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Examining the Association between Intervention-Related Changes in Diet, Physical Activity, and Weight as Moderated by the Food and Physical Activity Environments among Rural, Southern Adults

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ABSTRACT

Background Few studies have been conducted in rural areas assessing the influence of community-level environmental factors on residents' success improving lifestyle behaviors.

Objective Our aim was to examine whether 6-month changes in diet, physical activity, and weight were moderated by the food and physical activity environment in a rural adult population receiving an intervention designed to improve diet and physical activity.

Design We examined associations between self-reported and objectively measured changes in diet, physical activity, and weight, and perceived and objectively measured food and physical activity environments. Participants were followed for 6 months.

Participants/setting Participants were enrolled in the Heart Healthy Lenoir Project, a lifestyle intervention study conducted in Lenoir County, located in rural southeastern North Carolina. Sample sizes ranged from 132 to 249, depending on the availability of the data.

Intervention Participants received four counseling sessions that focused on healthy eating (adapted Mediterranean diet pattern) and increasing physical activity.

Potential moderating factors Density of and distance to food and physical activity venues, modified food environment index, Walk Score, crime, and perceived nutrition and physical activity neighborhood barriers were the potential mediating factors.

Outcome measures Diet quality, physical activity, and weight loss were the outcomes measured.

Statistical analyses Statistical analyses included correlation and linear regression and controlling for potential confounders (baseline values of the dependent variables, age, race, education, and sex).

Results In adjusted analysis, there was an inverse association between weight change and the food environment, suggesting that participants who lived in a less-healthy food environment lost more weight during the 6-month intervention period (P=0.01). Also, there was a positive association between self-reported physical activity and distance to private gyms (P=0.04) and an inverse association between private gym density and pedometer-measured steps (P=0.03), indicating that those who lived farther from gyms and in areas with lower density of gyms had greater increases in physical activity and steps, respectively.

Conclusions Contrary to our hypotheses, results indicated that those living in less-favorable food and physical activity environments had greater improvements in diet, physical activity, and weight, compared to those living in more favorable environments. Additional research should be undertaken to address these paradoxical findings and, if confirmed, to better understand them.

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COMMUNITY-LEVEL FACTORS CAN HINDER OR facilitate adult residents' attempts to consume a healthful diet and be physically active.[1] For example, there are inverse associations between access to supermarkets and farmers' markets and obesity,[2] and between access to recreational facilities and obesity.[3] Recent review articles have found that supermarket availability was generally inversely related to obesity, and fast-food availability was generally positively associated with obesity.[4,5] In the rural environment, distance to recreation facilities, feeling unsafe from crime, and few nonresidential destinations were associated with obesity.[6] In addition, built environmental characteristics, such as access to places to be active and neighborhood walkability are associated with physical activity (PA) and obesity.[7] Furthermore, residents of neighborhoods that have higher Walk Score (a measure of neighborhood amenity density) tend to walk more compared to those with lower Walk Score.[8,9]

These associations between the food and PA environment and diet and PA-related activities and outcomes have led to the hypothesis that environmental context might moderate the effect of diet and PA-related intervention outcomes. Two studies have examined the hypothesis that dietary behavior change interventions may be more effective when participants live in areas where more healthful foods are available,[10,11] with the potential causal mechanism being that individuals who live in areas with more healthy eating opportunities are more likely to increase healthy eating behaviors. Both studies found greater adherence to dietary interventions among those with improved access to healthy food sources, such as supermarkets, farmers' markets, and green carts.[10,11] Four additional studies have examined factors in the perceived and objectively assessed built environment related to PA, generally finding improvements in PA among those participants who lived in more favorable PA environments.[12-15] However, both the diet- and PA-focused studies[10-15] were set primarily in urban areas, further supporting the need to determine whether the food and PA environment can moderate the effect of diet and PA interventions among rural residents.

Therefore, in the Heart Healthy Lenoir Project lifestyle study, we compared changes in diet, PA, and weight loss (at 6 months) among lifestyle intervention participants who resided in healthier food and PA environments to those who resided in less-healthy environments. We hypothesized that those who lived closer to supermarkets and farmers' markets, and farther from fast-food restaurants and convenience stores, would have greater intervention-related increases in fruit and vegetable consumption and greater improvements in overall diet quality during the intervention period compared to those living in less-healthy food environments. We also hypothesized that those who lived closer to PA resources (eg, parks, gyms), and in more walkable, low-crime areas would have greater intervention-related increases in total PA and walking (as assessed by steps) during the intervention period, when compared to those living in neighborhoods less conducive to PA. Our study is unique from others in that it was set in a rural environment in the southern United States, whereas others were set in urban areas; it examined both perceived and objectively measured aspects of the food and PA environments; and it included both self-reported and objectively measured outcomes data on intervention-related dietary and PA changes.

MATERIALS AND METHODS

Study Setting and Participants

We used baseline and 6-month follow-up data from the Heart Healthy Lenoir lifestyle study, which enrolled residents primarily from Lenoir County, located in rural eastern NC.[16] The Heart Healthy Lenoir lifestyle intervention study, one of three coordinated studies (lifestyle, high blood pressure, and genomics) was conducted as part of the overall Heart Healthy Lenoir Project, a collaborative research effort designed to reduce cardiovascular disease risk and disparities in risk in Lenoir County, as described previously.[16,17] The study was approved by the University of North Carolina at Chapel Hill Institutional Review Board, with data collection beginning on September 20, 2011, and 6-month data collection completed on April 27, 2012. Research staff screened potential participants (primarily by phone) to determine whether they met eligibility criteria, as described previously.[16] If the participant met eligibility criteria, he or she was invited to an enrollment visit where written informed consent was first obtained, and then study-related questions were answered.[16]

In total, of 339 participants enrolled in the Heart Healthy Lenoir Lifestyle Study, 291 took part in the lifestyle intervention given during the first 6 months of the study. Of the 339 originally enrolled, 48 did not attend the 6-month follow-up visit, 40 withdrew, and 2 were excluded from analyses (1 was diagnosed with cancer, 1 withdrew), leaving 249 of the 339 for 6-month analysis. Compared on baseline characteristics, those who did not return for follow-up measures were more likely to be male, white, younger, and of lower educational status.[16]

Lifestyle Study Intervention

The lifestyle study was composed of three phases. During Phase 1, the focus of this article, the lifestyle intervention was given during four counseling sessions at monthly intervals with outcomes assessed at 6-month follow-up, as described in detail in an earlier publication.[16] The intervention content was culturally appropriate to the Southern diet and the lifestyle recommendations were individually tailored to participants' baseline lifestyle behaviors, as assessed previously in randomized trials.[18-21] However, in this study, the dietary content was modified to include a major focus on improving dietary fat as well as carbohydrate quality.[22,23] The dietary recommendations were very similar to those advocated in the PREDIMED randomized trial intervention study[16,23-25]; hence, the dietary intervention was called Med-South. (The Med-South dietary intervention materials can be found on the Heart Healthy Lenoir Project website at: http://www.hearthealthylenoir.com/lifestyle-intervention-materials.) Diet counseling comprised about three-fourths of intervention content and time; the remainder was devoted to PA counseling, with a goal of walking $\geq$7,500 steps/day or $\geq$30 minutes on at least 5 days/wk. Participants also received an illustrated guide listing local community resources for healthy eating and PA (eg, farmers' markets and local parks). The Phase 1 lifestyle intervention did not focus on weight loss specifically.