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Dyadic Collaboration in Shared Health Behavior Change: The Effects of a Randomized Trial to Test a Lifestyle Intervention for High-Risk Latinas

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Objective: This study sought to evaluate the feasibility of a pilot, dyad-based lifestyle intervention, the *Unidas por la Vida* program, for improving weight loss and dietary intake among high-risk Mexican American mothers who have Type 2 diabetes and their overweight/obese adult daughters. **Method:** Mother–daughter dyads ($N = 89$) were recruited from two federally qualified health centers and randomly assigned to either the *Unidas* intervention or to the control condition. The 16-week *Unidas* intervention consisted of the following: (a) four group meetings, (b) eight home visits, and (c) booster telephone calls by a lifestyle community coach. The control condition consisted of educational materials mailed to participants' homes. Participants completed surveys at T1 (baseline) and T2 (16 weeks) that assessed various demographic, social network involvement, and dietary variables. **Results:** Unidas participants lost significantly more weight at T2 ($p < .003$) compared with the control participants. Furthermore, intervention participants also were more likely to be eating foods with lower glycemic load ($p < .001$) and less saturated fat ($p = .004$) at T2. Unidas participants also reported a significant increase in health-related social support and social control (persuasion control only) and a decrease in undermining. **Conclusions:** The *Unidas* program promoted weight loss and improved dietary intake, as well as changes in diet-related involvement of participants' social networks. The results from this study demonstrate that interventions that draw upon multiple people who share a health-risk have the potential to foster significant changes in lifestyle behaviors and in social network members' health-related involvement. Future research that builds on these findings is needed to elucidate the specific dyadic and social network processes that may drive health behavior change.

Keywords: dyadic behavioral lifestyle intervention, social support and social control, type 2 diabetes control and prevention, weight loss, Hispanic, Latina

Being overweight or obese is a significant risk factor for chronic diseases such as diabetes. Mexican Americans, the largest Latino subgroup in the United States, are almost twice as likely to have diabetes as non-Hispanic Whites (Centers for Disease Control & Prevention, 2011). Furthermore, Mexican American women have

the highest lifetime risk for diabetes compared with Hispanic men and non-Hispanic white and black men and women, and they develop diabetes at a younger age (Narayan, Boyle, Thompson, Gregg, & Williamson, 2007). Many of the serious complications that arise from having Type 2 diabetes can be prevented or delayed

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by engaging in healthy lifestyle behaviors, particularly eating an appropriate diet and controlling one's weight. Yet many people with diabetes struggle to maintain strict dietary adherence, and those whose weight and dietary practices put them at risk for developing diabetes also often have difficulty adopting a healthier diet (Gonder-Fredrick, Cox, & Ritterband, 2002; O'Brien, Davey, Alos, & Whitaker, 2013). Thus, interventions aimed at improving the health habits of overweight/obese Mexican American women may be an effective way to prevent diabetes and limit the complications that arise from having poorly controlled diabetes.

Although most behavior change programs among obese adults have focused on changing individuals' behaviors (see reviews by Johnson et al., 2013; Perez et al., 2013), a growing number of researchers recognize that behavior change often occurs in a context that emphasizes the importance of social support (Greaves et al., 2011), including the involvement of informal social network members (for reviews, see Hogan, Linden, & Najarian, 2002; Martire, Lustig, Schulz, Miller, & Helgeson, 2004). Meals are often consumed with social network members, for example, and irrespective of such joint meals, social network members are often in a position to monitor and comment on a person's dietary intake or weight-loss efforts (Berkman, 2000; Bishop et al., 2013; Gallant, 2003). Intervention studies that have evaluated the effects of either including a social network member in the behavior change program or teaching the network member to support the focal person's behavior change efforts have generally reported benefits (Hogan et al., 2002; Martire et al., 2004). However, few studies have explicitly evaluated the role of support as the potential target of the intervention (Hogan et al., 2002; Martire et al., 2004). Furthermore, little research has examined the effectiveness of support interventions in which both members of a family may be seeking to make comparable changes in their health behaviors and outcomes.

This study sought to extend existing research by evaluating the feasibility of a lifestyle intervention, *Unidas por la Vida* (United for Life), in which two family members (Mexican American mothers who have Type 2 diabetes and their overweight/obese adult daughters) collaborate in an effort to change shared health behaviors. The study also sought to examine changes in the involvement of the social network in participants' dietary behaviors. Finally, given the importance of developing culturally tailored interventions (Lindberg, Stevens, & Halperin, 2013), the current study also sought to tailor the intervention for Latinas at high risk for developing, or experiencing complications of, diabetes. Although evidence suggests that a family-based lifestyle intervention may be more culturally appropriate for Mexican American women than an individually focused intervention (Coleman et al., 2010; Cousins et al., 1992; Marquez & Wing, 2013; Teufel-Shone, Drummond, & Rawiel, 2005), we know of no other studies that have targeted two adults in the same family who share a high risk for diabetes and its complications.

Health-Related Social Support, Social Control, and Undermining

Family members may facilitate health behavior change in a variety of ways, including encouraging and supporting a healthy lifestyle (Berkman, Glass, Brissette, & Seeman, 2000; Seeman, 2000). *Health-related social support* refers to efforts by social

network members to provide assistance and positive feedback aimed at promoting health-enhancing behaviors (Franks et al., 2006; Gallant, 2003). Family members can also facilitate behavior change by serving as sources of influence and regulation (Berkman et al., 2000). *Health-related social control* refers to attempts made by family members to monitor, and induce improvement in, an individual's health behaviors (Lewis & Rook, 1999). Whether or not social control attempts are effective may depend, in part, on the type of strategy used. Persuasive control strategies, or efforts to prompt or persuade another person to improve his or her health behaviors, have been found to elicit positive health behavior change in some studies (August & Sorkin, 2010; Stephens et al., 2009; Tucker, Orlando, Elliott, & Klein, 2006) but not others (e.g., Martire et al., 2013; Stephens et al., 2013). In contrast, control strategies that involve the use of pressure, such as criticizing or expressing doubts about the person's health behavior, have more often been found to be ineffective or even counterproductive in changing behavior (Lewis & Rook, 1999; Martire et al., 2013; Stephens et al., 2013; Tucker, Elliott, & Klein, 2006).

Social network members' actions, intentional or otherwise, might also have the effect of *undermining* a focal person's health behavior change efforts. Conceptually distinct from social control, undermining can be construed as attitudes or behaviors that subvert or interfere with (rather than foster) an important goal, such as adherence to a treatment regimen (e.g. Henry, Rook, Stephens, & Franks, 2013). In contrast to the rich literature that exists on the influence of social support on health behaviors (Franks et al., 2006), social control and undermining have received comparatively little research attention. Furthermore, social control and undermining have seldom been examined as potential targets of family interventions designed to improve participants' health behavior, such as dietary intake. The current study accordingly sought to examine three conceptually distinct facets of social network members' health-related involvement (Berkman et al., 2000; Rook, August, & Sorkin, 2011) that might be expected to change in the context of a family intervention to improve dietary practices in an at-risk population. We expected the *Unidas* program to increase support and the positive form of social control (i.e., persuasion), and to decrease the corrosive form of social control (i.e., pressure) and undermining.

The Mother–Daughter Dyad

The effects of health-related social support and control have often been examined in the context of spousal relationships (e.g., Franks et al., 2006; Stephens et al., 2013). Evidence suggests, however, that other family members also engage in health-related support and control (August & Sorkin, 2010; Rook, Thuras, & Lewis, 1990). Although spouses may be the most likely source of support for behavioral change in non-Hispanic white populations (McLean, Griffin, Toney, & Hardeman, 2003; Rosenthal, Allen, & Winter, 1980), the mother–daughter relationship may be a more important source of support for Mexican American women (Berg, Cromwell, & Arnett, 2002; Garcia-Maas, 1999). In a family-based intervention, for example, over half of Mexican American men refused to participate in the group meetings (Cousins et al., 1992), citing health and nutrition as “women's issues.” The cultural tendency for mothers and daughters to engage in daily activities like shopping and preparing meals together suggests the possibility

that intervention effects could be amplified in the mother-daughter dyad. Using the synergy of this natural intergenerational bond as a point of intervention may be a powerful and culturally appropriate way to affect health behavior change.

Current Study Aims

Given that the mother-daughter relationship is a particularly important bond in Latino culture, the *Unidas* program was developed specifically for mother-adult daughter dyads. The purpose of this study was to conduct a pilot test of a theory-driven, culturally responsive, behavioral lifestyle intervention designed to promote weight loss and improve dietary behavior among high-risk, Mexican American women. The primary objective was to establish the feasibility of the program (Aim 1). In addition, we sought to determine whether involvement in the *Unidas* program was effective in promoting participants' weight loss and improving dietary intake (Aim 2). Finally, we sought to determine whether participation in the *Unidas* program was associated with changes in diet-related social network involvement (social support, control, and undermining) as a function of participating in the *Unidas* program (Aim 3).

Method

Participants

Mexican American women with type 2 diabetes were recruited from two federally qualified health centers (FQHCs) from September 2010 through August 2012 (for more information, see Sorkin et al., 2013). FQHCs receive federal funding to serve underserved, underinsured, and uninsured Americans (U.S. Department of Health and Human Services). Women with Type 2 diabetes were identified from International Classification of Diseases, Ninth Revision (ICD-9) codes, and were recruited during regularly scheduled appointments at both health centers. Each patient received an explanation of the program from project staff and was then asked whether she would be interested in participating in the program to help improve her diabetes management and, in addition, whether she had an adult daughter who might be interested in losing weight. Project staff then contacted the patient's daughter to ascertain her interest in participating in the project. All participants completed an informed consent form and a Health Insurance Portability and Accountability Act (HIPAA) waiver to allow a review of their medical charts.

A total of 882 dyads were assessed for eligibility (Figure 1). Eligibility requirements included being self-identified as Latina (both mother and daughter), age ≥ 18 years, and mother's residence within 25 miles of the daughter's residence (coresidence was allowed, as well). In addition, mothers must have had a diagnosis of Type 2 diabetes, and daughters must have been overweight/obese (BMI ≥ 25 kg/m²). Participants were excluded if they were pregnant or became pregnant over the course of the project, had any contraindications to weight loss, or were considered not competent to consent to participation. Pairs were excluded if either the mother or a daughter did not meet the eligibility requirements. A total of 559 dyads were ineligible to enroll in the study. Of the 323 dyads who were eligible to enroll, 218 had at least one participant who declined to participate, 10 did not pass

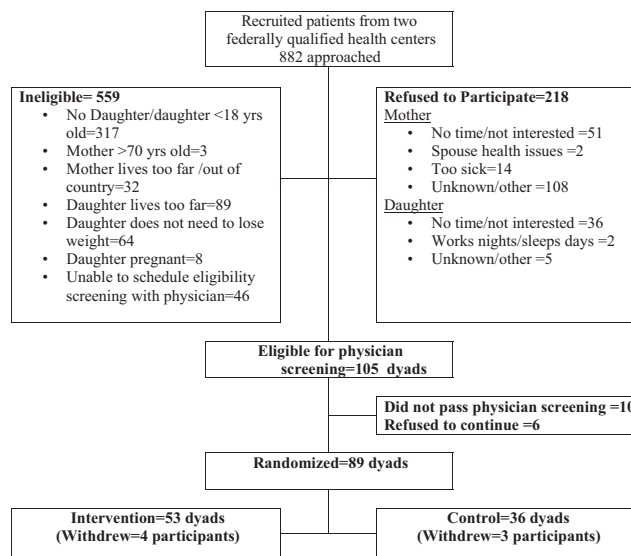


Figure 1. *Unidas por la Vida* study patient flow chart.

physician clearance, and 6 declined to participate after physician clearance, leaving 89 dyads (178 women) who were eligible and who agreed to participate in the *Unidas* program (27.6% response rate among eligible dyads). Mother-daughter dyads were randomized by research staff to the intervention or control using a block design to account for the two sites. Retention was very high across both arms of the trial, with an overall 96.1% retention rate. Four women withdrew from the intervention (2 daughters and a mother-daughter pair), and three women dropped from the control group (1 mother and a mother-daughter pair).

Intervention

The *Unidas por la Vida* intervention was a 16-week intervention, consisting of the following: (a) four group meetings, (b) eight home visits with a lifestyle community coach, and (c) four booster telephone calls by a lifestyle community coach between home visits. The intervention was modeled on the Diabetes Prevention Program's (DPP) *Lifestyle Change Program* (Diabetes Prevention Program Research Group, 2002). As previously mentioned, although the DPP lifestyle intervention has been effectively used with Latinos (Diabetes Prevention Program Research Group, 2002), we adapted it further to make it community-based. Participants were given a personal weight loss goal, which was expected to be achieved through two treatment objectives: reduction in caloric intake (1,200–1,800 kcal/day) and an increase in caloric expenditure through moderate physical activity (≥ 150 min/week). Participants were encouraged to self-monitor their daily intake of fruits and vegetables, protein, and carbohydrates (using "Create Your Plate" guidelines developed by the American Diabetes Association, 2013) and to record their daily physical activity in minutes. During each group session, a recipe demonstration was conducted with modified recipes from a Hispanic/Latino diet. In addition, approximately 20 min of moderate exercise was incorporated into the group session (including Zumba, salsa dancing, and walking) to facilitate increased physical activity, and partici-

pants were encouraged to exercise at other times as well. Building on partnerships developed within the community, participants were given free access to local facilities that provided safe and convenient areas to meet and exercise (e.g., local college athletic facilities).

Participants were taught standard behavioral weight loss techniques, including goal setting, problem solving, and relapse prevention; however, we further adapted these techniques to encourage dyadic collaboration in achieving improved health behavior. Specifically, during each session the women were asked to collaborate in selecting specific health behavior goals that they found challenging, and then were asked to discuss ways that they could support, monitor, and provide feedback to one another on their progress toward those goals. Participants were encouraged to develop shared strategies for improving adherence to their diet and exercise plans, overcoming barriers (including actions by others that might undermine their plans), and providing support to address potential relapses. Dyads were encouraged to check in with each other throughout the week and to plan ways that they could engage in shared healthy activities, such as preparing a healthy meal or taking a walk together. The women were encouraged to involve other members of their families in the home visits to garner their support for the behavior change and to discourage undermining. Furthermore, because the program was located in participants' own communities, it was more easily accessible to Latina women for whom participation might otherwise be difficult (see Sorkin et al., 2013 for additional information).

Patients randomized to the control group received education materials developed by the National Diabetes Education Program. Participants with diabetes (mothers) received information about the causes and complications of diabetes, as well as ways to reduce complication risks. Their adult daughters received information about diabetes prevention (<http://www.ndep.nih.gov/am-i-at-risk>; <http://www.ndep.nih.gov/i-have-diabetes>). In both intervention and control groups, mothers and daughters were advised to continue with the health care prescribed by their primary care provider.

Measures

All participants completed a self-report questionnaire at baseline (T1) and 16 weeks later (T2) that assessed: (a) demographic characteristics (e.g., age) and health status (e.g., number of chronic conditions) and, (b) health-related social support, control, and undermining. Questionnaires were available in either English or Spanish. In addition, respondents completed a detailed assessment of dietary intake and had their weight measured at T1 and T2.

Health-related social support, social control, and undermining. Health-related social support was assessed at T1 and T2 with three items (Stephens et al., 2009; Stephens et al., 2013). A sample item included: "Over the past month, how often did the important people in your life show appreciation for your efforts to stay on track with your diet or exercise regimen?" (0 = *not at all*, 5 = *everyday*). The composite measure of *health-related social support* demonstrated good reliability in this sample; Cronbach's alphas: T1 = 0.91; T2 = 0.93.

To assess health-related social control, seven items were derived from prior research (Stephens et al., 2009; Stephens et al., 2013). Participants were asked to indicate the frequency with which their

social network members sought to exercise health-related social control in the past month. Two types of social control were examined in this study: persuasion (3 items) and pressure (4 items). A sample item for persuasion included: "Over the past month, how often did the important people in your life try to do something to get you to improve your food choices or exercise regimen?" A sample item for pressure included: "Over the past month, how often did the important people in your life restrict you from making poor food choices?" Responses were made on a 6-point scale (0 = *not at all*, 5 = *everyday*), and composite variables were created to represent each strategy of health-related social control. For each strategy, the scale demonstrated good reliability (Cronbach's alpha for *persuasion*: T1 = 0.93, T2 = 0.92; Cronbach's alpha for *pressure*: T1 = 0.89, T2 = 0.85).

In the context of an intervention designed to promote healthy eating, undermining by others would be reflected in such behaviors as tempting (e.g., by eating foods high in sugar or fat around the individual) or expressing disregard for the individual's health-related goals (Henry et al., 2013). Accordingly, we assessed health-related undermining with seven items from the sabotage subscale of the Family and Friends Support for Heart Healthy Eating Habits scale (Sallis, Grossman, Pinski, Patterson, & Nader, 1987). Sample items included "refused to eat the healthy food you prepared" or "offered you high-sugar, high-fat foods." Responses were made on a 6-point scale (0 = *never*, 5 = *always*). The composite measure demonstrated good reliability in this sample (Cronbach's alpha for *undermining*: T1 = 0.88; T2 = 0.87).

Dietary intake. Dietary intake was examined using the Block "Alive" Screener (The Block "Alive" Screener: A modified version of the Block 2007.1 FSFV-GL, 2008-Nutrition Quest, Block Dietary Data Systems, Berkeley, CA), which is an abbreviated version of the full Block Food Questionnaire (Block et al., 1986). The full Block Food Questionnaire is a 100-item measure that assesses nutritional intake based on a detailed food frequency questionnaire derived from dietary recall data in the NHANES II study. The subsequently designed Block Screener is a 40-item measure that provides a valid, efficient assessment of nutritional intake; it yields estimates of multiple dietary targets, including saturated fats, glycemic load, and vegetable and fruit consumption. The abbreviated version has been shown to correlate strongly with the full Block Food Questionnaire (Block, Gillespie, Rosenbaum, & Jensen, 2000), has been validated for use in Hispanic populations (Block, Wakimoto, Jensen, Mandel, & Green, 2006), and has been used in intervention studies with short-term follow-up assessments (e.g., Lindberg et al., 2012). As a frame of reference for the assessment of their specific food intake, participants were first asked to consider what they typically consumed in the year. Respondents then chose one of seven frequency categories that reflected how many days in a week they ate a particular food item, ranging from "*none/less than 1 day*" to "*all the days of the week*." The number of servings per day was then assessed in common-place units (e.g., glass). We focused on saturated fats, glycemic load, and vegetable and fruit consumption, all of which are key factors in obesity and Type 2 diabetes (see reviews by Willett, Manson, & Liu, 2002). Reductions in glycemic load and saturated fat and increases in vegetable and fruit consumption have been found to be associated with weight loss and improved Type 2 diabetes outcomes (Livesey, Taylor, Livesey, & Liu, 2013; Manson et al., 2012).

Weight. Weight was measured on a flat, even surface, using a SECA 882 portable scale. Where possible, women were weighed in their homes around the same time of day at baseline and follow-up, after voiding, and with minimal clothing.

Statistical Analysis

Initial comparisons of mothers' and daughters' demographic characteristics, social network measures (support, control, undermining), and key study outcomes were conducted using paired sample *t* tests, chi-square analyses, and analyses of variance (ANOVAs). The key study hypotheses were examined with a series of Actor-Partner Interdependence Models (APIM; Kenny, Kashy, & Cook, 2006). Because individual participants' observations are nested within each dyad, the APIM takes into account the nonindependence of responses from mothers and their daughters (Campbell & Kashy, 2002). Our APIM models were run using a series of intention-to-treat, mixed effects linear regression models (analyses were run using SAS PROC MIXED, SAS v9.2). These mixed models made use of all available data for each participant (regardless of drop-out) and accounted for dyad-level clustering. All models included between-dyad (e.g., randomization group), within-dyad (e.g., whether the actor was a mother or daughter), and mixed-predictor (e.g., T1 dietary intake) variables.

Using the APIM framework, we examined separate main effects models of the impact of randomization group on weight loss, each of the T2 dietary outcomes, and diet-related social network involvement, controlling for coresidence and T1 actor and partner levels of the outcome variable being tested. In this approach, an actor effect reflects the extent to which an individual's own status on a particular variable influences the individual's outcome (e.g., weight, dietary intake, social support/control/undermining), whereas a partner effect reflects the extent to which a partner's status on a particular variable influences the individual's outcome. All analyses adjusted for dyad member's coresidence (lived together or apart), whether the respondent was a mother or daughter, and actors' and partners' baseline values for the dependent variables of interest. For ease of interpretation, effect coding (-1 vs. 1) was used for all categorical variables (i.e., randomization group, living together, whether the actor was the mother or daughter). All continuous predictor variables (i.e., T1 dietary and social network

involvement variables) were grand-mean centered. An alpha of ≤ 0.05 was used to indicate statistical significance. However, given the modest sample size, we also took note of trend-level (i.e., $p < 0.10$) associations among key variables.

Results

Baseline (T1) Demographic Characteristics

Consistent with their older age, the mothers ($M = 52.7$ years old, $SD = 6.9$) were more likely than their daughters ($M = 27.8$ years old, $SD = 7.4$) to have been born outside of the United States (95% vs. 63%, respectively, $p < .001$), to speak Spanish only (73% vs. 11%, $p < .001$), to have less than a high school level of education (83% vs. 25%, $p < .001$), and (at trend level) to be married or cohabiting with a partner (65% vs. 53%, $p = .08$). Mothers also reported more chronic conditions than did their daughters ($M_{count} = 2.5$ vs. 0.3; $SDs = 1.2$ and 0.7; $p < .001$). Approximately 75% of the mother-daughter dyads lived together, and nearly all (94%) reported incomes less than \$30,000 per year. Comparisons of participants randomly assigned to the invention versus control group revealed no significant differences in their demographic characteristics.

Descriptive Data for Health-Related Social Support, Social Control, Undermining, and Dietary Intake

Table 1 presents data describing T1 and T2 levels of support, control, and undermining, as well as weight and dietary intake for mothers and their adult daughters in the intervention and control groups. We also examined baseline differences in mothers' and daughters' key study variables. The findings (not shown) revealed few differences between mothers and daughters in T1 measures of these key variables. Mothers reported significantly lower average daily glycemic load at T1 compared with their adult daughters ($M_{grams} = 44.6$ [$SD = 24.8$] vs. 61.4 [$SD = 42.8$], $p = .003$), as well as lower saturated fat intake ($M_{grams} = 9.2$ [$SD = 4.9$] vs. 13.9 [$SD = 8.0$], $p < .001$) and greater vegetable intake ($M_{cups} = 1.2$ [$SD = 0.9$], vs. 0.9 [$SD = 0.6$], $p = .01$). No other variables differed significantly between mothers and daughters at T1. In

Table 1
Key Study Variables at T1 and T2

	<i>M (SD)</i>							
	Mothers				Adult daughters			
	Intervention (<i>N</i> = 53)		Control (<i>N</i> = 36)		Intervention (<i>N</i> = 53)		Control (<i>N</i> = 36)	
	T1	T2	T1	T2	T1	T2	T1	T2
Social support	3.8 (1.7)	4.8 (1.5)	3.7 (1.9)	3.9 (1.7)	3.7 (1.4)	4.8 (1.2)	3.5 (1.7)	3.4 (1.6)
Social control-persuasion	4.0 (1.9)	4.9 (1.5)	3.7 (1.5)	3.8 (1.8)	3.7 (1.5)	4.8 (1.1)	3.4 (1.6)	3.6 (1.6)
Social control-pressure	2.9 (1.6)	2.8 (1.6)	2.4 (1.6)	2.3 (1.5)	3.0 (1.7)	3.0 (1.7)	2.7 (1.6)	2.9 (1.5)
Undermining	1.6 (1.4)	0.8 (1.0)	0.9 (1.2)	0.7 (0.7)	1.5 (1.1)	1.0 (1.1)	1.9 (1.3)	1.7 (1.2)
Weight, pounds	176.1 (37.6)	172.6 (36.4)	179.4 (38.8)	180.7 (41.4)	186.0 (32.7)	181.4 (30.7)	188.2 (41.5)	186.6 (42.5)
Average glycemic load, g	46.3 (27.4)	32.3 (19.1)	42.2 (20.9)	50.4 (31.6)	52.0 (40.3)	36.2 (23.3)	73.8 (43.4)	52.9 (28.0)
Saturated fat, g	9.6 (5.4)	7.2 (4.0)	9.2 (4.4)	10.6 (5.7)	12.0 (5.9)	8.6 (5.5)	16.7 (10.2)	12.6 (7.3)
Fruit, cup equivalent	1.3 (1.2)	0.9 (0.6)	1.3 (1.0)	1.6 (1.0)	1.1 (1.0)	1.2 (1.0)	1.4 (1.1)	1.2 (0.9)
Vegetables, cup equivalent	1.1 (0.8)	1.4 (1.0)	1.2 (1.0)	1.5 (0.8)	0.8 (0.5)	1.3 (1.0)	1.0 (0.8)	0.7 (0.5)

addition, T1 comparisons of participants randomly assigned to the intervention versus control group revealed no significant differences in these variables.

Feasibility of the Intervention (Aim 1)

On average, women completed 11.7 (out of 16 possible) intervention sessions. Women were more likely to complete the home visits (an average of 7 out of 8 possible), compared with the group visits (an average of 2.2 out of 4 possible) and the booster telephone calls (an average of 2.5 out of 4 possible). *Unidas* participants reported high levels of satisfaction and success with the program (for more details, see Sorkin et al., 2013).

Actor–Partner Interdependence Models of the Effect of the Randomization Group on T1-T2 Change in Weight and Dietary Intake (Aim 2)

The first analysis examined whether participation in the *Unidas* intervention was associated with greater weight loss. Table 2 presents results from the main effects APIM models examining the association between randomization group and T2 weight, adjusting for T1 (baseline) weight and other covariates. The analysis revealed that participants in the intervention group had significantly lower T2 (16-week) weight than did those in the control group ($p < .003$).

The second set of analyses examined whether dietary intake improved as a function of participating in the *Unidas* intervention. Table 3 presents results from the main effects APIM models examining the association between randomization group and each of the four dietary outcomes (glycemic load, saturated fat, fruit consumption, vegetable consumption), adjusting for the corresponding T1(baseline) dietary measure. Analyses revealed, after adjusting for the covariates, that individuals in the intervention group had significantly lower T2 (16-week) glycemic load ($p < .001$) and saturated fat intake ($p = .004$) than did those in the control group. The intervention also was associated, contrary to expectation, with less (rather than more) fruit intake at T2 at a trend level ($p = .09$). Vegetable intake did not differ between intervention and control groups at follow-up.

Table 2
Actor–Partner Interdependence Model: Intervention and Control Group Differences in Follow-Up Weight (N = 89 Dyads)

Variable	Weight (pounds)	
	b (SE)	p
Intercept	181.65 (1.02)	<.001
Coresidence (Ref = live apart)	-1.85 (1.17)	.12
Actor (Ref = daughter)	0.43 (0.47)	.37
Actor T1 weight	0.97 (0.01)	<.001
Partner T1 weight	-0.02 (0.01)	.23
Group (Ref = control)	-1.61 (0.52)	.003

Note. T1 = Time 1 (baseline). T2 = Time 2 (16 weeks). Analysis included the following covariates: dyad member's residence (lived together or apart), whether the respondent was a mother or daughter, and actor's and partner's baseline values for weight.

Actor–Partner Interdependence Models of the Effect of the Randomization Group on T1-T2 Change in Diet-Related Social Network Involvement (Aim 3)

The next set of analyses examined whether diet-related social network involvement changed over time as a function of participation in the *Unidas* program. The analyses revealed that the intervention-group participants reported significantly greater health-related social support ($p < .001$) and persuasion ($p < .001$) at T2 than did the control-group participants (Table 4). Compared with participants in the control group, those in the intervention group also reported less undermining ($p = .05$). No group difference existed with respect to pressure. Thus, the intervention did have the expected effect on the social network involvement variables for three of the four measures.

Supplemental Analyses: The Modifying Effect of Mother Versus Daughter Status

In supplemental analyses, we examined the extent to which the effect of the randomization group on weight loss, dietary outcomes, and social network involvement was moderated by whether the actor was the mother or the daughter. It is plausible that the effects of the intervention would have been greater for mothers relative to daughters because they had already been diagnosed with Type 2 diabetes; therefore, they (and their social network members) might have been more motivated to see changes in the mothers' dietary practices.

There was no significant interaction effect of randomization group and actor's mother–daughter status on weight loss. However, models exploring the extent to which the association between randomization group and dietary outcomes was moderated by actor's mother–daughter status yielded significant effects for two of the four dietary intake measures. Specifically, whereas mothers in the intervention group were consuming less fruit at T2 relative to mothers in the control group, daughters in the intervention group were consuming more fruit at follow-up than were daughters in the control group, actor mother*group interaction: $b = -0.18$ ($SE = 0.07$), $t = -2.57$, $p = 0.01$. Similarly, mothers in the intervention and control groups reported comparable levels of vegetable intake, whereas daughters in the intervention group reported much higher vegetable intake than did daughters in the control group at T2, $b = -0.23$ ($SE = 0.08$), $t = -2.90$, $p = .01$.

Some trend-level effects emerged when examining social network characteristics that emerged. Daughters in the intervention group reported somewhat greater health-related social support at T2, relative to daughters in the control group, $b = -0.15$ ($SE = 0.08$), $t = -1.75$, $p = .08$. Similarly, daughters in the intervention group reported somewhat less undermining at T2, relative to daughters in the control group, $b = 0.12$ ($SE = 0.07$), $t = 1.81$, $p = .07$.

Discussion

Obesity has become one of the most urgent public health problems in the United States (Chang & Christakis, 2003; Flegal, Carroll, Kit, & Ogden, 2012), with estimates suggesting that approximately two-thirds of adults are overweight or obese (Flegal, Carroll, Ogden, & Curtin, 2010). In an era of limited resources

Table 3

Actor-Partner Interdependence Model: Intervention and Control Group Differences in Follow-Up Dietary Intake (N = 89 Dyads)

Variable	Dietary outcomes (T2)							
	Glycemic load (g)		Saturated fat (g)		Fruits (cup equivalent)		Vegetables (cup equivalent)	
	b (SE)	p	b (SE)	p	b (SE)	p	b (SE)	p
Intercept	43.57 (3.76)	<.001	10.30 (0.78)	<.001	1.16 (0.12)	<.001	1.38 (0.11)	<.001
Coresidence (Ref = live apart)	-3.11 (4.54)	.5	-1.07 (0.93)	.25	0.03 (0.15)	.85	-0.26 (0.13)	.05
Actor (Ref = daughter)	-1.84 (2.46)	.46	-0.09 (0.53)	.87	0.07 (0.07)	.33	0.21 (0.09)	.02
Actor T1 dietary intake	0.20 (0.06)	.003	0.38 (0.07)	<.001	0.30 (0.07)	<.001	0.26 (0.09)	.01
Partner T1 dietary intake	0.18 (0.06)	.01	0.12 (0.07)	.08	0.05 (0.07)	.48	0.02 (0.10)	.85
Group (Ref = control)	-7.67 (2.08)	<.001	-1.30 (0.44)	.004	-0.12 (0.07)	.09	0.10 (0.06)	.12

Note. T1 = Time 1 (Baseline). T2 = Time 2 (16 weeks). Analysis included the following covariates: dyad member's residence (lived together or apart), whether the respondent was a mother or daughter, and actor's and partner's baseline values for outcome of interest.

and high health care costs, it is important to target populations that are most at risk for chronic disease. The health risks associated with obesity are particularly pronounced among Mexican Americans, whose rates of diabetes are double those of non-Hispanic whites (Centers for Disease Control & Prevention, 2011). Mexican American women have an especially elevated risk for developing diabetes, making the design of culturally appropriate health interventions for this group an urgent priority. The current study accordingly investigated a novel dyadic intervention designed to improve the health behaviors of two adults in the same family who share a high risk for diabetes and its complications.

Our findings suggest that the *Unidas* program is more efficacious than usual care augmented with educational materials for promoting weight loss and dietary intake among high-risk adults. For example, compared with participants in the control group, participants in the *Unidas* program were significantly more likely to be eating foods with lower glycemic load and less saturated fat at the 16-week follow-up. A marginally significant reduction in fruit intake in the intervention group also was detected over the course of the study, but this counterintuitive finding was clarified when the mothers and daughters were evaluated separately. Mothers in the intervention group reported less fruit intake at follow-up relative to those in the control group, whereas daughters in the intervention group reported higher fruit and vegetable intake than those in the control group. The *Unidas* intervention emphasized

the importance of eating at least five fruits and vegetable a day. Given that the mothers in the study had already been diagnosed with Type 2 diabetes, however, they were encouraged to eat more vegetables than fruit. Thus, it is not surprising that the mothers showed a decrease in fruit consumption, while the daughters, for whom eating fruit was less of an issue, showed an increase in both fruit and vegetable consumption. The improvements in dietary intake that were observed in the *Unidas* intervention are important because previous intervention studies have yielded mixed evidence regarding improvements in eating behaviors in samples with low socioeconomic status (for a review, see Everson-Hock et al., 2013).

Our findings also suggest that the *Unidas* program was associated with significant increases in social network members' health-related social support and persuasion, as well as a significant decrease in social network members' undermining. This study was designed as a feasibility trial, and thus precluded a formal test of these changes in social network diet-related involvement as mediators of the effects of the intervention on health behavior change. Nonetheless, the reported changes in social network involvement associated with participating in the *Unidas* program offer important clues about potential processes that may have contributed to the health behavior changes. It is also possible that changes in the diet-related involvement of participants' social network members co-occur, for example, with increases in participants' motivation

Table 4

Actor-Partner Interdependence Model: Intervention and Control Group Differences in Follow-Up Social Network Involvement (N = 89 Dyads)

Variable	Social network involvement (T2)							
	Health-related social support		Persuasion		Pressure		Undermining	
	b (SE)	p	b (SE)	p	b (SE)	p	b (SE)	p
Intercept	2.34 (0.39)	<.001	4.18 (0.20)	<.001	3.00 (0.24)	<.001	0.78 (0.12)	<.001
Coresidence (Ref = live apart)	0.24 (0.28)	.39	0.20 (0.24)	.42	-0.19 (0.29)	.5	0.14 (0.15)	.33
Actor (Ref = daughter)	0.12 (0.09)	.17	0.07 (0.10)	.47	-0.15 (0.12)	.23	-0.16 (0.06)	.02
Actor T1 social network inventory	0.28 (0.06)	<.001	0.36 (0.06)	<.001	0.42 (0.08)	<.001	0.31 (0.07)	<.001
Partner T1 social network inventory	0.19 (0.06)	.002	0.17 (0.06)	.01	0.03 (0.08)	.67	0.002 (0.06)	.98
Group (Ref = control)	0.52 (0.12)	<.001	0.46 (0.11)	<.001	0.06 (0.13)	.62	-0.12 (0.06)	.05

Note. T1 = Time 1 (Baseline). T2 = Time 2 (16 week). Analysis included the following covariates: dyad member's residence (lived together or apart), whether the respondent was a mother or daughter, and actor's and partner's baseline values for outcome of interest.

for behavior change. This possibility highlights the value of examining moderated mediation in future studies. Alternatively, changes in the diet-related involvement of participants' social network members might have co-occurred with other interpersonal processes that were more directly related to changes in the dietary intake of participants in the intervention group. For example, the dyadic exchanges and collaboration that were explicitly encouraged in the *Unidas* intervention might have led the mothers and daughters to serve as role models and sources of timely and salient motivation for each other as they experienced improvements in their dietary behaviors, contributing to a kind of "contagion" of positive behavior change from one dyad member to the other. A mediating process of this type would be detected most easily in studies with multiple assessments during and after the period of the intervention, to allow examination of potentially correlated trajectories of change within dyads.

Limitations and Directions for Future Research

In evaluating the results of the study, additional limitations need to be considered, some of which point to useful directions for future research. Although a response rate of 27.6% may identify a more motivated group of participants than is typical of the general Latina population, the level of participation noted in this study is comparable to that reported in other similar intervention studies (e.g., Corsino et al., 2012; Marquez & Wing, 2013). Nonetheless, the overall low response rate highlights the importance of increasing efforts to reach out to individuals for whom low motivation might be a deterrent to study enrollment and participation. A second limitation is that our measures of social network involvement were constrained in that they did not identify the specific sources of the diet-related support, control, and undermining reported by the participants. Future research that uses finer-grained measures is needed to evaluate the importance of changes in the behavior of specific social network members (such as the daughter, spouse, or other key network members). This study was designed to obtain preliminary evidence regarding the feasibility of the *Unidas* intervention, and as such, a third limitation of the study is that it did not include more extensive follow-up assessments. Thus, it is unclear how long the weight loss and dietary benefits may have persisted after the intervention ended. Finally, the design of the current study did not allow us to compare the health outcomes of mothers and daughters in a partner-based intervention with those of women who participated in a comparable intervention, but as individuals. As such, although we can conclude that involving the mother and daughter together may be an efficient way to change the behavior of two high-risk individuals, we cannot determine the incremental effectiveness of a dyadic approach relative to an individual approach. Therefore, in our future efforts we plan to address this limitation by using a comparative effectiveness design that allows us to directly test the relative impact of a dyadic approach.

Conclusion

The role of social network involvement in behavioral lifestyle changes is still not fully understood. Although the current study did not identify the mechanisms that accounted for the effects of the *Unidas* intervention, the results of the study nonetheless con-

tribute to the literature in several ways. First, we delivered this program to at-risk individuals who are often difficult to reach and who have significant health-related needs. Unlike most past studies of behavior lifestyle interventions (Waters, Galichet, Owen, & Eakin, 2011), the women who participated in the current study were predominantly limited-English proficient and of low-socioeconomic status. A common criticism of intensive programs like the *Unidas* program is their cost (Ritzwoller et al., 2013; Herman et al., 2003), but in low-income, high-risk populations, brief low-cost interventions may not bring about sufficient and sustained improvements in health behaviors that are notoriously difficult to change, such as diet and weight management. Our findings suggest that interventions aimed specifically at low-socioeconomic status groups, such as the *Unidas* program, might be effective for people with limited resources who may experience unique needs and barriers (Cleland, Granados, Crawford, Winzenberg, & Ball, 2013).

Second, the preliminary evidence of feasibility of the *Unidas* program has implications for magnifying the effects of health interventions across multiple family members. Rising rates of obesity have led many family members, within and across generations, to share unhealthy behaviors and elevated risks for chronic illness. In view of this trend, family support interventions in which two or more family members collaborate in efforts to change such shared behaviors warrant greater attention. In the context of such interventions, lifestyle changes made by one family member have the potential to catalyze similar changes in another family member, perhaps radiating to other family members, as well (Gorin et al., 2008). Given the high prevalence of diabetes and obesity, prevention and treatment approaches must extend their reach beyond a given individual to make a substantial impact. Although replication studies with additional comparison groups are needed, the promising results of the current study suggest a means by which it may be possible to structure family support interventions to amplify their effectiveness and benefit multiple at-risk family members simultaneously.

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