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Factors Associated with Maintenance of Body Mass Index in the Jackson Heart Study: A Prospective Cohort Study Secondary Analysis

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Abstract

The purpose of this study was to compare the relationship of diet quality, physical activity, and environmental factors with body mass index (BMI) maintenance in African American adults. We analyzed data from 4041 participants in the Jackson Heart Study, a prospective cohort study based in Jackson, Mississippi. Exposures were baseline American Heart Association diet quality score, American Heart Association physical activity categories, the built environment, the food environment, and neighborhood safety. The outcome was weight maintenance or loss (no BMI increase -1.0 kg/m^2) versus weight gain (BMI increased $+1.0 \text{ kg/m}^2$) over a mean of 5.0 years. We found that 63% of participants maintained or lost weight and 37% gained weight. In multivariable analyses, Ideal diet quality was associated with a 6% greater likelihood of BMI maintenance (incidence rate ratio [IRR] 1.06, 95% confidence interval [CI]: 1.03, 1.10). Living in an unsafe neighborhood was associated with a 2% lower likelihood of BMI maintenance (IRR 0.98, 95% CI: 0.96, 0.99), as was poor built environment (IRR 0.98, 95% CI: 0.97, 0.998). Physical activity and poor food environment were not associated with BMI maintenance. In conclusion, among African American adults in Jackson, Mississippi, high quality diet was the strongest factor associated with BMI maintenance.

Background

The United States has the highest prevalence of obesity among developed countries, and this high prevalence of obesity disproportionately affects African Americans and the Southern United States (US).^{1,2} Mississippi has the second highest prevalence of obesity in the US: 36% of all adults and 43% of African American adults are obese.³ Obesity is in the causal pathway of more than 25 chronic diseases, and obesity prevention is a priority from local to national levels.⁴ To determine interventions with the greatest potential to prevent obesity, data on predictors of weight maintenance are needed.

The extent to which lower energy expenditure (e.g., sedentary lifestyle) versus greater energy intake (e.g., unhealthy diet) causes weight gain is debated, and likely varies across populations. The increase in the prevalence of obesity in the US since 1980 is posited to be primarily due to increased energy intake.^{5,6} The etiology of the US obesity epidemic is complex and rooted in socioeconomic position and factors that individuals cannot readily change, like how readily one's local environment facilitates healthy eating and physical activity.⁷ It is a national priority to understand factors associated with weight maintenance in populations at high-risk for cardiovascular disease, including African Americans in the Southern US, and how such factors differ across racial and ethnic groups.⁸

The Jackson Heart Study (JHS), based in Jackson, Mississippi, is one of the largest prospective cohort studies of African Americans designed to evaluate cardiovascular disease outcomes. We performed a secondary analysis of the JHS to analyze factors associated with BMI maintenance in African American adults at risk for weight gain and cardiovascular

disease. We hypothesized that BMI maintenance would be most strongly associated with diet quality and physical activity. We hypothesized that BMI maintenance would be weakly associated with a built environment conducive to walking, a food environment with access to grocery stores, and neighborhood safety.

Methods

Data Source

The JHS is a prospective, observational cohort study of 5301 African American adults living in the Jackson, Mississippi metropolitan area. Participants underwent baseline visits between 2000 and 2004, and returned for follow-up visits approximately every four years. We analyzed data for the period between enrollment and the first follow-up visit (mean time, 5.0 years). Our study population included participants in the JHS with a baseline body mass index (BMI) ≥ 18.5 kg/m².

The University of Mississippi Medical Center Institutional Review Board (IRB) approved the JHS, and participants gave written informed consent. Details of the study design and data collection methods are described in detail elsewhere.¹⁰ Local IRB approval was obtained for use of JHS data at the University of Washington.

Primary Outcome

Our primary outcome was maintaining or losing weight (no increase in BMI ≥ 1.0 kg/m²) versus weight gain (BMI increase ≥ 1.0 kg/m²) over 5 years of follow-up. For reference, a BMI change of 1.0 kg/m² is equivalent to a 3% – 4% change in body weight across adult heights.¹¹ Trained study personnel measured height and weight at clinic visits. Standing height was measured without shoes and recorded to the nearest centimeter. Weight in light clothing without shoes was measured on a scale, and BMI was computed by dividing weight (kg) by height squared (m²). The updated height at each visit was used to calculate BMI.

Diet

Diet was assessed with a semi-quantitative, 158-item food frequency questionnaire (FFQ) developed and validated for the JHS.¹² A diet quality score was constructed based on the AHA 2020 Strategic Impact Goals, which have been validated in multiple populations.¹³ The 50-point AHA diet quality score was constructed following the methods of Rehm and colleagues.¹⁴ Ten points were given for meeting each of the five primary AHA 2020 Strategic Impact Goals: (1) ≥ 4.5 cups/day of whole fruit, 100% fruit juice, or vegetables; (2) ≥ 2 100 gram servings/week of fish; (3) ≥ 3 1 oz. servings/day of whole grains (4) ≥ 36 fluid oz./week of sugar-sweetened beverages; (5) < 1500 milligrams of sodium/day. All dietary variables were energy-adjusted to 2000 kcal/day using the residual method prior to analysis. Intermediate intake was scored linearly between zero and 10. Additional details of the 50-point AHA diet quality score are presented in Supplemental Table A1. Energy and nutrient intakes were analyzed from the FFQ using the Nutrition Data System for Research (NDS-R, version 4.04, University of Minnesota).

Physical Activity

Participants completed an interviewer-administered physical activity survey at baseline, derived from surveys used in the Atherosclerosis Risk in Communities study.¹⁵ Physical activity was reported by named activity and the average amount of time per week spent at that activity. The average time per week spent engaged in all activities was tallied for vigorous and moderate levels separately. Each participant was then scored as having one of three levels of physical activity as recommended by the AHA's Life's Simple Seven guidelines: (1) Poor: 0 minutes/week of moderate or vigorous physical activity (MVPA); (2) Intermediate: 1–149 minutes/week of moderate activity or 1–74 minutes/week of vigorous activity or 1–149 minutes/week of MVPA; (3) Ideal: 150 minutes/week of moderate activity or 75 minutes/week of vigorous activity or 150 minutes/week of MVPA.¹⁶

Environment

Participants completed questionnaires at baseline about their built environment, food environment, and neighborhood safety. Four-level Likert-type scales measured responses to these survey questions (Supplemental Appendix A2). The built environment was assessed by asking participants if “access to parks, playgrounds, or sidewalks” is a problem. The food environment was assessed by asking if “access to food or grocery stores” is a problem. Neighborhood safety was assessed by asking participants to rate their agreement with the statement “this neighborhood is unsafe.” Responses to these 3 questions were collapsed into binary categories to increase power.

Chronic Conditions

Prevalent comorbidities were assessed through baseline surveys, medication use, and laboratory testing. Participants were assessed for depression using the Centers for Epidemiologic Studies Depression Scale (CES-D), a 20-item questionnaire developed to assess depressive symptoms in community populations.¹⁷ Prevalent depressive symptoms were defined as a CES-D score ≥ 16 . Prevalent diabetes was defined by (1) fasting glucose ≥ 126 mg/dL, (2) HbA1c $\geq 6.5\%$, or (3) report of taking oral diabetes medications or insulin.¹⁸ Prevalent cardiovascular disease was defined as self-reported coronary heart disease, carotid angioplasty, or stroke.¹⁹

Tobacco and Alcohol

Interviewers asked participants about tobacco and alcohol use at baseline. Participants were classified as current, former, or never smokers. Problem alcohol drinking was defined by >14 drinks/week in men < 65 years of age or >7 drinks/week in men ≥ 65 years and in women of all ages.²⁰ One drink was defined as 12 ounces of beer, 4 ounces of wine, or 1 ounce of liquor.

Stress

A global perceived stress scale was created for the JHS using 8 questions to measure the severity of chronic stress experienced over the prior one year.²¹ Global perceived stress was measured on a 24-point scale and analyzed continuously.

Socioeconomic Position

Social and demographic information was collected during the baseline visit. Education status was self-reported and collapsed into 4 groups (less than high school, high school, some college, and college/associate degree or higher). Income status was derived from family income and family size and was adjusted by enrollment year to account for inflation. Income status was reported as lower, moderate, and higher (Table 1 key).

Statistical Analysis

Baseline characteristics are presented as means $\pm$ standard deviations (SD) for continuous variables and proportions for categorical variables. The primary, binary outcome for this analysis was maintaining or losing weight (defined as no BMI increase ≥ 1.0 kg/m² between enrollment and the first follow-up visit) versus weight gain (defined as BMI increase ≥ 1.0 kg/m² over this time period).

Poisson regression analysis was used to examine the association of 5 main independent variables (diet quality, physical activity, food environment, built environment, and neighborhood safety) with the outcome of BMI maintenance. Models were adjusted for the following 10 known obesity risk factors and potential confounding variables: age, sex, education level, baseline BMI, prevalent depressive symptoms, prevalent diabetes, prevalent cardiovascular disease, global perceived stress, smoking status, and problem alcohol drinking. Independent variables and covariates of interest were all measured at baseline. Separate multivariable models were used for each of the 5 main independent variables, and all multivariable models adjusted for the above 10 covariates (Table 2). Poisson regression models were offset for the log of time, allowing for calculation of incidence rate ratios (IRR) for factors associated with BMI maintenance. IRRs > 1.0 are associated with BMI maintenance. Missing data were not imputed.

Sensitivity Analyses

To standardize diet quality and physical activity and facilitate a direct comparison between these two independent variables, quintiles of diet quality and physical activity were evaluated as ordinal variables to assess trend using the log-rank test. To assess the independent effect of each of the 5 main predictor variables, we created an additional multivariable model that adjusted for the 5 main independent variables and the 10 covariates of interest simultaneously.

We performed several sensitivity analyses of adjusted regression models of the relationship between physical activity and BMI maintenance. (1) We created interaction terms to investigate for the presence of effect modification between minutes/week of MVPA and age, sex, and baseline BMI, and tested each interaction term in the adjusted regression models for each of the 5 main independent variables. (2) We assessed minutes/week of MVPA as an alternative predictor variable (with and without log transformation to correct for skew) instead of the 3-category AHA physical activity level. (3) Because repeated assessment of physical activity was done at the second follow-up visit (mean 8 years after enrollment), we performed change analysis examining the association of the change in MVPA between

enrollment and the second follow-up visit and BMI maintenance over this 8-year time period.

We also compared the AHA Life's Simple Seven diet quality score to 50-point AHA 2020 Goals score.¹⁶ The AHA Life's Simple Seven diet quality score is a 5-point score that uses the same dietary goals, but does not give points for intermediate levels of encouraged or discouraged dietary factors. Both AHA scores were calculated after energy adjustment. Statistical analysis was conducted using Stata, version 14 (Stata Corp, College Station, TX). A two-sided p-value <0.05 was considered statistically significant for all analyses, including interaction terms.

Results

Of the initial JHS 5301 participants, 4041 (76%) were included in this analysis. Death occurred in 318 participants prior to their first follow-up visit, 789 participants (15% of the cohort) did not attend their first follow-up visit, 136 were missing a measured BMI at either enrollment or their first follow-up visit, and 17 were excluded because their baseline BMI was < 18.5 kg/m². The 789 participants who did not attend their first follow-up visit were younger and had lower levels of education, income, and diet quality compared to the 4041 included subjects (Supplemental Table A3). Additionally, those participants who did not attend their first follow-up visit reported higher levels of smoking, problem alcohol drinking, and better built and food environments.

Sixty-three percent of participants were weight stable or lost weight and 37% gained weight. The distributions of changes in weight and BMI over the 5-year follow-up period were skewed and negative outliers were present. The median weight change over the 5-year follow-up period was 0.66 kg (interquartile range [IQR]: -2.94 kg, 4.40 kg), and the median change in BMI over this period was 0.36 kg/m² (IQR: -0.97 kg/m², 1.69 kg/m²).

Participants who maintained or lost weight were older (56.9 years versus 51.9 years), had slightly lower educational attainment and income status, and were more likely to have prevalent diabetes, hypertension, and cardiovascular disease (Table 1). Participants who maintained or lost weight had slightly higher diet quality (7.6% had an AHA ideal quality diet, vs. 6.5% of participants who gained weight) and slightly lower physical activity levels (48.3% were sedentary, vs. 45.8% of participants who gained weight). Environmental factors and other factors were similar between participants whom maintained/lost weight and those who gained weight.

AHA ideal diet quality was associated with a 6% greater likelihood of BMI maintenance (adjusted IRR 1.06, 95% CI: 1.03, 1.10; Table 2). AHA intermediate diet quality was associated with a 3% greater likelihood of BMI maintenance (adjusted IRR 1.03, 95% CI: 1.01, 1.05). The association between increasing AHA diet quality category and BMI maintenance was statistically significant (P for trend 0.003). AHA physical activity categories were not significantly associated with BMI maintenance (P for trend 0.21). Residence in an unsafe neighborhood was associated with a 2% lower likelihood of BMI maintenance (adjusted IRR 0.98, 95% CI: 0.96, 0.99), as was residence in a neighborhood

with poor access to playgrounds, parks, and sidewalks (adjusted IRR 0.98, 95% CI: 0.97, 0.998). BMI maintenance was not significantly associated with poor access to food or grocery stores. Throughout the entire analysis, results were similar in adjusted and unadjusted models.

Sensitivity Analyses

Standardization of the AHA diet quality score and minutes/week of MVPA using quintiles yielded similar results to the primary analysis (Supplemental Tables A4 and A5). Comparing the highest to lowest quintiles of the AHA diet quality score, the adjusted IRR was 1.05 (95% CI 1.03, 1.07), and the P for trend across quintiles was <0.001. Comparing the highest to lowest quintiles of minutes/week of MVPA, the adjusted IRR was 1.00 (95% 0.99, 1.02) and the P for trend across quintiles was 0.12. Combining all 5 independent variables and 10 covariates of interest in the same adjusted model yielded very similar IRR's to the primary analysis (Supplemental Table A6).

Alternative methods of assessing physical activity, including creating interaction terms between minutes/week of MVPA and age, sex, and baseline BMI, did not change findings. The AHA Life's Simple Seven diet quality score showed nearly identical associations with BMI maintenance compared as the AHA 2020 Goals diet quality score (Supplemental Table A7).

Discussion

We found that high quality diet was the strongest factor associated with BMI maintenance in African American adults in the Jackson Heart Study over 5 years of follow-up. Ideal diet quality was associated with a 6% greater likelihood of BMI maintenance (adjusted IRR 1.06, 95% CI: 1.03, 1.10). An unsafe neighborhood and poor access to playgrounds, parks, and sidewalks were associated with small, but statistically significant lower likelihood of BMI maintenance. Contrary to our hypothesis and results in other cohort studies, physical activity was not associated with BMI maintenance in the JHS.

In prospective cohort studies of cardiovascular outcomes examining different populations, for example the Nurses Health Study, Nurses Health Study II, and the Health Professionals Follow-Up study, both diet and activity were associated with long-term weight change. An analysis of these three cohorts (combined n = 120,877) found that changes in diet quality were associated with greater weight loss over 4 years compared to changes in physical activity.²² An analysis of 736 African American participants in the Weight Loss Maintenance Trial found similar results to our analysis: the Healthy Eating Index score and older age were associated with weight maintenance after weight loss, but MVPA was not.²³ Levels of physical inactivity were much higher in the JHS (48%) compared to 2014 levels of physical inactivity among all adults at the state-level Mississippi (32%) and the United States (24%).²⁴

To our knowledge, no common definition of weight maintenance exists, and most studies of weight maintenance consider this outcome after an initial body weight loss of 5% – 10%.^{11,25} Changes of 3% – 5% of body weight are considered clinically significant in

adults, and a BMI change of 1.0 kg/m² is between 3% – 4% of baseline body weight across adult heights.¹¹ Different categorizations of weight maintenance in the scientific literature include (1) no weight increase 1.0 kg – 2.3 kg; (2) no increase 3% – 5% of body weight, (3) and no increase 1.0 kg/m² – 1.5 kg/m² of BMI.^{11,25} Defining weight maintenance in terms of BMI increases precision because the same weight change threshold is applied to individuals of the same height. Definitions of weight maintenance using percent change of baseline body weight are problematic in individuals with a very high baseline BMI, since higher absolute increases in body weight are observed. Our definition of weight maintenance as no increase in BMI 1.0 kg/m² is similar to how the Institute of Medicine defined “long-term weight loss.”²⁵

Adverse features of the built environment²⁶ and food environment²⁷ have been associated with weight gain and increased obesity rates. An analysis of 6,027 participants in the Multi-Ethnic Study of Atherosclerosis used geocoding to measure the association of changes in the built environment and changes in BMI and waist circumference.²⁸ This study found that a favorable built environment index score—measuring population density, land-use patterns, access to destinations, public transportation, and street patterns—was independently associated with lower BMI and waist circumference. Our analysis of the JHS used self-reported measures of the built environment, food environment, and neighborhood safety. Other studies have demonstrated that use of self-reported environmental measures, compared to measures objectively derived from geospatial data, may lead to exposure misclassification.²⁹

Studies examining neighborhood food environment and obesity have found mixed results, likely due to confounding by food and grocery purchasing outside of one’s local neighborhood. An analysis of the Seattle Obesity Study found that only 1 in 7 persons shopped at their nearest supermarket, that distance to the nearest supermarket was not associated with obesity, but that shopping primarily at a low-price supermarket was associated with obesity.³⁰ The Los Angeles Family and Neighborhood Study examined 2620 adults (55% Latino, 9% African American, 68% low socioeconomic position) and found that, controlling for individual-level factors and neighborhood socioeconomic position, shopping at a grocery store in a low-income neighborhood versus high-income neighborhood was associated with higher BMI.³¹ Our finding that diet quality, but not neighborhood food environment, was associated with weight maintenance is consistent with results in the Seattle Obesity Study and the Los Angeles Family and Neighborhood Study.^{30,31} It seems plausible that the primary type of food and grocery stores one shops at matters more than proximity.

Multiple cross-sectional studies link poor neighborhood safety with higher BMI,³² obesity,³³ and lower physical activity.³⁴ Our analysis of the JHS confirmed these results; an unsafe neighborhood was independently associated with lower likelihood of BMI maintenance. Similar to other studies that found these associations with BMI maintenance, we found a small effect (2% lower likelihood of BMI maintenance).

There are several possible explanations for why diet is the most important factor in weight maintenance in the JHS. National-level data suggest that high energy intake is primarily

responsible for adult weight gain in the US and other developed countries.^{5,6} Evidence from doubly labeled water studies suggests that neutral or negative energy balance is more readily achieved through dietary change than through activity change.³⁵ In the JHS, baseline physical activity levels were low: nearly half of participants were sedentary, and the average level of MVPA was about 70 minutes/week. The mean difference in total energy intake was 77 kcal/day higher in individuals who did not maintain their BMI, which aligns with the findings of Hill and colleagues, who estimated that reducing energy intake (or increasing physical activity) by about 100 kcal/day would prevent weight gain in most US adults.³⁶

This study is strengthened in that it is one of the largest prospective cohort studies in African Americans; however, it has limitations. Dietary data were collected at baseline only, which may cause results to be biased towards the null.⁹ Fifteen percent of the participants in the JHS were excluded from this analysis because they did not attend their first follow-up visit, and these excluded participants were at higher risk for weight gain by virtue of their lower socioeconomic position, lower levels of physical activity, higher daily calorie consumption, and lower diet quality. Exclusion of these participants may have biased our results towards the null. Although we adjusted for 10 potential confounding variables, there may be unmeasured confounding between physical activity level and BMI maintenance. We performed extensive sensitivity analyses of the association between physical activity and BMI maintenance, including change analysis, but associations were persistently non-significant.

Environmental variables were based on self-report, which may have led to exposure misclassification and systematically biased our results.

Conclusions

In this secondary analysis of 4041 African American adults in the Jackson Heart Study, a prospective cohort study based in Jackson, Mississippi, we found that high quality diet was the strongest factor associated with BMI maintenance over 5 years of follow-up. Unsafe neighborhood and poor access to playgrounds, parks, and sidewalks were associated with small, but statistically significant lower likelihoods of BMI maintenance.

Primary prevention of weight gain is an important national health goal, but may be difficult to measure. We found small relative risks between BMI maintenance and diet quality, neighborhood safety, and the built environment, but the population attributable risks may be large because of the high prevalence of obesity in the US. Our findings are similar to those in other cohorts, and suggest that obesity prevention efforts should include diet quality.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Highlights

- To inform obesity prevention efforts, evidence about weight maintenance is needed.
- We compared lifestyle factors associated with BMI maintenance in African American adults.
- High diet quality was associated with BMI maintenance over 5 years.
- This paper suggests that obesity prevention efforts should target diet quality.

Table 1

Baseline characteristics of 4041 African American adults in the Jackson Heart Study, by BMI change over 5 years of follow-up

	BMI maintenance: No BMI increase 1.0 kg/m ² (n = 2556)	BMI Gain: BMI increased 1.0 kg/m ² (n = 1485)
Mean age, years (SD)	56.9 (11.9)	51.9 (11.9)
Female	64.2%	65.2%
Mean baseline BMI, kg/m ² (SD)	31.9 (7.0)	31.7 (7.1)
Education		
Less than high school	18.6%	14.5%
High sch. graduate/GED	17.7%	15.9%
> High sch. but < bachelor's degree	20.8%	25.1%
Bachelor's degree or higher	42.9%	44.5%
Income status ^a		
Lower	12.9%	13.3%
Moderate	52.5%	54.7%
Higher	34.6%	32.0%
Current smoking	11.1%	11.7%
Problem alcohol drinking	3.5%	3.2%
Mean global perceived stress score ^b (SD)	4.9 (4.2)	5.7 (4.5)
Prevalent comorbidities		
Depressive symptoms	13.2%	15.8%
Diabetes	22.6%	16.3%
Hypertension	28.1%	22.9%
Cardiovascular disease	9.4%	7.9%
Mean AHA diet quality score (SD)	29.1 (7.5)	28.4 (7.9)
AHA diet quality score categories ^c		
Poor	10.4%	12.9%
Intermediate	82.0%	80.6%
Ideal	7.6%	6.5%
Total energy intake, kcal/day (SD)	2188 (867)	2265 (931)
Mean min/week MVPA (SD)	68.8 (110.3)	70.0 (116.5)
AHA physical activity levels ^d		
Sedentary	48.3%	45.8%
Intermediate	30.9%	35.7%
Recommended	20.9%	18.5%
Poor access to playgrounds, parks, or sidewalks	25.9%	24.9%
Poor food or grocery store access	7.9%	7.4%
Neighborhood unsafe	41.9%	41.0%

Key: AHA (American Heart Association), BMI (body mass index), GED (general educational development), MVPA (moderate or vigorous physical activity), SD (standard deviation)

The JHS is a prospective cohort study based in Jackson, Mississippi. N's are given for demographic factors like age, but vary from 2160 to 2556 in the BMI maintenance group and 1275 to 1485 in the BMI gain group.

^aLower <\$20,000 individual or <\$35,000 family of 4; moderate <\$35,000 individual or <\$75,000 family of 4; higher >\$35,000 individual or >\$75,000 family of 4. Incomes are adjusted by year to account for inflation.

^bThe global perceived stress scale is a 24-point scale, see methods for details

^cSee methods for details about 50-point AHA 2020 Goals diet quality score: Poor (0–19 points); intermediate (20–39 points); ideal (40–50 points)

^dDetails of AHA Life's Simple 7 physical activity levels: Sedentary (0 min/week MVPA); intermediate (1–149 min/wk MVPA, 1–74 min/wk of vigorous activity, or 1–149 min/wk MVPA); recommended (150 min/wk of moderate activity, 75 min/wk of vigorous activity, or 150 min/wk MVPA)

Table 2

Factors Associated with Maintaining BMI Among African American Adults in the Jackson Heart Study

	N	N At Risk	Unadjusted IRR (95% CI)	Adjusted IRR ^F (95% CI)
Model 1: AHA diet quality score ¹⁷				
Poor	425	3655	1.00 (referent)	1.00 (referent)
Intermediate	2970	3655	1.03 (1.01, 1.05)	1.03 (1.01, 1.05)
Ideal	260	3655	1.05 (1.03, 1.09)	1.06 (1.03, 1.10)
P for Trend			0.002	0.003
Model 2: AHA physical activity levels [±]				
Sedentary	1912	4037	1.00 (referent)	1.00 (referent)
Intermediate	1318	4037	1.00 (0.99, 1.02)	1.01 (0.99, 1.02)
Recommended	807	4037	1.01 (0.99, 1.02)	1.01 (0.99, 1.03)
P for Trend			0.37	0.21
Model 3: Poor access to playgrounds, parks, or sidewalks	975	3820	0.98 (0.96, 0.99)	0.98 (0.97, 0.998)
Model 4: Poor food or grocery store access	292	3779	1.00 (0.98, 1.02)	1.01 (0.99, 1.03)
Model 5: Neighborhood unsafe	1535	3690	0.97 (0.96, 0.99)	0.98 (0.96, 0.99)

Key: AHA (American Heart Association), BMI (body mass index), CI (confidence interval), IRR (incidence rate ratio), min/wk (minutes/week), MVPA (moderate or vigorous physical activity)

Notes:

^F 5 separate multivariable models were used for each main independent variable. The models assessed the IRR of BMI maintenance versus BMI increase. All multivariable models were adjusted for age, sex, education level, baseline BMI, global perceived stress, smoking status, problem alcohol use, and prevalent diabetes, cardiovascular disease, and prevalent depressive symptoms

¹⁷ See methods and Supplemental Table A1 for details about the 50-point AHA 2020 Strategic Impact Goals diet quality score: Poor (0–19 points); Intermediate (20–39 points); Ideal (40–50 points)¹⁴

[±] Details of AHA Life's Simple 7 physical activity levels: Sedentary (0 min/wk MVPA); Intermediate (1–149 min/wk MVPA, 1–74 min/wk of vigorous activity, or 1–149 min/wk MVPA); Recommended (> 150 min/wk of moderate activity, > 75 min/wk of vigorous activity, or > 150 min/wk MVPA)

The Jackson Heart Study is a prospective cohort study based in Jackson, Mississippi