0.90 to 0.18). However, maternal fasting blood glucose was lower for women on the low glycemic index diet (weighted mean difference: −0.28 mmol/L, 95% CI: 0.54 to −0.02) compared with women on the high glycemic index diet.

Recently, Luoto et al. (121) conducted a cluster-randomized trial among 399 women with at least 1 gestational diabetes mellitus risk factor in any earlier pregnancy in 14 municipalities in Finland. Women were randomized to a lifestyle intervention consisting of individual counseling on physical activity, diet, and weight gain at 5 antenatal visits or to usual care. There was no significant difference in gestational diabetes mellitus incidence between the intervention group compared with the usual care group (RR = 1.36, 95% CI: 0.71–2.62). However, there was some indication that the

intervention led to positive changes in diet and physical activity.

In another recent study, Quinlivan et al. (122) randomized 124 obese pregnant women in Australia to a 4-step multidisciplinary prenatal care program or to standard obstetric care. The intervention included brief dietary counseling and education including itemization of the food consumption of the previous day with a focus on reducing consumption of fast foods, sports drinks, carbonated drinks, and commercial fruit juices and increasing the consumption of fruit and vegetables. Compared with the standard obstetric care group, women randomized to the intervention group had a significant reduction in the incidence of gestational diabetes mellitus (OR = 0.17, 95% CI: 0.03–0.95) and reduced weight gain in pregnancy (7 vs. 13.8 kg, $P < 0.0001$), although the number of cases was small (21 cases).

Promising findings from several pilot feasibility studies have also been recently published. Korpi-Hyövälti et al. (123)randomized 54 women at high risk of gestational diabetes mellitus in Finland to a lifestyle intervention consisting of healthy lifestyle counseling including compliance with dietary recommendations and moderate physical activity or to a single session of lifestyle advice. Although there were no differences between arms in terms of glucose tolerance, the lifestyle intervention group had a tendency toward lower weight gain (11.4 $\pm$ 6.0 kg vs. 13.9 $\pm$ 5.1 kg, $P = 0.062$, adjusted for prepregnancy weight) compared with the single session group.

In another feasibility study, Callaway et al. (124) conducted a randomized, controlled trial among 50 obese pregnant women in Australia. Women were randomized to an individualized exercise program with an energy expenditure goal of 900 kcal/wk or to routine obstetric care. Although insulin resistance did not differ between the 2 groups, the intervention arm experienced a modest increase in physical activity. A total of 73% of women in the intervention group achieved >900 kcal/wk of exercise-based activity at 28 wk compared with 42% in the control arm ($P = 0.047$).

Wolff et al. (65) conducted a randomized, controlled trial of a dietary intervention among 50 non-Latina white obese pregnant women. Women were randomized to a gestational weight gain target of 6–7 kg via ten 1-h dietary consultations or to standard care. The women in the intervention group limited their energy intake and had lower gestational weight gain (6.6 kg vs. 13.3 kg) compared with the standard care group. At 36 wk of gestation, fasting insulin was reduced by 23% (-25 pmol/L, $P = 0.022$) and the fasting glucose was reduced by 8% (-0.3 mmol/L, $P = 0.03$) compared with the standard care group.

Finally, several ongoing interventions are currently investigating the impact of lifestyle changes on gestational diabetes mellitus risk (125,126). In one of the only trials to include a significant proportion of Latina women, the BABY (Behaviors Affecting Baby and You) study is an ongoing exercise trial among an ethnically diverse sample of prenatal care patients in Western Massachusetts at high risk of gestational diabetes mellitus (60% Latina) (125). Women are randomized to a 12-wk motivationally targeted, individually tailored physical activity intervention involving multimodal contacts (in person, mail, and telephone) or to a comparison health and wellness intervention. The overall goal of the exercise intervention is to encourage pregnant women to achieve the ACOG guidelines for physical activity during pregnancy through increasing walking and developing a more active lifestyle. The intervention takes into account the specific social, cultural, economic, and physical environmental challenges faced by pregnant women of diverse socioeconomic and ethnic backgrounds.

Another ongoing trial, FitFor2 Study (126), is being conducted in Amsterdam, the Netherlands and is designed to assess whether a prenatal exercise program will improve insulin sensitivity and fasting plasma glucose levels. Women are randomized to an intervention group who receives an exercise program consisting of aerobic and strength exercises twice per week or to usual care.

In summary, few lifestyle interventions targeting risk of gestational diabetes mellitus have been published. Findings from larger ongoing studies such as the BABY study and FitFor2 study will be critical in adding to the sparse literature on the efficacy of lifestyle intervention trials designed to prevent gestational diabetes mellitus.

Recommendations for future research

In addition to a focus on predominantly white populations, small sample sizes, and use of historical control groups, the majority of previous intervention studies failed to control for contact time, faced rates of loss to follow-up >20%, and were not translatable into clinical practice. There is a critical need for studies focusing on Latina overweight and obese women. Such studies should include the following: 1) randomization of women to a lifestyle intervention or a comparison arm, thereby controlling for contact time; 2) a translatable intervention feasible for primary health care providers including both physical activity and diet; 3) follow-up from pregnancy through the postpartum period allowing the evaluation of both maternal and offspring outcomes; and 4) a sample size designed to ensure statistical power.

Lifestyle intervention programs for Latina women should be based on psychosocial theories and tested to ensure that they are efficacious in the Latina population. Multidimensional (subjective and objective) measures of physical activity and dietary behaviors validated in the study population should be included. In addition, such studies would be strengthened by the use of measures of adiposity in addition to weight and multiple and fasting measures of serum biomarkers of insulin resistance.

Strategies for recruiting pregnant Latina women into research studies

Few studies have evaluated strategies designed to increase inclusion of Latinas in research on maternal and fetal health disparities. For almost 2 decades, the National Institutes of Health have required recruitment plans for the inclusion

of women and minorities in clinical research or scientific justification for their exclusion (127,128). However, studies have found that conducting longitudinal studies involving Latinos is challenging (129). Factors such as low income and educational levels, which are associated with nonparticipation in health research, are more prevalent in U.S. Latinos compared with non-Latino whites (130). Among Latinos, reduced rates of participation in health research have been associated with lower levels of literacy and health literacy and a higher proportion of Spanish-only speaking households in a community (131). Ineffective communication and informed consent procedures by research staff, lack of or poor quality incentives, burdensome protocols, and lack of accessible sites for participation have also been identified as critical reasons for low participation among Latinos (132).

Chasan-Taber et al. (14) reported strategies used to recruit pregnant Latinas of varying educational and socioeconomic status into Proyecto Buena Salud, an observational prospective cohort study of pregnant women of Puerto Rican and Dominican descent with the goal of evaluating modifiable determinants of gestational diabetes mellitus. Proyecto Buena Salud used several techniques to promote recruitment from a clinical setting. These included the following: 1) use of bilingual recruiters, 2) a flexible recruitment process, 3) training recruiters to be culturally sensitive, 4) use of culturally tailored materials, 5) prescreening of participants, 6) compensating participants, 7) seeking cooperation from the clinic staff, and 8) continuously monitoring recruitment goals.

A recruitment challenge unique to clinical settings is cancelled prenatal care appointments. In Proyecto Buena Salud, 55.0% of potential participants did not show for their scheduled prenatal care appointment or had rescheduled. Low attendance to prenatal visits may be due to personal and child sickness, domestic tasks, unanticipated employment opportunities, and partner restrictions. These barriers may be even more important in younger Latina populations because previous studies indicate that ~40% of Latina young girls, especially in low-income families, drop out of school by eighth grade, are frequently in partnered relationships, and begin childbearing early (133). Therefore, the traditional approach of asking potential participants to make separate (nonmedical) trips to the clinic may not be feasible for this population.

Similarly, El-Khorazaty et al. (134) evaluated recruitment and retention of low-income pregnant Latinas and African-American women into a behavioral intervention in Washington, DC, designed to reduce smoking, depression, and intimate partner violence. Women were recruited at 6 prenatal care clinics. Retention strategies included financial and other incentives, regular updates of contact information, and attention to cultural competence by the research staff. The authors found that women retained in the study were not statistically different from those not retained with regard to sociodemographic characteristics and targeted risks. The successful recruitment and retention of low-income minority women in this study are in contrast to earlier findings that recruitment rates of ethnic minorities in clinical trials are small compared with nonminorities (135). However, this and other recent studies of recruitment strategies among racial and ethnic groups (132) point to the benefits of using multiple different but complementary strategies.

Summary

Changes in lifestyle risk factors (e.g., regular exercise, healthy diet) among overweight and obese Latinas may reduce the risk of obesity and impaired glucose tolerance and subsequent type 2 diabetes and cardiovascular disease for both mother and offspring. Indeed, recent recommendations by the National Heart, Lung, and Blood Institute highlight the need for interventions early in life, particularly among vulnerable populations including ethnically diverse groups (136). Women receive closer medical attention during the prenatal and postpartum periods than at other times in their adult lives and are often highly motivated to improve their health to benefit themselves and their children. Pregnancy and postpartum lifestyle interventions can capitalize on this teachable moment. The public health impact of such lifestyle modifications is likely to be greatest in ethnic groups, such as Latinos, with consistently high rates of obesity, diabetes, and the highest rates of sedentary behavior.

Barriers and facilitators that may be unique to pregnant women, in particular, pregnant Latina women, are critical to target when designing exercise and dietary interventions for these population groups (137). Identification of those barriers and facilitators perceived as most powerful could enable the design of more targeted interventions. In addition, future studies should include a range of Latino groups because health status and behaviors vary widely among Latino subgroups. Therefore, researching and designing strategies tailored to the needs of specific Latino subgroups become critical. For example, patterns of physical activity among Latinas vary by country of origin, suggesting that effective interventions to improve physical activity should be based on an understanding of culture and environment. Similarly, dietary patterns vary among Latina subgroups. For example, 1 study showed that, unlike other Latina groups, Puerto Rican mothers in New York were predominantly U.S. mainland born and had more adverse behaviors related to assimilation in poor inner city neighborhoods such as higher consumption of sodas, fruit juices, and snack foods (37).

In summary, high-reach, low-cost intervention strategies have great potential for adoption on a larger scale and thus high potential for reducing existing health disparities in the United States.

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