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Perceived Influences on Physical Activity and Diet in Low-income Adults from Two Rural Counties

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Abstract

Background—Despite the increased use of ecological models in health behavior research, multilevel influences on health behaviors in rural, low-income people, an aggregate at high risk for sedentary behavior and inadequate diets, have been examined in few studies.

Objective—To describe influences on physical activity and diet in low-income, rural adults.

Method—A cross-sectional survey was conducted using face-to-face interviews in a convenience sample of 137 low-income Anglo and Latino adults recruited from two rural Wisconsin counties. The survey included questions on health behaviors, self-efficacy, barriers, social support, and community environments. Self-report data on physical activity and fruit and vegetable intake were categorized into outcome variables of *meets recommendation* or *does not meet recommendation*. Latent class cluster analysis was used to identify clusters of participants with similar influences on health behaviors, and cluster membership was used as an independent variable in logistic regression of physical activity and diet outcomes.

Results—Fifty-two percent of participants met a recommendation for physical activity, but only 8% met their MyPyramid recommendation for fruit and vegetable intake. Participants in the Moderate Self-Efficacy/High Safety cluster were significantly more likely than those in the Low Self-Efficacy/Moderate Safety cluster to meet a recommendation for physical activity (odds ratio [OR] = 2.65). For healthy diet, participants in the Low Barriers cluster were significantly more likely to eat more fruits and vegetables (OR = 4.13) than those in the High Barriers cluster.

Discussion—People with healthier behaviors were distinguished from those with less healthy behaviors by higher levels of intrapersonal, interpersonal, and community supports. Results support the importance of multilevel approaches to promoting healthy lifestyles in rural, low-income adults.

Keywords

low-income; rural population; health behavior

Abundant evidence for the health benefits of physical activity and diets rich in fruits and vegetables has accumulated in recent years. Despite the well-recognized role in risk reduction for major causes of morbidity and mortality, such as cardiovascular disease, stroke, and type 2 diabetes, the prevalence of these health-promoting behaviors remains low in the United States adult population. Only 50% of adults report moderate or vigorous physical activity at recommended levels, and just 24% report eating five or more daily servings of fruits and vegetables (Centers for Disease Control and Prevention [CDC], 2008).

Population subgroups at high risk for inactivity or inadequate diets include people with low incomes and those living in rural areas. People with lower incomes are less likely to meet recommendations for moderate or vigorous physical activity than higher-income people (National Center for Health Statistics [NCHS], 2007). Studies examining disparities in physical activity have found that rural residents are less likely than people in urban areas to be physically active (Patterson, Moore, Probst, & Shinogle, 2004) and, within rural populations, people with lower incomes are less active than people with higher incomes (Parks, Housemann, & Brownson, 2003). Low-income people also report less healthy diets than those with higher incomes (Drewnowski, 2004) and spend less on fruits and vegetables (Stewart, Blisard, & Jolliffe, 2003).

Environmental factors may help to explain the lower prevalence of healthy lifestyle behaviors in low-income and rural populations. Increasingly, research on physical activity and dietary practices is guided by ecological models proposing that health and health behaviors are influenced by environmental and social factors as well as individual characteristics (Sallis & Owen, 2002). High produce prices and limited access to grocery stores may limit fruit and vegetable consumption in rural areas (Krebs-Smith et al., 2001). Perceived access to recreational trails is associated positively with physical activity in poor rural areas (Wilson, Kirtland, Ainsworth, & Addy, 2004) and use of recreational trails increases walking in rural, low-income adults (Brownson et al., 2000). Rural White women in a focus group study indicated that lack of sidewalks, uneven pavement, and distance to resources such as parks or exercise facilities were impediments to physical activity (Eyler & Vest, 2002).

Few studies of rural or low-income populations have examined a range of individual, social, and environmental influences on physical activity or diet. Wilcox and others found that individual, social, and perceived environmental variables were significant predictors of physical activity in older rural women (Wilcox, Bopp, Oberrecht, Kammermann, & McElmurray, 2003). In a sample of urban low-income women, women with higher support from family and friends, health care providers, and community organizations were more likely to meet physical activity guidelines and have healthier diets (Bull, Eakin, Reeves, & Kimberly, 2006). Self-efficacy was the strongest direct correlate of physical activity and a mediator for the effects of social and physical environments in a sample of lower and middle-income urban adults (McNeill, Wyrwich, Brownson, Clark, & Kreuter, 2006).

Despite the increased use of ecological models in health behavior research, no studies have applied a comprehensive ecological model to the health behaviors of rural, low-income adults of any ethnicity. Low-income Latinos represent a rapidly growing segment of the rural population, and public health and community agencies serving low-income clients in rural areas are facing demands for health promotion programming that can meet the needs of Latinos as well as the majority Anglo population (Riffe, Turner, & Rojas-Guyler, 2008). The purpose of this study was to describe perceived influences on physical activity and diet in an ethnically diverse sample of low-income adults in two rural southeastern Wisconsin counties.

Methods

An interview survey was designed and administered as part of a larger project to develop an action plan for promoting healthy lifestyles in the study counties. A community-based participatory research orientation was used as the overarching approach for the project (Minkler & Wallerstein, 2003). A four-person project team representing the major community and academic partners managed all activities related to the study. The project team was supported by a Community Advisory Committee and diverse partners in the community, including interpreters, public health nurses, clergy, business owners, and service providers. The academic and community partners were involved jointly in coordinating the project; building community support; modifying and translating study instruments; recruiting participants; administering surveys; analyzing data; and producing reports and presentations to share with community stakeholders. Recruiters and interviewers completed a training module in the protection of human subjects. The study was approved by the Minimal Risk Health Sciences Institutional Review Board at the University of Wisconsin-Madison.

Setting

The study was conducted in two rural Wisconsin counties, defined by the U.S. Census Bureau as non-metropolitan statistical areas. The combined population of the counties is 169,008. The largest city straddles the border between the two counties and has a population of 21,598. The Latino population in each county increased more than 100% between 1990 and 2000 and, since 2000, the counties' growth rates in Latino populations have exceeded the national growth rate (U.S. Census Bureau, 2008).

Sample

Inclusion criteria for the study participants included age 18 years or older; English-speaking or Spanish-speaking; residency in one of the study counties; and annual household income not greater than 200% of 2006 Federal Poverty Guidelines for reported household size (U.S. Department of Health and Human Services, 2006). For a family of four, the maximum household income to qualify for the study was \$40,000. Recruitment was stratified by county, ethnicity, and gender. Latinos were oversampled because they represent an increasingly important client population for community agencies in the study counties.

Face-to-face recruitment was conducted at free clinics, a church, local health and human services departments, job centers, free meal programs, a literacy council, and grocery stores. Interested individuals received an information sheet, and consent was implied by participating in an interview. Interviews were conducted immediately after recruitment in a private area or scheduled for completion at a later date. Interviews were conducted in either English or Spanish; the Spanish interviews were conducted by certified bilingual interpreters. Interviews lasted about 40 minutes, and participants received \$5.00 at the end of the interview.

Measures

An ecological model of health describing multiple determinants of health behavior was used (McLeroy, Bibeau, Steckler, & Glanz, 1988; see Figure 1). At the core of the model are intrapersonal factors such as individual knowledge, skills, attitudes, and behaviors. Interpersonal processes are social networks and social support systems. Organizational factors are practices, policies, and environments within organizations, such as workplaces or schools. Community factors include resources and the physical environment. Public policy includes laws and regulations enacted by government agencies.

The survey instrument was adapted from one developed to measure physical activity behavior and individual, social, and environmental influences on physical activity among adults (Brownson, Baker, Housemann, Brennan, & Bacak, 2001; Brownson et al., 1999). Included on the survey were items on diet, physical activity, and smoking behaviors; barriers, self-efficacy, and social support for healthy behaviors; community and workplace environments; self-reported height and weight; and general health and demographics.

The survey was translated from English to Spanish by a native Spanish speaker, and back-translated from Spanish to English by a native English speaker who was masked to the original survey. The lead author and a bilingual consultant compared the back-translation to the original survey to appraise semantic equivalence (Maneesriwongul & Dixon, 2004). Items lacking equivalence were given another round of translation, back-translation, and appraisal.

English and Spanish versions of the survey were pilot-tested with members of the target population to assess response burden, comprehensibility, and acceptability. After an initial round of pilot testing with 12 participants, two changes were made to the survey format. First, the barriers items were revised to state the health behavior of interest explicitly. For example, the statement “I don’t have time to prepare healthy foods” was revised to “I don’t eat healthy because I don’t have time to prepare healthy food.” Second, for questions on barriers, self-efficacy, and social support, items were reformatted to use a two-step process for selecting an answer. For example, rather than asking participants to select an answer from a 4-point Likert scale (strongly agree, agree, disagree, strongly disagree), participants first were asked if they agreed or disagreed, and then asked them to make a finer distinction (“Do you strongly agree or just agree?”) A second round of pilot testing with six participants confirmed that the two-step process facilitated participant response. The final survey contained 63 questions and had a Flesch-Kincaid reading level of 5th–6th grade.

Influences on physical activity and healthy diet were measured using behavior-specific scales to address self-efficacy, barriers, social support, and community resources; there was also a community safety scale for physical activity. Self-efficacy questions are derived from subscales with Cronbach’s alpha ranging from 0.83 to 0.93 (Sallis, Pinsky, Grossman, Patterson, & Nader, 1988). The social support scales have demonstrated moderate test-retest reliability (Cohen’s kappa 0.4) and adequate internal consistency (Cronbach’s alpha = 0.70; Eyler et al., 1999). Items addressing barriers to physical activity have demonstrated fair or moderate test-retest reliability (Cohen’s kappa 0.2 – 0.6; Brownson et al., 1999). The psychometric properties of questions on barriers to fruit and vegetable intake are unknown.

For analysis, three additional scales were created by combining survey items. Two questions on traffic safety and criminal safety in the community were combined to create a community safety scale for physical activity. These questions have demonstrated moderate test-retest reliability (intraclass correlation coefficients 0.58 – 0.60; Brownson et al., 2004). A healthy diet resources scale consisted of two questions on the availability and cost of fruits and vegetables in the community. The physical activity resources scale consisted of seven yes-no items (scored 1-0) about the presence of features that may facilitate activity, such as sidewalks or parks.

For analysis, the least positive response in each set was coded 0, so that higher scale scores always corresponded to healthier responses (higher self-efficacy, higher social support, lower barriers). The barriers scales had five choices (4 = *never a barrier*, 0 = *very often a barrier*). Four-point scales were used to measure self-efficacy (3 = *I’m sure I could do it*, 0 = *I’m sure I could not do it*), social support (3 = *strongly agree*, 0 = *strongly disagree*),

safety (3 = *very safe*, 0 = *very unsafe*), and healthy diet resources (3 = *very available* or *very inexpensive*, 0 = *very unavailable* or *very expensive*).

Measures of physical activity and healthy diet were used as both descriptive and outcome variables. Two survey questions on physical activity, originally developed in the Behavioral Risk Factor Surveillance System (BRFSS; CDC, 2003), were used to address time spent doing moderate or vigorous physical activity in a usual week; the questions included definitions and examples of moderate and vigorous. Examples of moderate physical activity included brisk walking and bicycling, and examples of vigorous activity included running and aerobics. To account for occupational physical activity, each list of examples was modified by adding work as another possible example of moderate or vigorous physical activity. The original BRFSS questions have demonstrated validity and reliability (Ainsworth et al., 2000). The scoring for the physical activity variables was based on a recommendation of 30 minutes of moderate activity five times per week or 20 minutes of vigorous activity three times per week (Haskell et al., 2007). Participants who reported 150 or more total weekly minutes of moderate physical activity or 60 or more minutes of vigorous physical activity were categorized as meeting a physical activity recommendation.

Two survey questions addressed average daily servings of fruits and vegetables during the previous week; the questions included definitions of *serving*. A case-specific recommendation for fruit and vegetable intake was created for each participant (Table 1). Using established formulas for estimated energy requirements (Institute of Medicine, 2005), recommended daily calorie intakes were calculated based on self-reported gender, age, height, weight, and physical activity level. Participants were then classified into one of 12 food intake patterns created for the U.S. Department of Agriculture MyPyramid Food Guidance System (Britten, Marcoe, Yamini, & Davis, 2006). Each food intake pattern specifies daily amounts of food (in cup units) to consume from basic food groups, including fruits and vegetables, to meet calorie requirements and recommended nutrient intakes. Cup units in the intake patterns were converted to servings ($\frac{1}{2}$ cup = 1 serving), the unit used in the survey questions, and fruit and vegetable recommendations were combined to create an overall recommendation for each participant. MyPyramid recommendations for total fruit and vegetable intake range from 4 daily servings for the 1000-calorie intake pattern to 13 servings for the 3200-calorie intake pattern, and 5 daily servings is considered adequate only for the 1000 and 1200 calorie intake patterns (Britten et al.). A ratio of self-reported servings to recommended servings was calculated as a measure of healthy diet, and a two-level healthy diet variable was created based on the median split of this ratio. Diets in the upper half of the ratio distribution (ratio ≥ 0.364) were coded 1 and those in the lower half were coded 0. For purposes of comparison, a *five a day* dichotomous variable (five or more servings daily, less than five servings daily) was created also.

Age, gender, education, employment status, and health insurance were addressed in demographic questions. Body mass index (BMI) was calculated from self-reported height and weight, and participants were categorized into standard categories of normal weight (BMI < 25), overweight (BMI 25.0–29.9), or obese (BMI ≥ 30.0).

Analysis

Survey data were coded numerically and entered into Stata 9.2® for analysis. Random checks were performed on 10% of the surveys to verify accurate coding and data entry. Descriptive analysis included item frequencies and scale means. Reported univariate frequencies are based on the total sample of 137 participants unless otherwise noted. Internal consistency of scales was assessed with Cronbach's alpha. Bivariate analysis included Pearson's chi-square, Fisher's exact, and student's t-test.

Multivariate analysis included latent class cluster analysis using LatentGOLD® version 4.5 and logistic regression. Latent class cluster analysis (LCA) is an approach to identifying subgroups containing cases that are similar on specific criteria. A common application of LCA is in the field of marketing to identify market segments of customers with specific attitudes, preferences, and values. In health promotion research, the identification of subgroups based on similar characteristics can inform the development of specific services for particular segments within a population. The LCA technique does not rely on assumptions of linearity, normality, or homoscedasticity (Vermunt & Magidson, 2002). Program output includes indices of model fit and a classification error statistic that estimates the proportion of observations that are classified incorrectly in a given model. When comparing successive cluster models, lower values for fit indices and classification error indicate improved fit.

Two separate LCAs were conducted for physical activity and healthy diet, using the five physical activity scales (self-efficacy, barriers, social support, safety, and resources) and the four healthy diet scales (self-efficacy, barriers, social support, and resources). Means for each behavior-specific scale were used as indicators in the models, except the physical activity resources scale, which was entered as count data. Each LCA started with a one-cluster model and progressed to two- and three-cluster models; each model included all of relevant scales for the behavior of interest. Only cases meeting a criterion of completeness for an individual scale (data for at least 75% of items in scale) were included in calculations of scale means and the cluster analysis. For each model, a profile plot was generated to graphically display the standardized scale means for each cluster.

Classification statistics from the LCA, indicating cluster assignment for each case, were used in logistic regression analysis. Cluster assignments were used as predictors of dichotomous physical activity and healthy diet outcomes. Clusters with predominantly lower scale means were coded 0 and used as referents. Covariates were added to logistic regression models with statistically significant findings to assess whether demographic factors attenuated the relationship between clusters and outcomes. Findings are presented as odds ratios (OR) and 95% confidence intervals (CI) for achieving the behavior of interest.

Results

Demographics

The demographic characteristics of the study sample are displayed in Table 2. The mean age of participants was 42.8 years. Most of the Latinos ($n = 62$, 82%) reported their ethnic group as Mexican. A majority of participants ($n = 100$, 73%) reported annual household incomes of less than \$20,000. Twenty-nine percent ($n = 40$) reported excellent or very good health status, 64% ($n = 87$) reported good or fair health, and 7% ($n = 10$) reported poor health. There were no significant differences in self-reported health status by ethnicity. Among participants who provided height and weight data ($n = 122$), 31% were classified as normal weight, 34% as overweight, and 34% as obese. Latinos were significantly more likely to be normal weight, compared to overweight or obese, than Anglos ($\chi^2 = 4.425$, $df = 1$, $p = .035$), but after controlling for age, the difference was no longer statistically significant. Twenty-five percent of participants were current smokers, and Latinos were significantly less likely than Anglos to smoke ($\chi^2 = 12.436$, $df = 1$, $p < .001$). Only 13% ($n = 10$) of Latinos were smokers, compared to 39% ($n = 24$) of Anglos.

Physical Activity and Diet Behaviors

The most frequently reported physical activities were walking and housework; each of these activities was ranked as the most frequent type of physical activity by 36% ($n = 50$) of

participants. Fifty-five percent of women ($n = 43$) reported housework as their most common activity, compared to 12% of men ($n = 7$), while 46% of men ($n = 27$) reported walking as their most common activity, compared to 29% of women ($n = 23$). Thirty-eight percent ($n = 52$) met the recommendation of 150 weekly minutes of moderate physical activity, and 31% ($n = 42$) met the recommendation for 60 weekly minutes of vigorous physical activity. Overall, 52% ($n = 72$) met at least one of the physical activity recommendations. Adults 70 years of age or older were less likely to meet a physical activity recommendation (Fisher's exact test, $p = .022$), but there were no other differences by ethnicity, gender, or age.

Thirty-six percent of participants ($n = 49$) ate five or more servings of fruits and vegetables daily. MyPyramid recommendations for daily fruit and vegetable intake ranged from 5 to 13 total servings, and the average number of recommended servings was 10.5 ($SD = 1.89$). Very few participants met their MyPyramid recommendation for daily fruit and vegetable servings. The median healthy diet ratio was 0.36. Nine people (7.6%, $n = 118$) had healthy diet ratios of at least 1.0, indicating that their total daily fruit and vegetable intake met or exceeded their MyPyramid recommendation; four of these individuals also met the physical activity recommendation. There were no statistically significant differences among ethnic, gender, or age groups on being closer to, as opposed to further from, meeting the recommendation.

Influences on Health Behaviors

Descriptive data for the behavioral scales are shown in Table 3. Comparing across behaviors, means for self-efficacy, social support, and barriers were slightly higher for healthy diet compared to physical activity, with higher scores representing a more positive response (e.g., greater self-efficacy or social support, fewer barriers). The difference between social support means for physical activity and healthy diet was statically significant ($t = -1.98$, $df = 135$, $p = .049$). In group comparisons of scale means, Latinos had significantly lower self-efficacy for a healthy diet than Anglos ($t = -3.19$, $df = 134$, $p = .0018$) and lower healthy diet resources ($t = -3.25$, $df = 128$, $p = .0015$), but there were no other significant differences in scale means by ethnicity, gender, or age groups. Internal consistencies were highest for the barriers and social support scales and lowest for the healthy diet resources scale.

Cluster Analysis

The fit indices for the cluster models are displayed in Table 4. For each behavior, the models with 2 and 3 clusters were retained for use in logistic regression, based on their acceptable fit indices and classification error. Results are presented only for models with statistically significant findings in logistic regressions: the 3-cluster solution for physical activity and the 2-cluster solution for healthy diet. In the 3-cluster solution for physical activity, the Low Self-Efficacy/Moderate Safety cluster ($n = 48$) had the lowest standardized means for self-efficacy, barriers, and social support. The Moderate Self-Efficacy/High Safety cluster ($n = 29$) was distinguished by a high standardized mean for the safety scale. The High Self-Efficacy/Low Safety cluster ($n = 44$) had the highest means for self-efficacy and barriers, but the lowest means for safety and physical activity resources. In the 2-cluster solution for healthy diet, means were lower for the High Barriers cluster ($n = 76$) than the Low Barriers cluster ($n = 53$) on all four scales (self-efficacy, barriers, social support, and resources), with the largest relative difference on the barriers scale. There were no statistically significant differences in cluster membership for healthy diet or physical activity models by ethnicity, gender, or age groups.

Logistic Regression

Results of the logistic regression of physical activity and healthy diet outcomes on behavior-specific cluster solutions are displayed in Table 5. People in the Moderate Self-Efficacy/High Safety cluster ($n = 44$) were significantly more likely than those in the referent cluster, Low Self-Efficacy/Moderate Safety ($n = 48$), to meet a physical activity recommendation ($OR = 2.65$, $CI = 1.13, 6.25$, $p < .05$). This finding remained statistically significant when ethnicity, gender, and age were added to the model. There were no statistically significant differences in physical activity between the High Self-Efficacy/Low Safety cluster ($n = 29$) and the referent Low Self-Efficacy/Moderate Safety cluster. There were also no statistically significant differences in physical activity between the Moderate Self-Efficacy/High Safety cluster and the High Self-Efficacy/Low Safety cluster (logistic regression results not shown).

The 2-cluster solution for healthy diet generated statistically significant results. People in the Low Barriers cluster ($n = 53$) were significantly more likely than people in the referent High Barriers cluster ($n = 76$) to be closer to meeting their MyPyramid recommendation for fruit and vegetable intake ($OR = 4.13$, $CI = 1.82, 9.39$, $p < .001$). This difference remained significant when demographic variables were included as covariates.

Discussion

Despite the disadvantages imposed by limited financial resources, some participants in this study were able to engage in recommended levels of physical activity or eating five daily servings of fruits and vegetables. Approximately one-third of the study participants reported five daily servings of fruits and vegetables. Notably, when MyPyramid recommendations were used to assess diet, only 8% of participants met their recommendation. These results suggest that surveillance data based on the five-a-day recommendation are likely to overestimate adequate daily consumption of produce.

In the study sample, the prevalence of meeting a recommendation for physical activity was higher than nationwide rates for low-income populations (CDC, 2008). These findings may reflect the inclusion of occupational activity in the measures of physical activity. Occupational activity can make important contributions to overall levels of physical activity, especially in low-income populations and racial and ethnic minorities (CDC, 2000; Marquez, Bustamante, McAuley, & Roberts, 2008). The lack of statistically significant differences between ethnic groups on meeting physical activity recommendations contrasts with nationwide data which consistently indicate a lower prevalence of physical activity in Latinos compared to Anglos (NCHS, 2007). The inclusion of occupational activity in the study definition of physical activity may account for this difference, since Latinos were more likely than Anglos to be employed.

Only four participants (3%) met both a physical activity recommendation and their MyPyramid recommendation for fruits and vegetables. Nationwide, the combined prevalence of physical activity and eating five-a-day in adults is 14.6% (Kruger, Yore, Solera, & Moeti, 2005). Findings from the current study, using a more stringent standard for meeting fruit and vegetable recommendations, suggest that this low rate would be reduced even further if dietary guidelines based on the MyPyramid algorithms were used to gauge adequate intake of fruits and vegetables.

Multilevel influences on health behaviors were evident in this ethnically diverse sample. In the model for physical activity, people in the Moderate Self-Efficacy/High Safety cluster and the High Self-Efficacy/Low Safety cluster had greater self-efficacy, fewer barriers, and higher social support than participants in the Low Self-Efficacy/Moderate Safety cluster.

However, only participants in the Moderate Self-Efficacy/High Safety cluster were significantly more likely to meet a physical activity recommendation than participants in the Low Self-Efficacy/Moderate Safety cluster. Perceptions of safety may account for the differential effects of intrapersonal and interpersonal factors. The High Self-Efficacy/Low Safety cluster exhibited the highest means for intrapersonal factors, but the lowest mean for perceived safety; the lack of difference in physical activity outcomes between this cluster and the Low Self-Efficacy/Moderate Safety cluster suggests that perceived safety may buffer people from the effects of low self-efficacy or high perceived barriers. As a corollary, perceived safety may be less salient for people who are confident of their ability to be active and who perceive few barriers--there were no significant differences in physical activity outcomes between the Moderate Self-Efficacy/High Safety cluster and the High Self-Efficacy/Low Safety cluster, which had comparably high ratings on intrapersonal factors. Perceptions of safety may be amenable to change through environmental engineering, as well as community-based interventions that expand social networks and create structured opportunities for participating in physical activity with other people (Griffin, Wilson, Wilcox, Buck, & Ainsworth, 2008).

For healthy diet, people in the High Barriers cluster, who were significantly less likely to have a healthier diet, were distinguished from people in the Low Barriers cluster by every influence measured, including higher perceived barriers, lower self-efficacy, lower social support, and fewer resources for healthy diet. The large difference between the two clusters on barriers suggests that personal and environmental barriers may constitute particularly important influences on fruit and vegetable consumption in the rural, low-income population. Community gardens have the potential to mitigate barriers by improving access to fresh food and increasing opportunities for social support (Wakefield, Yeudall, Taron, Reynolds, & Skinner, 2007).

Results from this study using a convenience sample cannot be generalized to the entire population of rural, low-income adults. The cross-sectional design did not allow for causal inference, and the analytic technique did not support detailed evaluation of the relative importance of different types of behavioral influences. Several of the study scales had low reliability. There were no objective measures of the environment, and health behaviors and height and weight were based on self-report, increasing the likelihood of bias. Each behavioral outcome was measured using just two questions; more rigorous measures of behavioral outcomes would produce more credible findings.

A strength of the study included successful recruitment of low-income Latinos. Important strategies for facilitating participation included recruitment and survey administration in diverse community settings by local interpreters who were well-known within the Latino community. A unique contribution was the development and use of the healthy diet ratio, which reflected adherence to current dietary recommendations more accurately than measures based on five-a-day outcomes. Finally, the measurement of multiple influences on two health behaviors provided a thorough assessment of lifestyle behaviors in a vulnerable population.

Results from this study suggest that multipronged strategies should be used in programs promoting healthy lifestyles in rural communities. Evidence-based approaches, such as walking clubs and behavioral change programs offered in worksites and churches (Task Force on Community Preventive Services, 2002), should be tailored to low-income, rural residents to build skills for engaging in health behaviors, increase opportunities for social support, and address concerns about safety and other perceived barriers. For example, in walking programs, safe walking routes can be identified, walking with a partner or group can be promoted, and opportunities to learn strategies for dealing with personal barriers to

physical activity can be provided. Initiatives to simultaneously promote healthy diet and physical activity, such as community gardens, may be cost-effective approaches to health promotion in rural communities with limited resources. Finally, broad environmental strategies such as building trails (Pierce, Denison, Arif, & Rohrer, 2006); enhanced access to school fields, gymnasiums, and pools (Choy, McGurk, Tamashiro, Nett, & Maddock, 2008); and development of farmer's markets (Payet, Gilles, & Howat, 2005) can ensure that all community residents, regardless of income, have access to resources to support healthy lifestyles.

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References

- Ainsworth BE, Bassett DR Jr, Strath SJ, Swartz AM, O'Brien WL, Thompson RW, et al. Comparison of three methods for measuring the time spent in physical activity. *Medicine & Science in Sports & Exercise* 2000;32(9 Suppl)
- Britten P, Marcoe K, Yamini S, Davis C. Development of food intake patterns for the MyPyramid Food Guidance System. *Journal of Nutrition Education & Behavior* 2006;38(6 Suppl):S78–92. [PubMed: 17116598]
- Brownson RC, Baker EA, Housemann RA, Brennan LK, Bacak SJ. Environmental and policy determinants of physical activity in the United States. *American Journal of Public Health* 2001;91(12):1995–2003. [PubMed: 11726382]
- Brownson RC, Chang JJ, Eyler AA, Ainsworth BE, Kirtland KA, Saelens BE, et al. Measuring the environment for friendliness toward physical activity: A comparison of the reliability of 3 questionnaires. *American Journal of Public Health* 2004;94(3):473–483. [PubMed: 14998817]
- Brownson RC, Eyler AA, King AC, Shyu YL, Brown DR, Homan SM. Reliability of information on physical activity and other chronic disease risk factors among US women aged 40 years or older. *American Journal of Epidemiology* 1999;149(4):379–391. [PubMed: 10025482]
- Brownson RC, Housemann RA, Brown DR, Jackson-Thompson J, King AC, Malone BR, et al. Promoting physical activity in rural communities: Walking trail access, use, and effects. *American Journal of Preventive Medicine* 2000;18(3):235–241. [PubMed: 10722990]
- Centers for Disease Control and Prevention. Prevalence of leisure-time and occupational physical activity among employed adults--United States, 1990. *Morbidity & Mortality Weekly Report* 2000;49(19):420–424. [PubMed: 10905821]
- Centers for Disease Control and Prevention. Behavioral Risk Factor Surveillance System Survey Questionnaire. Atlanta, GA: U.S. Department of Health and Human Services; 2003.
- Centers for Disease Control and Prevention. Behavioral Risk Factor Surveillance System, Prevalence and trends data, nationwide (states and DC) - 2007. 2008. Retrieved February 27, 2008. Available from <http://apps.nccd.cdc.gov/BRFSS/page.asp?cat=XX&yr=2007&state=UB#XX>
- Choy, LB.; McGurk, MD.; Tamashiro, R.; Nett, B.; Maddock, J. Increasing access to places for physical activity through a joint use agreement: A case study in urban Honolulu [Electronic Version]. *Preventing Chronic Disease: Public Health Research, Practice, and Policy*. 2008. Retrieved March 3, 2009 from http://www.cdc.gov/pcd/issues/2008/jul/07_0117.htm
- Drewnowski A. Obesity and the food environment: Dietary energy density and diet costs. *American Journal of Preventive Medicine* 2004;27(3 Suppl):154–162. [PubMed: 15450626]
- Eyler AA, Brownson RC, Donatelle RJ, King AC, Brown D, Sallis JF. Physical activity social support and middle- and older-aged minority women: Results from a U.S. survey. *Social Science & Medicine* 1999;49(6):781–789. [PubMed: 10459889]

- Eyler AA, Vest JR. Environmental and policy factors related to physical activity in rural white women. *Women & Health* 2002;36(2):111–121.
- Haskell WL, Lee IM, Pate RR, Powell KE, Blair SN, Franklin BA, et al. Physical activity and public health: Updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. *Circulation* 2007;116(9):1081–1093. [PubMed: 17671237]
- Institute of Medicine. Dietary reference intakes for energy, carbohydrate, fiber, fat, fatty acids, cholesterol, protein, and amino acids. Washington, D.C: National Academies Press; 2005.
- Krebs-Smith SM, Kantor LS, Hosler AS, Rajulu DT, Fredrick BL, Ronsani AE. Choose a variety of fruits and vegetables daily: Understanding the complexities. *Journal of Nutrition* 2001;131(2S-1):487S–501S. [PubMed: 11160580]
- Kruger J, Yore M, Solera M, Moeti R. Prevalence of fruit and vegetable consumption and physical activity by race/ethnicity—United States, 2005. *Morbidity & Mortality Weekly Report* 2005;56(13):301–304.
- Maneesriwongul W, Dixon JK. Instrument translation process: A methods review. *Journal of Advanced Nursing* 2004;48(2):175–186. [PubMed: 15369498]
- McLeroy KR, Bibeau D, Steckler A, Glanz K. An ecological perspective on health promotion programs. *Health Education Quarterly* 1988;15(4):351–377. [PubMed: 3068205]
- Miles R, Panton L. The influence of the perceived quality of community environments on low-income women's efforts to walk more. *Journal of Community Health* 2006;31(5):379–392. [PubMed: 17094646]
- Minkler, M.; Wallerstein, N., editors. Community-based participatory research for health. San Francisco: Jossey-Bass; 2003.
- National Center for Health Statistics. Health, United States, 2007. Table 74: Leisure-time physical activity among adults 18 years of age and over, by selected characteristics: United States, 1998, 2005, and 2006. 2007. Retrieved May 26, 2009, from <http://www.cdc.gov/nchs/data/has/has08.pdf#074>
- Parks SE, Housemann RA, Brownson RC. Differential correlates of physical activity in urban and rural adults of various socioeconomic backgrounds in the United States. *Journal of Epidemiology & Community Health* 2003;57(1):29–35. [PubMed: 12490645]
- Patterson PD, Moore CG, Probst JC, Shinogle JA. Obesity and physical inactivity in rural America. *Journal of Rural Health* 2004;20(2):151–159. [PubMed: 15085629]
- Payet J, Gilles M, Howat P. Gascoyne Growers Market: A sustainable health promotion activity developed in partnership with the community. *Australian Journal of Rural Health* 2005;13(5):309–314. [PubMed: 16171506]
- Pierce JR Jr, Denison AV, Arif AA, Rohrer JE. Living near a trail is associated with increased odds of walking among patients using community clinics. *Journal of Community Health* 2006;31(4):289–302. [PubMed: 16894827]
- Riffe HA, Turner S, Rojas-Guyler L. The diverse faces of Latinos in the Midwest: Planning for service delivery and building community. *Health & Social Work* 2008;33(2):101–110. [PubMed: 18510124]
- Sallis, JF.; Owen, N. Ecological models of health behavior. In: Glanz, K.; Rimer, BK.; Lewis, FM., editors. *Health behavior and health education: Theory, research, and practice*. 3. San Francisco: Jossey-Bass; 2002. p. 464–484.
- Sallis JF, Pinsky RB, Grossman RM, Patterson TL, Nader PR. The development of self-efficacy scales for health-related diet and exercise behaviors. *Health Education Research* 1988;3(3):283–292.
- Steptoe A, Perkins-Porras L, McKay C, Rink E, Hilton S, Cappuccio FP. Psychological factors associated with fruit and vegetable intake and with biomarkers in adults from a low-income neighborhood. *Health Psychology* 2003;22(2):148–155. [PubMed: 12683735]
- Stewart H, Blisard N, Jolliffe D. Do income constraints inhibit spending on fruits and vegetables among low-income households? *Journal of Agricultural and Resource Economics* 2003;28(3):465–480.
- Task Force on Community Preventive Services. Recommendations to increase physical activity in communities. *American Journal of Preventive Medicine* 2002;22(4 Suppl):67–72. [PubMed: 11985935]

- U.S. Census Bureau. American FactFinder. 2008. Available from http://factfinder.census.gov/home/saff/main.html?_lang=en
- U.S. Department of Health and Human Services. Annual update of the Health and Human Services Poverty Guidelines. 2006. Available from <http://aspe.hhs.gov/poverty/06fedreg.htm>
- Vermunt, JK.; Magidson, J. Latent class cluster analysis. In: Hagenaars, JA.; McCutcheon, AL., editors. Applied latent class analysis. 2002. p. 89-106.
- Wilson DK, Kirtland KA, Ainsworth BE, Addy CL. Socioeconomic status and perceptions of access and safety for physical activity. *Annals of Behavioral Medicine* 2004;28(1):20–28. [PubMed: 15249256]

Figure 1. Ecological Model and Study Concepts (adapted from McLeroy, Bibeau, Steckler, & Glanz, 1988)

*The organizational and public policy levels were not addressed in this

Table 1**Example of Calculating Healthy Diet Ratio**

<ul style="list-style-type: none"> Estimated Energy Requirements (EER) formula for female, age 19 or older (IOM, 2005) $\text{EER} = 354 - (6.91 * \text{age in years}) + \text{physical activity coefficient}^a (9.36 * \text{weight in kg.} + 726 * \text{height in m.})^b$ EER for 54-year-old active female, weight 150 lb., height 5 ft. 4 in. $\text{EER} = 354 - (6.91 * 54) + 1.27(9.36 * 68.18 + 726 * 1.63) = 2294 \text{ calories}$ Fruit and vegetable recommendations for 2200-calorie dietary intake pattern (Britten, Marcoe, Yamini, & Davis, 2006) Recommended daily intake = 2 cups fruit + 3 cups vegetables Conversion of cups to serving units $(2 \text{ c. fruit} \times 2 \text{ servings/cup}) + (3 \text{ c. vegetables} \times 2 \text{ servings/cup}) = 4 \text{ servings fruit} + 6 \text{ servings vegetables} = 10 \text{ servings}$ Self-reported daily intake of fruits and vegetables 2 servings fruit + 1 serving vegetables = 3 daily servings fruit and vegetables Healthy Diet ratio 3 reported servings fruit and vegetables/10 recommended servings = 0.30

Notes.

^aPhysical activity coefficients vary by gender, age group, and activity level (sedentary, low active, active).

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Table 2

Demographic Characteristics of Survey Participants

Characteristic	Total <i>n</i> = 137		Anglos (<i>n</i> = 61)		Latinos (<i>n</i> = 76)		χ^2	df	<i>p</i>
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%			
Age (in years)							28.576	3	.001 ^a
less than 30	39	28.5	10	16.4	29	38.2			
30–49	53	38.7	17	27.9	36	47.4			
50–69	32	23.4	22	36.1	10	13.2			
70 or older	13	9.5	12	19.7	1	1.3			
Gender									
Female	78	56.9	39	63.9	39	51.3			
Education									
High school or more	72	52.5	50	82.0	22	29.0	38.150	1	.001
Employment									
Working	69	50.3	18	29.5	51	67.1	19.134	1	.001
Health insurance									
Medical	16	11.8	14	23.3	2	2.6	13.843	1	.001 ^a
Assistance/BadgerCare									
Medicare	15	11.0	13	21.7	2	2.6	12.380	1	.001 ^a
Employer-offered	25	18.4	6	10.0	19	25.0	5.028	1	.027 ^a
None	79	58.1	26	43.3	53	69.7	9.601	1	.002

Notes.

^aReported *p* based on Fisher's exact test due to small cell sizes.

Table 3

Behavioral Scales

Scales	Mean	SD	Items	Sample Item	Coefficient alpha
Physical Activity					
Self-efficacy ^a	2.01	0.64	4	Could you stick to exercise if you were tired?	0.54
Social support ^b	1.82	0.73	5	Friends encourage you to exercise.	0.73
Safety ^a	2.33	0.71	2	How safe is it to walk, run, or bike in your community?	— ^c
Barriers ^b	3.17	0.57	14	I don't exercise because I don't have time.	0.79
Resources ^d	4.29	1.73	7	Do you have access to free public outdoor exercise facilities?	0.61
Healthy Diet					
Self-efficacy ^b	2.07	0.57	6	Could you eat five fruits and vegetables every day?	0.62
Social support ^b	1.91	0.68	5	Relatives encourage you to eat healthy.	0.74
Resources ^e	1.72	0.59	2	How expensive are fruits and vegetables in your community?	— ^f
Barriers ^b	3.23	0.60	9	I don't eat healthy because fast food is more convenient.	0.74

Notes. Scales ranged from 0 to 3 (self-efficacy, social support, safety, healthy diet resources), 0 to 4 (barriers), and 0 to 7 (physical activity resources).

^a *n* = 132.
^b *n* = 136.
^c *r* = 0.53.
^d *n* = 128.
^e *n* = 130.
^f *r* = 0.22

Table 4
Fit Indices for Cluster Models of Influences on Physical Activity and Healthy Diet

Models ^a	LL	BIC	AIC	AIC3	CAIC	Npar	Class. Err.
Physical Activity							
1	-724.68	1492.52	1467.36	1476.36	1501.52	9	0.00
2	-694.61	1480.35	1427.23	1446.23	1499.35	19	0.11
3	-643.44	1425.86	1344.88	1373.88	1454.96	29	0.10
Healthy Diet							
1	-469.85	978.58	955.70	963.70	986.58	8	0.00
2	-439.71	962.05	913.43	930.43	979.05	17	0.11
3	-368.01	862.38	788.03	814.03	888.38	26	0.06

Notes. LL = log likelihood; BIC = Bayes Information Criterion; AIC = Akaike Information Criterion; CAIC = Consistent Akaike Information Criterion; Npar = Number of parameters; Class. Err. = proportion of classification error.

^aModel numbers correspond to number of clusters.

Table 5

Logistic Regression of Physical Activity and Healthy Diet Outcomes on Cluster Membership

Meets Physical Activity recommendation^a (<i>n</i> = 118)		
Independent Variables	Odds Ratio	95% CI
Step 1		
Moderate Self-Efficacy/High Safety	2.65*	1.13 – 6.25
High Self-Efficacy/Low Safety	1.43	.56 – 3.65
Step 2		
Moderate Self-Efficacy/High Safety	2.57*	1.08 – 6.10
High Self-Efficacy/Low Safety	1.45	0.55 – 3.83
Latino	0.78	0.82 – 1.83
Female	0.59	0.27 – 1.27
Age	0.99	0.97 – 1.02
Closer to MyPyramid recommendation^b (<i>n</i> = 110)		
Step 1		
Low Barriers	4.13*	1.82 – 9.39
Step 2		
Low Barriers	4.72*	2.00 – 11.13
Latino	2.05	0.33 – 5.11
Female	1.00	0.44 – 2.29
Age	0.99	0.97 – 1.02

Notes. CI = Confidence Interval,

^aLow Self-Efficacy/Moderate Safety group is referent,^bHigh Barriers Group is referent,*
p < .05.