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Attitudes and barriers to healthy diet and physical activity: A latent profile analysis

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Abstract

Healthy diet and physical activity (PA) prevent and reduce chronic disease. Social cognitive theory delineates multiple attitudes and barriers that influence these behaviors. Understanding co-variation in these attitudes and barriers is complex. We examined whether individuals could be grouped into a small number of categories that are easier to study. Interviews were conducted with 982 adults from two low-income, predominantly African American neighborhoods in the same city. Social cognitive constructs, including self-efficacy, social norms, and internal and external barriers to diet and exercise, and walking were self-reported. We measured moderate to vigorous physical activity (MVPA) with accelerometers and diet with 24 hour recalls. We conducted a latent profile analysis of attitudes and barriers to diet and PA and identified four classes: (1) *moderate diet and negative exercise attitudes*, where participants were roughly average on dietary attitudes but reported exercise-related challenges, including lower social support, outcome expectancies, physical functioning, and self-efficacy, (2) *few barriers and benefits of healthy diet and exercise*, where participants reported fewer barriers and lower outcome expectancies for diet and PA, (3) *moderate overall attitudes*, where participants had average scores on most indicators but below-average exercise self-efficacy and slightly more exercise barriers, and (4) *positive overall attitudes*, characterized by more positive attitudes toward both diet and PA across most domains, particularly regarding self-efficacy to overcome exercise barriers. These profiles could inform efforts to tailor individual-level interventions for diet and PA of persons at high risk of chronic diseases.

Keywords

diet; physical activity; social cognitive theory; health behavior; obesity

Diet and physical activity (PA) are modifiable risk factors for chronic diseases, including diabetes (Hu et al., 2001), cancer (Key, Allen, Spencer, & Travis, 2002), and cardiovascular disease (Hung et al., 2004). Most U.S. adults do not meet federal guidelines for diet (Ervin, 2011) or PA (Ward, Clarke, Freeman, & Schiller, 2015). Unsurprisingly, related chronic diseases constitute a major public health problem (Beaglehole et al., 2011). Improving diet and PA is critical to reducing chronic disease overall and to reducing racial/ethnic health disparities, as racial/ethnic minorities have poorer diet and PA than whites (August & Sorkin, 2011). Thus, finding ways to improve diet and PA should be a priority.

A promising approach to improving diet and PA is to intervene on psychosocial influences. Theoretical models of health behavior, including social-cognitive theory (SCT) (Bandura, 1986, 1998; McAlister, Perry, & Parcel, 2008), the theory of reasoned action (Ajzen & Fishbein, 1980), and the transtheoretical model (Prochaska & Marcus, 1994), delineate numerous psychosocial influences. Moreover, empirical support for the effects of self-efficacy (Steptoe, Perkins-Porras, Rink, Hilton, & Cappuccio, 2004), social support (Greaves et al., 2011; Olander et al., 2013; Steptoe et al., 2004), positive outcome expectancies (Steptoe et al., 2004), and behavioral intentions (Conn, Hafdahl, & Mehr, 2011) on diet and PA has been demonstrated. Although less research has examined these influences among racial/ethnic minorities, there is evidence for the roles of self-efficacy and social support among African Americans (Ainsworth, Wilcox, Thompson, Richter, & Henderson, 2003; Eyler et al., 2002). In addition, many interventions that target psychosocial influences have been developed and evaluated (Conn et al., 2011; Greaves et al., 2011; Olander et al., 2013). Consistent with SCT (McAlister et al., 2008), intervention components that improve diet and PA include modeling of the behavior (Conn et al., 2011), boosting self-efficacy (Bully, Sánchez, Zabaleta-del-Olmo, Pombo, & Grandes, 2015), and enhancing self-regulation through self-monitoring, goal-setting, and engaging social support (Greaves et al., 2011; Olander et al., 2013). A large literature suggests that, on average, psychosocial interventions effectively improve diet and PA, at least in the short-term (Conn et al., 2011; Greaves et al., 2011).

Although the evidence base supports the utility of psychosocial interventions for diet and PA, it is also characterized by modest effect sizes (e.g., average effect size for PA interventions of Cohen's $d = 0.19$) (Conn et al., 2011), thereby indicating substantial room for improvement. Many interventions are limited in that they tend to treat participants similarly, despite individual differences in the attitudes and barriers that undermine their diet and PA. Interventions might be more effective if they specifically target the unique profile of influences on an individual's diet and PA. For example, some people might have low PA because of low self-efficacy, whereas others might have high self-efficacy but perceive few benefits of PA and thus lack motivation. Someone with the first profile might benefit more from an intervention that includes peer modeling of PA, whereas someone with the second might benefit more from a motivational intervention (e.g., motivational interviewing).

One strategy to improve the match between interventions and individuals is audience segmentation, i.e., the division of a population into homogeneous subgroups based on similarity in characteristics related to an outcome of interest (e.g., demographic characteristics, attitudes) (Slater, 1996). Interventions can then be tailored to each segment's unique characteristics. Although used more commonly in advertising to influence consumer behavior, audience segmentation has also been used to create homogeneous groups based on health behavior (Boslaugh, Kreuter, Nicholson, & Naleid, 2005; Heitzler et al., 2011).

The purpose of the current study was to identify profiles of attitudes and barriers to diet and PA that distinguish subgroups of individuals and determine whether these profiles demonstrate associations with diet and PA. Accordingly, we conducted a latent profile analysis (LPA) of attitudes and barriers among predominantly low-income African Americans who had poor diet, low levels of PA, and high rates of obesity. Guided by SCT,

one of the most commonly-studied theories of health behavior (Bandura, 1986, 1998), we included in the LPA factors that have been successfully targeted in previous research on interventions, including perceived social norms, self-efficacy, goal-setting, and social support. We included factors related to both diet and PA in the same LPA because the resultant profiles are intended to inform the development of an intervention for both behaviors, which produces better outcomes (Greaves et al., 2011).

To our knowledge, this is the first LPA of attitudes and barriers to healthy diet and PA. Absent similar studies to inform hypotheses, we didn't hypothesize any particular solution for the LPA, but did hypothesize that the profiles obtained would be associated with diet and PA.

Methods

Study Design

Participants completed both baseline household interviews for two linked studies of environmental interventions for diet and PA ($N = 982$). The first study, the Pittsburgh Hill/Homewood Research on Eating, Shopping, and Health (PHRESH), is a quasi-experimental study of two predominantly African American, low-income "food deserts" in Pittsburgh, Pennsylvania, one of which acquired a new full-service supermarket during the study. The second study, PHRESH Plus, has a similar design but is examining greenspace renovations. Baseline household interviews for PHRESH and PHRESH Plus were administered in 2011 and 2013, respectively, before the environmental interventions began. Both study protocols were approved by the institution's Institutional Review Board.

PHRESH participants were randomly sampled from households drawn from a complete listing of residential addresses in the study neighborhoods. Trained data collectors went door-to-door to 4,002 addresses to identify and recruit eligible residents, i.e., those who were the primary household food shopper and at least 18 years old. Ultimately, 1,649 household residents were eligible, of which 1,434 (87%) enrolled and 1,372 provided complete, usable data. Baseline interviews assessed dietary attitudes, barriers, and intake. All PHRESH participants were eligible to complete the PHRESH Plus baseline interview, which focused on PA and related attitudes and barriers, and 982 participants did.

Measures

We used several measures of diet- and PA-related constructs from SCT (Bandura, 1986) that had already been developed and validated (see Table 1). All items and scales were scored so that higher scores indicated more positive attitudes and/or fewer barriers.

Diet was assessed twice with the Automated Self-Administered 24-hour recall (ASA-24), with 7–10 days between each recall (Subar et al., 2012). Averaged over both recalls, the dietary indicators we analyzed were total cups of fruit and vegetable (FV) intake and the Healthy Eating Index (HEI) (Guenther et al., 2014), a validated measure of overall dietary quality that assesses conformance to the United States Dietary Guidelines for Americans. HEI-2010 scores can range from 0 to 100; higher scores indicate a healthier diet.

We analyzed two PA indicators: 1) self-reported minutes of walking 10+ consecutive minutes over the past week as measured by the International Physical Activity Questionnaire (IPAQ) (Craig et al., 2003) and 2) average daily minutes of moderate to vigorous PA (MVPA) using data collected with a tri-axial accelerometer (i.e., Actigraph GT3X+) that participants wore on their non-dominant wrist for 7 consecutive days. Consistent with previous research (Sabia et al., 2014), nonwear time was identified when the standard deviation (SD) was less than 14 mg for 2 of the 3 axes or if the value range of each accelerometer axis was less than 150 mg, calculated for moving windows of 60 minutes with 15-minute increments (van Hees et al., 2013). Minutes of MVPA were defined as a bout of at least 10 minutes of activity above the 100 mg threshold (Hildebrand, van Hees, Hansen, & Ekelund, 2014), where at least 80% of the bout was above this threshold. MVPA was calculated only for those with valid wear time, i.e., at least 10 hours on at least 4 days (Trost, McIver, & Pate, 2005).

Participant characteristics included sociodemographic characteristics, prior health conditions diagnosed by a health professional, and weight status based on body mass index (BMI) computed with height and weight measured during the interview.

Statistical Analyses

To form subgroups of respondents based on their attitudes and barriers to diet and PA, all of which are continuous variables, we conducted a latent profile analysis (LPA) (Lazarsfeld & Henry, 1968). LPA is considered more rigorous than alternative methods such as K-means clustering because LPA 1) allows for statistical testing of competing models and therefore provides a more rigorous basis for selecting the final model, and 2) is less sensitive to outliers (Schreiber & Pekarik, 2014). To facilitate interpretation of results, all indicators were standardized prior to the LPA. All modeling was conducted in Mplus version 7.3 (Muthén & Muthén, 1998–2015).

We estimated five different models, varying the number of classes from two to six. To select the best-fitting model, we considered several fit indices, including the sample-size adjusted Bayesian Information Criterion (SSA-BIC), entropy, the Lo-Mendell-Rubin test, and the Bootstrap Likelihood Ratio Test (BLRT)¹; each solution's interpretability; and the number of respondents in each class.

After selecting the best-fitting model, we sought to validate the classes by examining their associations with dietary and PA indicators. Using the maximum posterior probability approach, in which each participant's class membership is set to 1 for their most likely class and 0 for all other classes (Berlin et al., 2014), we examined associations between participants' most likely class membership and dietary and PA outcomes with and without adjustment for sociodemographic characteristics. For FV intake and HEI-2010 scores, we estimated ordinary least squares (OLS) regression models. For walking and MVPA, whose distributions were characterized by large proportions of zeros and over-dispersion, we

¹Fit indices are interpreted as follows: Lower values on SSA-BIC indicate better model fit, higher values of entropy indicate greater accuracy of classification, and the Lo-Mendell-Rubin test and BLRT are significance tests of the improvement in model fit from adding another class (Berlin, Williams, & Parra, 2014).

estimated zero-inflated negative binomial regression (ZINB) models and included the same predictors in the count and binary portions.

Because the maximum posterior probability approach introduces error by effectively treating a latent variable as an observed variable, we examined the impact of this error by conducting sensitivity analyses with the three-step method and the posterior probability-based multiple imputation method (i.e., pseudo-class draws) (Asparouhov & Muthen, 2013; Berlin et al., 2014). These alternative methods preserve the variable's latent nature in estimating the relationships between latent class membership and outcomes. The newer of these, the three-step method, has demonstrated greater robustness and less bias in the estimation of the associations between classes and outcomes, in contrast to posterior probability-based multiple imputation (i.e., pseudo-class draws) (Asparouhov & Muthen, 2013; Berlin et al., 2014). The three-step method consists of (i) estimating the latent class model; (ii) using the resultant latent class posterior distribution to generate the most likely class membership variable; (iii) specifying the latent class membership variable with measurement error, and, finally, including the auxiliary variable in the analysis to estimate its association with the latent class variable.

We also assessed potential response bias due to missing data, which were relatively uncommon in the interviews. However, 17.8% ($n = 175$) of the 982 participants had missing MVPA data due to insufficient valid accelerometer wear days. Accordingly, we compared participants with and without missing MVPA data on several sociodemographic characteristics, self-reported walking and MVPA, years of residence in the neighborhood, social-cognitive variables, obesity, and BMI. The only significant differences were that participants with nonmissing data had higher BMI, more years in the neighborhood, and higher likelihood of obesity than those with missing data. For all modeling, missing data were handled by the default robust maximum likelihood estimator (MLR), a full information estimator that uses all available information and provides consistent, unbiased estimates in the presence of missing data under the assumption that data are missing at random or missing completely at random.

Results

The sample consisted predominantly of unmarried, non-Hispanic black women without children in their households (see Table 2). Roughly half of participants were 55 or older, had a high school education or less, per capita annual household income less than \$10,000, household resident receiving SNAP benefits, vehicle access, obesity, and a history of hypertension. Average HEI-2010 scores and FV consumption suggested low compliance with USDA dietary guidelines. On average, over the past week, participants reported walking for a total of roughly 4.5 hours, and completed 5–10 minutes of MVPA daily per accelerometer data.

Of the models estimated, the four-class solution was chosen based on goodness-of-fit and parsimony. Although the SSA-BIC and BLRT suggested that a six-class solution best fit the data, both entropy and the Lo-Mendell-Rubin Adjusted Likelihood Ratio Test indicated that model fit improved with each additional class only until four classes and then declined (see

Table 3). Moreover, some classes in the five- and six-class solutions were fairly small, and the four-class solution was more parsimonious.

Average scores for each class on dietary and PA attitude indicators are shown in Figure 1 and Figure 2, respectively. The largest class ($n = 441$, 44.9%), *moderate overall*, had average scores on most indicators but below-average self-efficacy to overcome exercise barriers and slightly more exercise barriers. The second largest class ($n = 355$, 36.2%), *positive overall*, reported relatively more positive attitudes toward healthy diet and PA, particularly regarding self-efficacy to overcome exercise barriers. This class was average on perceived healthy food availability, social support for diet and exercise, and social norms for exercise. The third largest class ($n = 98$, 10.0%), *few barriers and benefits*, had low dietary intentions and particularly lacked positive dietary outcome expectations, but was slightly below-average on dietary self-efficacy and barriers. This class reported above-average self-efficacy to overcome exercise barriers and few exercise barriers, but below-average (i.e., more negative than positive) exercise outcome expectancies. In other words, this group generally believed they could eat healthy and exercise but did not perceive many benefits of doing so. The smallest class ($n = 88$, 9.0%), *moderate diet and negative exercise attitudes*, was roughly average on dietary attitudes but reported more exercise-related challenges with social support, outcome expectancies, physical functioning, and self-efficacy to overcome barriers.

Next, we estimated associations between class membership and dietary outcomes, obtaining similar results in models that did and did not adjust for sociodemographic characteristics. Given this similarity, we present unadjusted class means on each outcome and the magnitude of class differences here (see Figure 3) to streamline the description of results and display unadjusted and adjusted regression coefficients in Appendix A.

In general, associations conformed to expectation: Classes with more positive attitudes had healthier diets than those with less positive attitudes. All significant differences were of small or nearly medium magnitude per Cohen's conventions (Cohen, 1992). The *positive overall* class reported significantly greater FV consumption than the *moderate overall* ($d = .33$), *few barriers and benefits* ($d = .40$), and *moderate diet, negative exercise attitudes* classes ($d = .49$) and significantly higher HEI-2010 scores than the *moderate overall* ($d = .25$) and *few barriers and benefits* ($d = .34$) classes. The *positive overall* class also had significantly higher HEI-2010 scores than the *moderate diet, negative exercise attitudes* class in adjusted analyses only ($\beta = -0.30$, $p < .05$).

Walking and MVPA also distinguished between classes in the binary portions, but not the count portions, of ZINB models: Classes differed in *whether* they had walked or engaged in MVPA for at least 10 minutes at a time, but not in the number of minutes of walking or MVPA. For ease of interpretation, we present here unadjusted relative risk ratios from the binary portions of the ZINB models for walking and MVPA and display results from unadjusted and adjusted models in Appendix B.

In unadjusted and adjusted models, the *few barriers and benefits*, *moderate overall*, and *positive overall* classes were significantly less likely than the *moderate diet, negative exercise attitudes* class not to have walked for at least 10 consecutive minutes during the past

week. As Figure 4(a) shows, the *few barriers and benefits* and *moderate overall* classes had a relative risk of not having walked for at least 10 minutes that was approximately one-third of the risk of the *moderate diet, negative exercise attitudes* class. The risk of the *positive overall* class of not having walked for at least 10 minutes was .15 of the risk of the *moderate diet, negative exercise attitudes* class.

Results from unadjusted and adjusted models of MVPA differed slightly. In unadjusted models, only the *moderate overall* class had a significantly lower risk than the *moderate diet, negative exercise attitudes* class of not having at least 10 minutes of MVPA during the past week (see Figure 4(b)). In adjusted models, only the *positive overall* class differed significantly from the *moderate diet, negative exercise attitudes* class (adjusted odds ratio = 0.19).

In sensitivity analyses, the three-step and posterior probability-based multiple imputation approaches yielded results that very closely resembled those of the regression models for all outcomes in terms of the magnitude and statistical significance of class differences.

Discussion

Using LPA, we grouped respondents by their attitudes and barriers to healthy diet and PA and identified four classes: 1) *moderate diet, negative exercise attitudes*, 2) *few barriers and benefits*, 3) *moderate overall*, and 4) *positive overall*. The classes' validity was demonstrated by their associations with diet and PA: Classes with more positive attitudes reported healthier diet and were more likely to have engaged in at least 10 minutes of walking and MVPA over the past week. The current findings converge with past research demonstrating the effects of self-efficacy (Ainsworth et al., 2003; Steptoe et al., 2004), social support (Eylar et al., 2002; Greaves et al., 2011; Olander et al., 2013; Steptoe et al., 2004), positive outcome expectancies (Steptoe et al., 2004), and behavioral intentions (i.e., goal-setting) (Conn et al., 2011) on diet and PA. To our knowledge, this is the first study that has formed latent profiles based on these constructs and linked them to diet and PA. Thus, current findings also extend past research by showing that meaningful groups of individuals with different profiles of diet- and PA-related attitudes can be created and demonstrating the relevance of SCT-related influences on diet and PA among low-income, African Americans, a population in which relatively less research of this type has been conducted.

One interesting finding is that we observed associations between class membership and whether participants had at least 10 consecutive minutes of walking and daily MVPA over the past week, but not between class membership and the number of minutes of walking or MVPA. Thus, psychosocial interventions may be more likely to affect movement from a sedentary state to at least 10 minutes of walking or MVPA than to move those who are already active to higher levels of activity. Alternatively, the lack of observed associations could be attributable to limited variation in minutes of walking and MVPA; in general, participants were largely sedentary, and those who had at least 10 minutes of walking or MVPA had limited amounts of activity.

Implications for Practice

These findings also have implications for improving diet and PA, as these profiles could be used to match individuals to interventions that most directly target their particular attitudes and barriers. For example, respondents in the *few barriers and benefits* class, which had less positive dietary intentions and outcome expectancies, might benefit especially from motivational interviewing, an evidence-based behavioral technique that targets motivation and increases healthy eating and exercise (Greaves et al., 2011). Those in the *moderate diet, negative exercise attitudes* class, which had lower social support for exercise, might benefit more from interventions that mobilize social support, which increase PA (Greaves et al., 2011; Olander et al., 2013), and from interventions that increase self-efficacy to overcome exercise barriers, which was particularly low. Previous research suggests that establishing exercise goals tailored to the individual effectively bolsters barrier self-efficacy to exercise (Higgins, Middleton, Winner, & Janelle, 2014). Another effective means of building self-efficacy is peer modeling of behavior (Schunk, 1987), and modeling of PA has been found to increase PA (Conn et al., 2011). Respondents in the *moderate overall* class, which also evidenced low self-efficacy to overcome exercise barriers, might additionally benefit from such interventions. Those in the *moderate overall* class also reported more internal exercise barriers (e.g., lack of enjoyment, physical limitations, and pain) and therefore might benefit from individually tailored goal-setting and recommendations for exercises that accommodate physical limitations. Lastly, the need for neighborhood improvements is underscored by endorsement of external exercise barriers in the *moderate overall* class.

Limitations and Strengths

This study has limitations and strengths. The study's primary limitation is its cross-sectional design, which precludes inferences of causation. Thus, inferences about the profiles' utility in informing the tailoring of interventions to individuals remain tentative and should be subjected to further study before drawing firmer conclusions about this application of these findings. Another limitation is the generalizability of findings to other populations. Participants were predominantly lower-income, unmarried, non-Hispanic black women without children in Pittsburgh, and thus it is unclear whether the study's findings would hold for other populations. Additional limitations concern the lack of temporal correspondence (i.e., 2-year gap) between assessments of diet and PA and the use of self-report measures of diet and walking, particularly given documented effects of social desirability bias on measurement in this area (Klesges et al., 2004).

The study's strengths include the use of accelerometers, the gold-standard method of measuring PA, and examination of attitudes and barriers to healthy diet and PA in an underserved, understudied population.

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Figure 1.

Average scores on dietary attitudes by class; higher scores indicate healthier attitudes. F&V = fruits and vegetables. LC = low-calorie foods and beverages. IN = intentions. SE = self-efficacy. SS = social support. OE = outcome expectancies. BA = barriers.

Figure 2.

Average scores on physical activity attitudes by class; higher scores indicate healthier attitudes. IN = intentions. SE = self-efficacy. SN = social norms. SS = social support. OE = outcome expectancies. BA = barriers.

(a)

(b)

Figure 3.

Estimated unadjusted mean levels of fruit and vegetables consumption (c.) and Healthy Eating Index (HEI)-2010 scores by class. Error bars depict + one standard error around the mean. The positive overall class had significantly higher mean levels of fruit and vegetable consumption and HEI-2010 scores than the other three classes.

(a) Estimated unadjusted average (mean) fruit and vegetable consumption in cups by class.

(b) Estimated unadjusted average (mean) Healthy Eating Index (HEI)-2010 score by class.

(a)

Figure 4.

Unadjusted relative risks of not having walked and engaged in moderate-to-vigorous physical activity (MVPA) for at least 10 minutes during the past week by class. Estimated risks for each class are relative to the *moderate diet, negative exercise attitudes* class.

(a) Unadjusted relative risks of not having walked for at least 10 minutes by class. For each class shown in the figure, the relative risk represents the classes' risk of not having walked for at least 10 minutes divided by (relative to) the reference classes' risk of not having walked for at least 10 minutes, where the reference class is the *moderate diet, negative exercise attitudes* class. All classes shown in the figure have relative risks less than one and

differ significantly from the reference class (all p s < .05), indicating that all have a significantly lower risk of not having walked for at least 10 minutes relative to the reference class.

(b) Unadjusted relative risks of not having at least 10 minutes of MVPA by class. For each class shown in the figure, the relative risk represents the classes' risk of not having at least 10 minutes of MVPA divided by (relative to) the reference classes' risk of not having at least 10 minutes of MVPA, where the reference class is the *moderate diet, negative exercise attitudes* class. Only one class, the *moderate overall* class, differed significantly from the reference class on risk of not having at least 10 minutes of MVPA (p < .05). The moderate overall class had a relative risk less than one, indicating significantly lower risk of not having at least 10 minutes of MVPA relative to the reference class.

Table 1

Characteristics of Measures of Social-Cognitive Constructs in Household Interviews

Social-cognitive constructs	Description of measure/items	Item response scale	Cronbach's alpha for composite measures in the current study	Sources
Diet				
Intentions to eat a healthy diet	Two individual items assessing the likelihood of (1) eating 5+ servings of fruits and vegetables (FV) and (2) eating and drinking mostly low-calorie foods and beverages in the next year Example item: <i>How likely is it that you will have 5+ servings of FV in the next year?</i>	1 = <i>very unlikely</i> to 4 = <i>very likely</i>	N/A	(Smith-McLallen & Fishbein, 2008)
Self-efficacy to eat a healthy diet	Two individual items assessing the respondent's confidence in his/her ability to eat 5+ servings of FV, and to eat or drink mostly low-calorie foods and beverages in the next year. Example item: <i>If you wanted to, how sure are you that you can eat five or more FV on most days over the next year?</i>	1 = <i>very unsure</i> to 5 = <i>very sure</i>	N/A	(Campbell et al., 2009)
Social support for eating a healthy diet	Sum of six items measuring the frequency with which friends or family interacted with the respondent over eating a healthy diet during the past three months Example item: <i>In the past three months, how often have your friends or family discussed healthy eating habits with you?</i>	1 = <i>never</i> to 5 = <i>very often</i>	0.88	(Sallis, Grossman, Pinski, Patterson, & Nader, 1987)
Expectancies regarding the benefits of eating a healthy diet	Five individual items assessing the extent to which respondents agreed that eating 5+ FV a day makes them feel good, be healthy, look good, and be a healthy weight and how much they would regret it if they don't start eating more FV. Example item: <i>If I eat five or more FV a day, I will feel good about myself</i>	1 = <i>strongly agree</i> to 5 = <i>strongly disagree</i>	N/A	(Steptoe et al., 2004)
Internal barriers to FV consumption	Five individual items assessing the perceived cost of FV, the time to prepare vegetable dishes, the taste of FV, and wasting food when serving FV. Example item: <i>Eating five servings of FV a day is difficult because they cost too much</i>	1 = <i>strongly agree</i> to 5 = <i>strongly disagree</i>	N/A	(Cullen et al., 2004; Langenberg et al., 2000)
External barrier of perceived availability of healthy food	Sum of 10 items pertaining to the perceived availability of three types of healthy food — FV, low-fat foods, and whole grains. Example item: <i>It is easy to buy FV in my neighborhood</i>	1 = <i>strongly disagree</i> to 5 = <i>strongly agree</i>	.95	(Caldwell, Miller Kobayashi, DuBow, & Wytinck, 2009; Cummins, Flint, & Matthews, 2014; Dibsdaill, Lambert, Bobbin, & Frewer, 2003)
Physical Activity (PA)				
Intentions to engage in PA	One individual item assessing intentions to engage in PA for 3+ times per week for 10+ minutes at a time during the next year Item: <i>Do you intend to engage in PA three or more times a week for at least 10 minutes at a time during the next year?</i>	1 = <i>definitely not</i> to 5 = <i>definitely</i>	N/A	(Boudreau & Godin, 2007; Godin, Valois, Shephard, & Desharnais, 1987; Valois, Godin, & Bertrand, 1992)

Social-cognitive constructs	Description of measure/items	Item response scale	Cronbach's alpha for composite measures in the current study	Sources
Self-efficacy to engage in PA	10 individual items assessing the ability to exercise under several potentially challenging conditions, including being tired, depressed, having bad weather, having competing interests, having a lot to do, not having support, not having exercised, having no one to go with, and the workout not being enjoyable Example item: <i>How confident are you that you could exercise when tired over the next six months?</i>	0 = <i>I cannot do it at all</i> to 10 = <i>I'm completely certain that I can do it</i>	N/A	(Garcia & King, 1991)
Social norms for PA	Three individual items assessing the frequency with which the respondent has observed his/her family members, friends, and neighbors participating in PA Example item: <i>How often do you see people in your neighborhood participating in PA such as walking, jogging, bicycling, or playing sports?</i>	1 = <i>never</i> to 5 = <i>very often</i>	N/A	(Booth, Owen, Bauman, Clavisi, & Leslie, 2000)
Social support for PA	Sum of six items that asked how often family and friends did PA with, encouraged, and offered to do PA with the respondent over the past three months Example item: <i>During the past three months, how often did your family do PA with you?</i>	1 = <i>never</i> to 5 = <i>very often</i>	.82	(Sallis et al., 1987)
Outcome expectancies of PA	Five individual items assessing the extent to which respondents believed they would be less depressed and/or bored, lose weight or get into better shape, feel less tension and stress, experience improvements in health or reduced risk of disease, and feel more attractive as a result of engaging in PA. Example item: <i>If you participate in PA for three or more times a week for at least 10 minutes at a time, then you will lose weight or get into better shape</i>	1 = <i>strongly disagree</i> to 5 = <i>strongly agree</i>	N/A	(Calfas, Sallis, Lovato, & Campbell, 1994; Forsyth, Oakes, & Schmitz, 2009; Hovell et al., 1989)
Internal barriers to PA: psychological	Average of two items assessing how often lack of interest in and not enough enjoyment from PA kept the respondent from engaging in PA Example item: <i>How often does lack of interest in exercise or PA keep you from engaging in PA three or more times a week for at least 10 minutes at a time?</i>	1 = <i>never</i> to 5 = <i>very often</i>	.82	(Forsyth et al., 2009)
Internal barriers to PA: physical functioning	Assessed with the 10-item Physical Functioning subscale of the SF-36 Example item: <i>Does your health limit you a lot, a little, or not at all when lifting or carrying groceries?</i>	1 = <i>not limited</i> to 3 = <i>limited a lot</i>	.93	(Ware, Kosinski, Dewey, & Gandek, 2000)
Internal barriers to PA: pain	Assessed with the two-item Bodily Pain subscale of the SF-36 Example item: <i>How much bodily pain have you had during the past four weeks?</i>	1 = <i>none</i> to 6 = <i>very severe</i> ; 1 = <i>not at all</i> to 5 = <i>extremely</i>	.85	(Ware et al., 2000)
External barriers to PA	Average of six items assessing the frequency with which a lack of facilities, no safe places, no sidewalks, lack of well-lit places, too much traffic, and danger of crossing the streets keep the respondent from engaging in PA Example item: <i>How often does a lack of facilities in your neighborhood keep you from engaging in</i>	1 = <i>never</i> to 5 = <i>very often</i>	.89	(Forman et al., 2008; Forsyth et al., 2009)

Social-cognitive constructs	Description of measure/items	Item response scale	Cronbach's alpha for composite measures in the current study	Sources
	<i>PA three or more times a week for at least 10 minutes at a time?</i>			

Note. FV = fruits and vegetables. N/A = not applicable. PA = physical activity.

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Table 2**Participant Characteristics (N = 982)**

Characteristic	n	%	M	SD
Demographics				
Male	231	23.5		
Non-Hispanic black	891	90.7		
≥55 years old	491	50.0		
Married or living with partner	171	17.4		
Children under 18 in household	269	27.4		
Socioeconomic status				
High school education or less	512	52.1		
Annual per capita household income ^a < \$10,000	525	53.5		
SNAP recipient in household	512	52.1		
Owns or has access to a vehicle	549	56.2		
Weight status				
Not overweight or obese (BMI < 25)	211	21.7		
Overweight (BMI 25–29)	287	29.5		
Obese (BMI 30+)	475	48.8		
History of conditions diagnosed by health professional				
High blood pressure or hypertension	498	51.0		
Arthritis	399	41.0		
High cholesterol	256	26.3		
Diabetes	218	22.3		
High blood sugar	183	18.8		
Heart disease	144	14.7		
Cancer	71	7.3		
Kidney disease	45	4.6		
Healthy Eating Index-2010 score			48.95	12.97
Fruit and vegetable intake (cups), past 24 hours			2.26	1.56
Self-reported total minutes of walking for at least 10 minutes at a time, past week			272.89	355.21
Total daily minutes of MVPA based on accelerometer data, past week			6.46	20.23

Note. BMI = body mass index.

^aAnnual per capita household income is total household income divided by the number of people in the household.

Table 3

Fit Indices for Models Estimated with Two to Six Classes (N = 982)

Number of classes	SSA-BIC	Entropy	LMR ALRT	BLRT
2	107618.53	.89	3667.85	3680.84
3	106033.52	.92	1731.14	1737.27
4	105217.86	.93	964.50	967.91
5	104729.50	.90	638.36	640.62
6	104101.68	.91	604.68	606.82

Note. SSA-BIC = Sample-Size Adjusted Bayesian Information Criterion. LMR ALRT = Lo-Mendell-Rubin Adjusted Likelihood Ratio Test. BLRT = Bootstrap Likelihood Ratio Test.