

Diabetes Prevention and Treatment

Diabetes Prevention for Latino Youth: Unraveling the Intervention “Black Box”

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The translation of research findings into sustainable health promotion and disease prevention programs in community settings remains a challenge. This report describes the process of substantiating a community-developed diabetes prevention program for Latino youth through research. Included are design considerations, measurement strategies, and the context through which the project is culturally grounded for relevance and fit within a local community. The process included (1) refining the program to include salient, stakeholder-identified behavioral components; (2) refining the collaborative effort to embrace the capacity for facilitating relevant behavior change on targeted health-related outcomes to enhance intervention effectiveness; and (3) including the accurate assessment of intervention efficacy via precise assessment of diabetes-related health outcomes. We explain the process of collaborating with community partners to enhance the cultural relevance and sustainability of intervention effects on both individuals and communities. We discuss the rationale for empirical support for academic–community collaborations that function in both a “top-down” and a “bottom-up” manner to advance the science and practice of sustainable and efficacious community health promotion.

Keywords: theory-based intervention; obesity; type 2 diabetes prevention

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► INTRODUCTION

The translation of research findings into sustainable health promotion and disease prevention programs in community settings remains challenging. In part, the success of health education and intervention programs in communities is predicated on organization and delivery factors. These factors include (1) how embedded the program is within the community and (2) the engagement and active participation of community members in the intervention. Considerations have been well discussed in current reports with a focus toward emphasizing behavioral change strategies and their contribution to healthy behavioral change (Shediak-Rizkallah & Bone, 1998). Programs that are proven to be efficacious, that is, that “work,” need to be developed

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with a clear explanation regarding a health-related “goal.” Dedicated involvement of stakeholders in defining these health-related goals as well as stakeholder contributions to the construction of approaches are linked to improvements in measurable health outcomes (Scott & Sechrest, 1989).

Often, community-based prevention programs are perceived by community agencies to be “successful” yet have not been evaluated using rigorous scientific approaches. This remains a major challenge as community programmers implement cogent and culturally relevant interventions, yet fail to systematically assess whether such interventions are improving health outcomes. If an evaluation is conducted, it is limited to measures of attendance and acceptability. Often, there is a disconnect between community-based programming and identification of (1) which program elements were effective as implemented with a given population and (2) what, if any, health outcomes are attributable to the intervention.

This report describes the process of developing a community-driven, evidence-based intervention and highlights relationships between problem definition and intervention development within a nonprofit community-based medical clinic serving a vulnerable population. The process of moving a community-developed education program that addresses obesity-related health disparities for Latino youth from practice to research is described and includes (1) expanding the intervention to include culturally relevant and stakeholder-identified behavioral components; (2) decision making with regard to mediators and moderators that may produce and influence healthy behavior change; (3) the inclusion of relevant, reliable, and valid assessments of health outcomes; and (4) cultural factors that ground the program within the local community context.

► TARGETED HEALTH CONDITIONS AMONG LATINO YOUTH IN COMMUNITIES

Community agencies and organizations that serve families that are at risk for poor health outcomes invest considerable resources into delivering health promotion programs. While these programs are thought to be efficacious or relevant to the needs of the local community, they may lack rigor in the assessment of efficacy and fidelity. These efforts provide an opportunity for collaboration between researchers and community agencies that may lead to direct and measureable benefits for both (Parsai, Castro, Marsiglia, Harthun, & Valdez, 2011).

The disproportionate rates of obesity and type 2 diabetes (T2D) that exist among minority populations

represent a critical opportunity to improve health equity by bridging the translational gap between rigorous science and community practice. Latinos constitute one of the largest and fastest growing segments of the U.S. population but exhibit major disparities in obesity-related diseases that have antecedents early in life. At the population level, Latino adolescents are the most insulin-resistant subgroup (Lee, Okumura, Davis, Herman, & Gurney, 2006) and exhibit the highest rates of prediabetes (Duncan, 2006) and metabolic syndrome (Johnson et al., 2009).

In addition to physical health consequences, obesity in youth is associated with significant psychosocial maladjustments that lead to lower quality of life (QoL) in this population (Zeller & Modi, 2006). Moreover, the pervasive nature of obesity-related stigma across multiple levels of influence including peers, family, educators, and health care practitioners underscores the need to design interventions that address emotional well-being in addition to physical health and health behaviors (Puhl & Heuer, 2009).

► METHODS

Initial Development of Rigor in Community Programming: Proof of Concept

The *first step* deployed in developing a culturally grounded, community-based diabetes prevention program for obese Latino youth was community engagement. This initial partnership served three focal areas to enhance program efforts: (1) to establish community-based resources for addressing the prevention of upstream lifestyle-related behaviors (nutrition and physical activity) that are linked to obesity and subsequent metabolic risk, (2) to integrate cognitive behavioral components into an established education program, and (3) to introduce outcome measures that target with greater precision the etiology of T2D and reduced QoL as observed among obese Latino youth. In collaboration, we conducted a retrospective review of community clients (youth) to (1) identify the risk profile of members of the target population, (2) explore evidence of success in terms of changes in health behaviors and outcomes, (3) evaluate sustainability of the programs effects over time, and (4) identify potential mediators of sustained improvement. This initial project established the prevalence of cardiometabolic risk and highlighted the ability of the clinic to identify and enroll an at-risk population that was in need of targeted T2D prevention. The “proof of concept” work set the stage for the academic–community partnership to further refine and evaluate a community-based diabetes prevention program for obese Latino youth.

Initial Intervention Development, Feasibility Testing

The *second step* in the process refined the partnership to apply a conceptual framework that addressed social, cultural, and environmental influences on population-specific factors. Accordingly, the research team piloted a 12-week lifestyle intervention program in a group of 18 overweight and obese Latino adolescents. Health education was delivered to adolescents and their families in weekly sessions by bilingual/bicultural *promotoras* at the local YMCA. In addition to these education classes, adolescents participated in three 1-hour moderate-to-vigorous physical activity sessions per week that included both structured (i.e., aerobic and resistance exercise) and unstructured (e.g., team sports, swimming, racquetball) activities. The intervention curriculum was developed and manualized to ensure delivery fidelity. Participants were recruited through the community clinic's broad network of referral sources, and outcome measures were collected in a clinical research unit by trained research staff. The primary target outcomes included insulin sensitivity and weight-specific QoL that could be used to estimate preliminary efficacy, effect sizes, and power calculations, which constitute important evidence-based intervention design parameters. The preliminary findings supported the team's ability to recruit and implement a lifestyle intervention tailored to the needs of a vulnerable and underserved population of adolescent youth.

Final Intervention Model

The *third step* included characterizing and developing the behavioral components of the final intervention model. Developing efficacious programs is as important as identifying how and for whom programs work (or do not). This ability is critical for informing and refining interventions to produce a local adaptation of an evidence-based intervention (Castro, Barrera, & Steiker, 2010). This third step incorporated several critical strategies that addressed some of the difficulties in reconciling approaches to health promotion programs developed within academic-community partnerships. The first critical strategy was encouraging culturally and contextually (i.e., neighborhoods and within community venues) embedded community programmers to deconstruct the "black box" of adolescent/family behaviors. Behavioral components were incorporated into the intervention protocol and manualized for delivery fidelity. Research reviews have demonstrated that the core constructs of self-efficacy and social support in social cognitive theory (SCT) operate

as mediators of behavior change within health promotion and disease prevention programs (Bandura, 2004). Elements from SCT constitute core components within many successful diabetes prevention lifestyle programs in adults (Baker, Simpson, Lloyd, Bauman, & Singh, 2011). We acknowledged that contextual influences (e.g., cultural, social, and environmental characteristics) should be addressed as these influences could affect intervention design, delivery, and, ultimately, efficacy.

We used an inductive approach to intervention design, actively including the community partners in the process, eliciting their perspectives in understanding the problem, and adapting the intervention to the setting, cultural preferences, and developmental stage of the participants. This approach to program design combined empirical intervention building predicated on evidence-based reports and incorporated salient variables that would be influential in effecting changes in subsequent outcome variables. Experiential elements from community partners provided concept-specific aspects of the problem to be targeted (e.g., cultural norms for parent and child roles in meal planning, and food purchasing and preparation). In this way, the development of intervention strategies were built within the programming partners group. This approach (compared to empirical approaches) capitalized on stable community partners with tremendous experience and knowledge of the local population. This knowledge was leveraged for finalizing the intervention design and delivery. We worked to develop a curriculum that addressed treatment strength, including decisions regarding the dose, intensity, and duration of the intervention (Scott & Sechrest, 1989). Furthermore, we specified the cognitive behavioral variables that may contribute to sustainable behavioral change. The characteristics of the problem, enhancing self-efficacy and social support for initiating lifestyle changes, and maintaining these behavior changes over time were discussed among the community partners. From this extensive formative work, an intervention model was developed (Figure 1).

Proximal Mediators and Cultural Relevance

We then operationalized the behavioral components of the intervention in the context of the local culture. Two important points were emphasized: (1) the community partners deep and enduring relationships with community constituents where the constructs of SCT included goal setting and enhancing self-efficacy and (2) the need for emphasizing cultural strengths that focus on the family unit. Thus, family

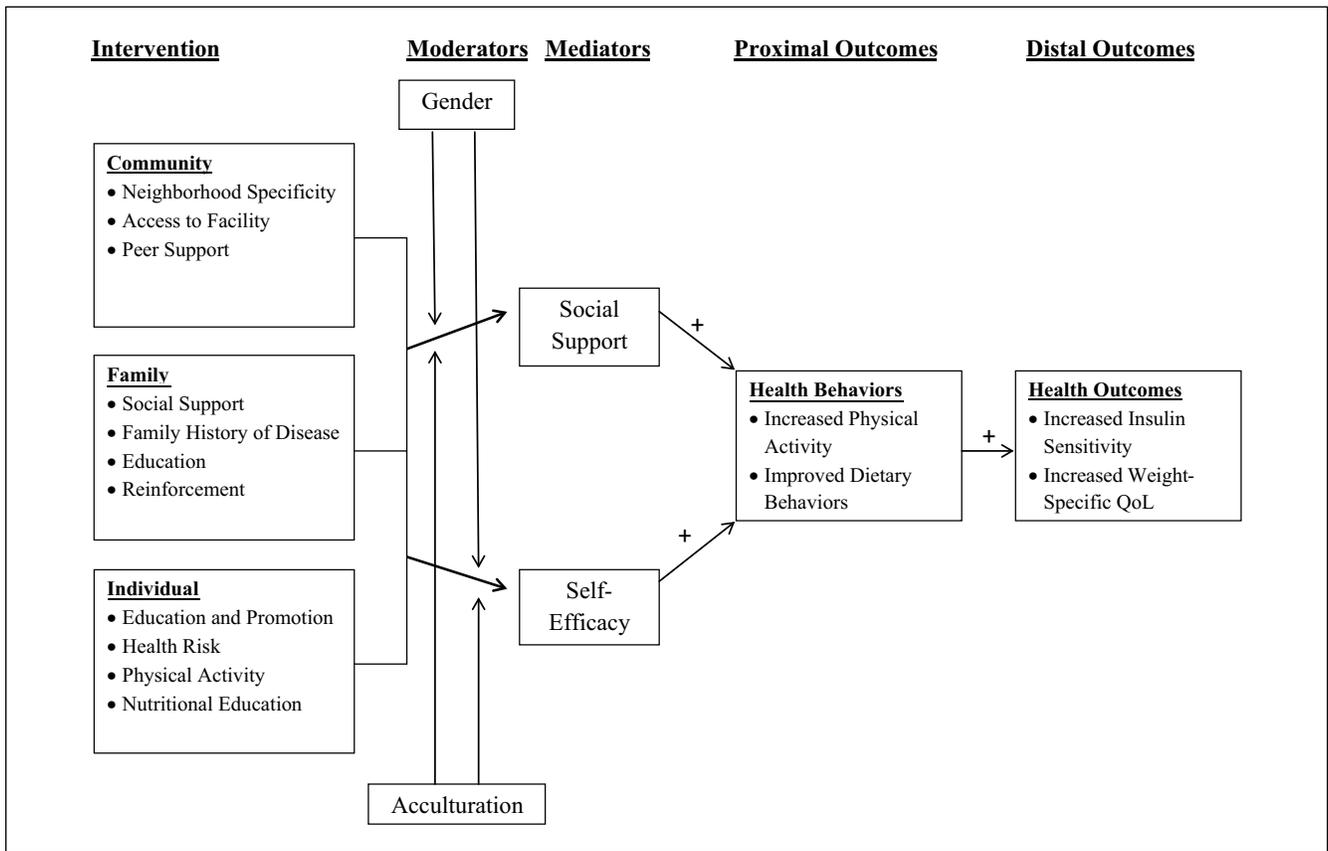


FIGURE 1 Intervention Framework for Critical Inputs of Community, Social, and Individual Factors Applied Using a Culturally Grounded Approach
 NOTE: QoL = quality of life.

activities, developmentally relevant strategies, and cultural factors were operationalized during intervention refinement.

A core value among the Latino culture is *familismo* (familism): the notion that family is a central and important construct in terms of identity, involvement, and influence (Castro & Alarcon, 2002). Similarly important is the concept of collectivism, which refers to the importance given to family as the unit of activity and decision making. Family decision making may be regarded as more important than individual decision making within a collectivistic culture. Accordingly, strong family bonding among many Latino families who exhibit a collectivistic family orientation is a critical leverage point for interventions. These cultural values have been shown to be operationally stronger among many Latino youth as contrasted with youth from other non-Latino groups (Murray-Johnson et al., 2001). For this reason, social support from both family and friends is believed to operate as a major influence

on leisure-time physical activity among Latinos (Marquez & McAuley, 2006). For example, Latino girls receive less support for PA as compared with girls from other racial/ethnic groups (Grieser et al., 2008). Given that social support for physical activity is a primary predictor of physical activity levels over time in youth (Neumark-Sztainer, Story, Hannan, Tharp, & Rex, 2003) and social support is an important predictor of health-related QoL in obese youth (Zeller & Modi, 2006), we hypothesized that *social support* would be a critical theoretical factor (and proximal mediator) that would influence improvements in health behaviors and outcomes.

Social support is characterized by four attributes: instrumental, informational, emotional, and appraisal (Heaney & Israel, 2008), and these attributes were integrated into the intervention design. *Instrumental support* is provided in the form of free YMCA memberships for youth and bus/light rail passes to help families who need transportation assistance to attend the intervention.

Information on how to prevent T2D is delivered didactically in the lifestyle education sessions by promotores. *Emotional support* is intrinsic to the intervention in that it is delivered in a group setting of family members and peers. Physical activity sessions are designed to promote teamwork, encouragement, and bonding among participants and include homework assignments for exercise with family members and friends outside of class. Furthermore, lifestyle education sessions encourage parents to affirm and praise their children daily. *Appraisal* is provided by monthly physical fitness assessments and by individualized nutrition and physical activity goals.

Self-efficacy is proposed as an important factor that is antecedent to behavior change (Bandura, 2004). This construct is regarded as an important mechanism that influences both dietary and physical activity behavior change among youth (Cerin, Barnett, & Baranowski, 2009; Lubans, Foster, & Biddle, 2008). Accordingly, *self-efficacy enhancement* for healthy eating and physical activity is a critical factor that we hypothesize as a proximal mediator of behavior change related to maintaining healthy behaviors and improved health outcomes. Table 1 presents descriptors of how the mediators of social support and self-efficacy are operationalized in the context of this intervention along with the instruments used to assess these constructs as they pertain to behavior change.

Moderators

Additional measures were discussed regarding potential influence on intervention efficacy. Cross-sectional analyses from National Health and Nutrition Examination Survey have identified important gender interactions in the associations between health behaviors (nutrition and physical activity) and obesity-related health outcomes in youth with interactions differing by racial/ethnic subgroupings (Bremer, Byrd, & Auinger, 2010). We proposed to explore gender as a potential moderator of intervention effects.

Given the complex, multidimensional processes underlying cultural adaptation, several tools to assess acculturation status will be employed. Relevant acculturation factors included country of origin, preferred language in the home and with friends, and parents/grandparents country of origin. Comprehensive multidimensional measures of acculturation included the brief Acculturation Rating Scale for Mexican Americans-II (ARSMA-II) for youth (Bauman, 2005). In addition to the ARSMA-II, the Acculturation, Habits, and Interests Multicultural Scale for Adolescents (AHIMSA) developed by Unger et al. (2002) will be

implemented. The AHIMSA is an eight-item scale developed specifically to assess acculturation in adolescents through multiple cultural preference domains. Previous work employing both the AHIMSA and ARSMA-II in a sample of Latino youth found only modest correlations between the two scales ($r = .15-.40$) and suggests that each scale may tap a different aspect of acculturation (Unger, Ritt-Olson, Wagner, Soto, & Baezconde-Garbanati, 2007).

Lifestyle Curriculum

The curriculum was developed and refined through the team's extensive experience working with obese Latino youth. The intervention is delivered in the community by bilingual/bicultural promotores to adolescents and their families. Promotores deliver weekly education classes in groups that focus on healthy eating, family roles and responsibilities, physical activity and inactivity, and emotional well-being. Participants are presented with their baseline clinical metabolic measures, and this information is used to initiate the discussion on making healthy lifestyle choices. Participants learn behavior change strategies, such as goal setting, self-monitoring, decision making, and positive self-talk as they pertain to health risks, nutrition education (i.e., healthy meal planning, reducing sugar and fat intake), physical activity, and self-efficacy for making healthy nutrition and activity choices. Classes are delivered using an interactive format where youth and families are encouraged to share their personal experiences, beliefs, successes, and challenges. Out-of-class activities (e.g., shopping for and preparing a healthy meal) are used to facilitate curriculum integration into day-to-day lifestyle changes. Throughout the program, youth and their families are asked reflection questions of how they incorporate information into their everyday life (e.g., "What did you do last week to improve how you feel about yourself?"). Recognizing the importance of ongoing support after the intensive intervention, we incorporate three booster sessions delivered on a monthly basis following the 12-week intervention.

Health Behaviors and Outcomes

Primary behavioral determinants of diabetes-related health include nutrition and physical activity. Physical activity is measured using the 3-Day Physical Activity Recall (3DPAR), an interviewer-administered recall instrument that measures the type of physical activity performed during the past 3 days (e.g., Tuesday, Monday, Sunday). The 3DPAR captures up to 55 activity types performed every 30 minutes between 7:00 a.m. and

TABLE 1
Intervention Components and Operational Assessment of Mediators

<i>Mediation Concept</i>	<i>Didactic Intervention</i>	<i>Family/Peer Activities</i>	<i>Operational Assessment of Mediating Variables</i>
Social support for healthy eating and physical activity	<ul style="list-style-type: none"> • Parent/child reflection: Why is it important to you to be healthy? • Setting an example for your child • Setting an example for your siblings • Parent's role in healthy eating • Importance of teamwork to support exercise habits 	<ul style="list-style-type: none"> • Homework assignment: Family discussion on how to help each other be healthy • Grocery shopping with parents to prepare a healthy family meal • Eating as a family • Reading food labels as a family • Group exercise class • Peer affirmation of positive exercise goals • Exercising as a family 	The PACE+ Physical Activity and Diet Survey for Adolescents assesses support from family and peers for physical activity and nutrition behaviors. Reliability for support from family ranges from .74 to .76 (ICC = .82) for fruits and vegetables, .77 to .78 (ICC = .67) for dietary fat, .79 (ICC = .79) for physical activity, and .90 (ICC = .93) for physical inactivity. Reliability for support from peers ranges from .74 to .82 (ICC = .43) for fruits and vegetables, .80 to .89 (ICC = .70) for dietary fat, and from .60 to .75 (ICC = .69) for physical activity.
Self-efficacy for healthy eating and physical activity	<ul style="list-style-type: none"> • Child Reflection—what positive lifestyle changes did you make this week? • Children's responsibility for portion control and healthy eating (e.g., responsible snacking) • Awareness of what, when, and why we eat • Importance of goal setting • Discussion of barriers and roadblocks to reaching goals 	<ul style="list-style-type: none"> • Weekly reflection on dietary and physical activity goals • Develop healthy menu • Review progress of monthly physical activity assessments • Plan and practice strategies to overcome barriers and setbacks • Write 2 to 3 positive affirmations and practice each morning • Create a monthly fitness goal • Create personal belief statements related to nutrition and physical activity goals 	The PACE+ Physical Activity and Diet Survey for Adolescents assesses self-efficacy for eating fruits and vegetables and limiting dietary fat intake, as well as self-efficacy for physical activity. Reliability for fruit and vegetable consumption ranges from .77 to .87 (ICC = .81). Reliability for dietary fat ranges from .90 to .93 (ICC = .79). Reliability for physical activity ranges from .76 to .84 (ICC = .71).

NOTE: PACE = patient-centered assessment and counseling for exercise; ICC = intraclass correlation coefficients.

midnight. Each day is broken up into morning, afternoon, and evening to aid in recall. Participants recall the primary type of activity (e.g., sleep/bathing, eating, after-school chores, sports, and watching TV) performed during each 30-minute block and rate each activity as light, moderate, hard, or very hard. Pictures of activities are provided to help respondents assess the intensity of each activity (Pate, Ross, Dowda, Trost, & Sirard, 2003). The 3DPAR allows for assessment of time spent in sed-

entary behaviors and types of activity that can be useful to identify differences in activity patterns between adolescents (Pratt et al., 2008). Activities selected for each 30-minute period are assigned a MET (metabolic equivalent of task) level with summary scores tallied as total METs/day.

Dietary intake is measured using the 2007 Block Food Screener for Ages 2-17 (Nutrition Quest, 2007). This 41-item screener assesses foods eaten during the

previous week and was designed to identify dietary intake by food group. The focus of this questionnaire is the intake of fruit and fruit juices, vegetables, potatoes (including French fries), whole grains, meat/poultry/fish, dairy, legumes, saturated fat, and “added sugars” (in sweetened cereals, soft drinks, and sweets). The questionnaire includes items commonly consumed by Latino youth (e.g., *licuados*).

Primary diabetes-related outcomes include insulin sensitivity and glucose tolerance, which are assessed via a multiple-sample oral glucose tolerance test. Blood samples are collected to assess plasma glucose and insulin at fasting and at 30, 60, 90, and 120 minutes after ingestion of 75 g of glucose in solution. Insulin sensitivity is estimated by the whole-body insulin sensitivity index using plasma glucose and insulin values as described by Matsuda and DeFronzo (1999). The whole-body insulin sensitivity index provides an estimate of in vivo insulin action that combines liver and skeletal muscle insulin sensitivity and has been shown to correlate reasonably well ($r = .78, p < .0005$) with the gold standard hyperinsulinemic-euglycemic clamp in obese youth (Yeckel et al., 2004). Additional diabetes-related measures that are captured from the oral glucose tolerance test include fasting and 2-hour glucose values to differentiate normal from prediabetic youth per the American Diabetes Associations guidelines, estimates of insulin secretion by the insulinogenic index using fasting and 30-minute insulin and glucose concentrations (Phillips, Clark, Hales, & Osmond, 1994), and β -cell function by the disposition index as the product of insulin sensitivity and insulin secretion (Bergman, Ader, Huecking, & Van Citters, 2002). Collectively, these assessments provide a comprehensive assessment of diabetes risk that are proximally related to the pathophysiology of T2D and are sensitive to change in response to lifestyle intervention.

In addition to diabetes-related health outcomes, the primary psychosocial health outcome that is assessed is weight-specific QoL. Weight-specific QoL is assessed using the multicultural Weight and Quality of Life Instrument. This instrument measures three domains related to QoL (Self, Social, and Environmental) and was developed using ethnographic methods drawing directly on the experiences of and language used by youth from diverse ethnic backgrounds. It is specific to overweight adolescents (11-18 years) for use in evaluating weight-related interventions in clinical and community research (Morales, Edwards, Flores, Barr, & Patrick, 2011). The instrument may be more sensitive than generic measures for detecting QoL changes in obese youth participating in lifestyle interventions (Patrick et al., 2011).

► RESULTS

Three significant processes occurred during intervention development that served to guide the framework for the current study. First, the notion of designing rigorous intervention research in a community setting was incorporated into a deeply embedded, long-standing, and respected community-based lifestyle education program for Latino adolescents. The established community program had well-developed educational elements that were culturally grounded and developmentally appropriate. However, the causal mechanisms supporting changes in health behaviors and effects on specific health outcomes were not clearly defined or enacted resulting in a “black box” intervention. Thus, the second step entailed collaborative planning efforts, reconciliation of behavioral elements and their terms, as well as definitions and operational assessment of measures. In addition, we were able to hypothesize critical intervention components that may effect changes in health behaviors and outcomes. These intervention components were integrated into the education intervention and explicitly assessed. Third, the study design incorporated clearly defined measures (to assess intervention effectiveness and determine what “works”) in terms of health behaviors and health outcomes and was tested using a rigorous, randomized controlled design. This latter component is a critical and necessary step because success in program implementation is important only if the program is shown to be effective and *worth* implementing (Shediac-Rizkallah & Bone, 1998).

These considerations are directly related to sustainability issues surrounding both community-based interventions that are delivered “top-down” from academics and “bottom-up” from community agencies. In general, “top-down” programmatic interventions are less sustainable without “mutually respectful negotiations” with community stakeholders to establish trust and build capacity in the local community. These community relations and structures are needed to maintain health benefits resulting from programs and to sustain effective programs via support from organizational structures (Shediac-Rizkallah & Bone, 1998).

Engagement in the negotiation process and targeting reconciliation of top down/bottom up programming served our team in building capacity that would facilitate expansion to other at-risk community members, individuals, families, and systems through programs and policies. We further promote community capacity using a prevention framework that can be expanded beyond traditional biomedical models through cost-effective approaches and mutually beneficial academic–community partnerships.

► CONCLUSIONS

We offer several conclusions salient to this report and related to community-based partnering in the design of community-embedded prevention interventions. First, by necessity, the integration of community setting interventions, largely educational, and academic theory-based interventions may be optimized by “top-down” and “bottom-up” approaches. Second, this negotiation processes will contribute directly to program sustainability through clearly delineated mechanisms of behavioral change, as well as evaluation of health-related outcomes that have great potential to show program efficacy to improve the long-term health of adolescent Latinos. Third, both the intervention design and the program delivery that is overseen by strong community leadership can contribute to the development of explanatory models that dissect how interventions work and with whom.

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