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Breakfast Consumption Frequency and Its Relationships to Overall Diet Quality, Using Healthy Eating Index 2010, and Body Mass Index among Adolescents in a Low-Income Urban Setting

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Abstract

The aim of this study was to describe the relationship of breakfast frequency to diet quality and BMI among low-income, predominantly African American adolescents aged 9–15 ($n = 239$). Mean frequency of breakfast consumption was 5.0 ± 0.15 times per week. A significant, positive relationship was seen between HEI scores and frequency of breakfast consumption ($p = .01$). Dairy ($p = .02$) and whole grains ($p < .01$) HEI component scores were significantly related to breakfast frequency. No relationship was seen between breakfast frequency and BMI. Research with more rigorous designs should be conducted to assess the potential effects of breakfast consumption on diet quality in this population.

Keywords

Adolescent; breakfast consumption; diet quality HEI 2010; low-income African American; obesity

In the United States, obesity disproportionately affects urban minority youth (Lobstein, Baur, and Backson-Leach 2010). Over 20% of African Americans aged 2–19 years are obese and 15.0% are overweight, compared to the 14.1% obese and 14.4% overweight non-Hispanic white youth (Ogden et al. 2014). In addition to its association with poor psychosocial outcomes in adulthood (Needham et al. 2010; Sweeting, Wright, and Minnis 2005), childhood obesity has been linked to a higher risk of adverse health conditions such as type 2 diabetes, metabolic syndrome, cardiovascular disease, stroke, some cancers, and

premature mortality (Biro and Wien 2010; Daniels et al. 2005; Dietz 1998; Ebbeling and Ludwig 2001; Liu, Wade, and Tan 2007; Reilly and Kelly 2011; Williams et al. 2002).

Studies suggest that breakfast consumption may be related to mental and physical health benefits (Affenito et al. 2005; Barton et al. 2005; Croezen et al. 2009; Deshmukh-Taskar et al. 2010; Rampersaud et al. 2005; Sjöberg et al. 2003; Timlin and Pereira 2007). Mental health benefits, including reduced stress, reduced depression, and improved cognitive function, have been associated with regular breakfast eating (Hoyland, Dye, and Lawton 2009; Smith 2002). In addition, in a longitudinal study, higher cholesterol and increased waist circumference were seen among individuals who did not typically eat breakfast throughout life (Smith et al. 2010). According to a review of studies (Rampersaud et al. 2005), quality and content of child breakfast varies substantially and benefits of regular breakfast consumption may be dependent on several factors, including quality (Mahoney et al. 2005; Smith, Maben, and Brockman 1994), variety (Aranceta et al. 2001), and portion (Michaud et al. 1991). Compared to girls, boys generally tended to have higher total energy, carbohydrate, protein, and fat intakes at breakfast (Rampersaud et al. 2005).

Breakfast skipping is prevalent in the United States and elsewhere throughout the world. Girls, children from families with lower socioeconomic statuses, older adolescents (Evers et al. 2014; Lawman et al. 2014; Lytle et al. 2014; Morgan, Zabik, and Stampley 1986; Murata 2000; Ostachowska-Gasior et al. 2016; Rampersaud et al. 2005; Resnicow 1991; Sampson et al. 1995; Siega-Riz, Popkin, and Carson 1998; Singleton and Rhoads 1982; Videon and Manning 2003), and some ethnic minorities are more likely to skip breakfast (Rampersaud et al. 2005). Some cited reasons for these patterns include time, lack of hunger, or intention to lose weight (Rampersaud et al. 2005; Reddan, Wahlstrom, and Reicks 2014; Shaw 1998; Singleton and Rhoads 1982). Adolescents who skip breakfast tend to have a higher body mass index (BMI); however, this was not a consistent finding (Lawman et al. 2014; Nuru and Mamang 2015; Ostachowska-Gasior et al. 2016; Rampersaud et al. 2005). Compared to their normal or underweight peers, overweight or obese children and adolescents are more likely to skip breakfast, especially females (Rampersaud et al. 2005). Reverse causality may be a factor in these findings; that is, girls who are overweight are likely to skip breakfast as a means to reduce energy intake. Among children and adolescents, eating breakfast was associated with better food choices such as consuming more vegetables and milk and fewer soft drinks and a lower intake of french fries; skipping breakfast among children and adolescents has been associated with poorer food choices such as increased snacking or intakes of high-fat snacks (Nuru and Mamang 2015; Rampersaud et al. 2005).

Few studies (Sampson et al. 1995; Skinner et al. 1985) have investigated breakfast consumption within communities, as opposed to national samples. To our knowledge, this is one of the first studies to examine breakfast consumption among low-income, urban adolescents. This study aims to address the following questions among low-income, predominantly African American adolescents in an urban setting:

1. What is the relationship between frequency of breakfast consumption and overall diet quality, as measured by the Healthy Eating Index 2010?
2. What is the relationship between frequency of breakfast consumption and BMI?

Methods

Study design and sample

Baltimore City, Maryland, comprises hundreds of neighborhoods, with disproportionate access to food among those neighborhoods. Many of the low-income areas are often defined as “food deserts” (Behren Buczynski, Freishtat, and Buzogant 2015), where access to grocery stores and healthy foods is limited, and “food swamps,” where access to fatty, sugary prepared foods is profuse and corner stores and carryouts that stock these foods are ubiquitous.

This analysis comprises baseline data from an ongoing 5-year obesity prevention intervention trial, B’More Healthy Communities for Kids, being conducted in Baltimore, Maryland. Additional details regarding this study have been published elsewhere (Gittelsohn et al. 2014). The sample of the larger study is drawn from 30 low-income, predominantly African American neighborhoods. This population was chosen due to the disproportionality of obesity among urban minority youth (Lobstein, Baur, and Backson-Leach 2010). Participants in the study were recruited from a variety of venues and events, such as recreation centers, libraries, swimming pools, grocery stores, back-to-school activities, and so on. Other means of recruitment included walking the streets of the neighborhoods, engaging in conversation with children and members of the community, and posting flyers.

Approximately 75 dyad (child and caregiver) names and contact information were collected in each neighborhood. Following collection of this information, the adolescents were screened on the following eligibility criteria: (1) being between the ages of 10 and 14 when recruited; (2) living within a mile and a half radius of the recreation center in that neighborhood zone; (3) shopping frequently at corner stores and carryout restaurants in that neighborhood; and (4) having no intention of moving within the next 2 years. Among those recruited and screened, 24 dyads were randomly selected in each neighborhood. If a randomly selected dyad was unable to complete the interview, then the next eligible dyad was chosen from the recruitment list. In select neighborhoods, there was difficulty following up with the recruited participants due to frequent changes in participant phone numbers in this population. In these cases, additional convenience sampling methods were used to recruit additional participants.

Data collectors were graduate-level public health students and staff that underwent an extensive training on each of the data collection instruments. Each data collector learned the instruments through a didactic presentation of the instruments and was taught to evaluate each question and articulate potential variability in responses from the given population. As a part of the training session, potential data collectors partook in role-playing scenarios, conducting each of the interviews with a partner. Following the training session, each individual in training observed a certified data collector and was then observed conducting an interview for critique and correction. Data were checked for errors and missing responses by the interviewer following the interview and by a second party after the interview, were entered by a third party, and were finally cleaned.

Prior to each interview, the adults provided consent for themselves and their child and the child assented to their interview. Adults received \$20 in gift cards and adolescents received \$30 in gift cards for participation in the interviews. All components of this study were approved by the Johns Hopkins Institutional Review Board (IRB No. 00004203).

Instruments

The child interview consisted of two instruments—the Block Kids 2004 Food Frequency Questionnaire (FFQ) and a Child Impact Questionnaire (CIQ). The Block Kids 2004 FFQ asks about frequency and portion of consumption of 77 food items in the past 7 days and is based on NHANES 1998–2002 data (NutritionQuest 2014; Cullen, Watson, and Zakeri 2008; Marshall et al. 2008; Smith and Fila 2014). This instrument has been validated in minority youth (Cullen, Watson, and Zakeri 2008). The CIQ consisted of 79 questions pertaining to demographics, food purchasing, food preparation, intentions about food, outcome expectancies, self-efficacy, food knowledge, social support, and breakfast consumption. Income level data were obtained from an Adult Impact Questionnaire (AIQ) used in the larger B'More Healthy Communities for Kids study. Anthropometric data (height and weight) were collected from both the caregiver and the child using a Seca 213 Portable Measuring Rod stadiometer and a Tania BF697W Duo Scale. BMI-for-age percentiles were calculated using measured height and weight and compared to the age- and sex-specific Centers for Disease Control (CDC) growth charts (Centers for Disease Control and Prevention 2010).

Data on breakfast consumption were derived from two questions. Adolescents were asked, “In the past 7 days, how many days did you consume breakfast?” with answer choices of “(a) 0 times; (b) 1 time; (c) 2 times; (d) 3–4 times; (e) 5–6 times; (f) Everyday.” Breakfast was considered anything consumed within 2 hours of waking. The second question was a recall of the breakfast consumed the previous day using portion estimation aids. All participants were asked the second question, regardless of their response to the previous question.

Calculation of the Healthy Eating Index 2010 scores

Overall diet quality was scored by using the Healthy Eating Index (HEI) 2010 (Guenther et al. 2013) based on the participants' Block Kids Food Frequency Questionnaire data. The HEI consists of 12 component scores including empty calories, sodium, refined grains, fatty acids, seafood and plant protein, total protein, dairy, whole grains, beans and greens, total vegetables, whole fruit, and total fruit. Overall HEI scores are on a scale from 0 to 100; higher scores indicate better diet quality (Guenther et al. 2013, 2014). For this study, output variables from the Block FFQ were coded in order to calculate the participants' HEI scores. Derivation methods of these variables can be found elsewhere (Sattler et al. 2015).

Statistical analyses

Data were checked for error and missing responses. Analysis was conducted using Stata IC 12.1 (“StataCorp” 2011) software. Exploratory data analysis was conducted and data were checked for normality. The final baseline sample for the larger B'More Healthy Communities for Kids study consisted of 299 participants. The questions about breakfast

consumption were added to the data collection instrument after baseline data collection began. Therefore, breakfast data were not collected on 45 participants; thus, they were excluded from this analysis. If daily caloric intake was reported as < 500 or $> 5,000$ kcal or if their HEI score was ± 3 standard deviations from the mean, then the participant was excluded from the analysis as the consumption values are likely due to measurement error rather than actual intake (Black et al. 2010). This resulted in an additional 14 individuals being excluded. The final sample size for this study was 239 participants.

To assign participants with a value for frequency of breakfast consumption, the midpoint of each frequency category was taken; that is, a response of “3–4 times per week” was counted as 3.5 times per week. Age categories were created, 9–12 and 13–15, for descriptive analyses. Pairwise comparisons of means testing were used to identify relationships in frequency of breakfast consumption and overall diet quality among age and sex categories.

Linear regression analyses were performed to examine the relationships between frequency of breakfast consumption and (1) overall diet quality and (2) BMI-for-age percentile. The models were based on knowledge of relationships with the variables of interest that is supported in the literature (Patrick and Nicklas 2005; Ebbeling, Pawlak, and Ludwig 2002; Kumanyika 2008). Sex, age, household income, race, and total HEI score were included as confounders in the regression model of breakfast frequency and child BMI. Sex, age, household income, BMI-for-age percentiles, and race were considered in the regression model of breakfast frequency and HEI. The sex of the adolescents was categorized as either male or female. In the models, race was included as a dichotomous variable, being African American or not African American. Statistical significance was set at the $p = .05$ level.

Post hoc analyses were conducted to further probe the data. Regression analyses assessing the relationship between frequency of breakfast consumption and the individual HEI component scores were conducted. A majority of the component scores were transformed to improve normality. Robust standard errors, using the Huber-White sandwich estimations, were estimated for all component scores, except the “empty calorie score,” due to heteroscedasticity.

Results

Descriptive characteristics of the sample are shown in table 1. The average frequency of breakfast consumption was 5.0 ± 0.15 times per week with 4.2% consuming no breakfast in the past week, 6.7% consuming breakfast one time in the past week, 11.3% consuming breakfast two times in the past week, 15.4% consuming breakfast three to four times in the past week, 13.0% consuming breakfast five to six times in the past week, and 49.4% consuming breakfast every day.

Frequency of breakfast consumption and BMI

Approximately 28% of the adolescents were categorized as either overweight or obese (table 1). In both the unadjusted model and adjusted models, frequency of breakfast consumption was not significantly associated with BMI-for-age percentile, but trended toward significant with p values $< .10$.

Frequency of breakfast consumption and overall diet quality

The average HEI score was 56.0 ± 0.6 . Younger girls demonstrated significantly higher HEI scores than older boys (57.7 ± 1.1 vs. 53.5 ± 1.5 , $p = .02$) (table 2). The remaining differences in HEI scores across age and sex groups are presented in table 2. In unadjusted and adjusted models, HEI scores were positively associated with frequency of breakfast consumption ($\beta = 0.70$, $p < .01$; $\beta = 0.71$, $p = .01$) (table 3).

HEI component scores

The results for the individual HEI component score regression analyses are presented in table 4. Frequency of breakfast consumption was positively associated with the beans and greens score and the total fruit score, and these associations were significant at the .10 level (beans and greens: $\beta = 0.04$, $p = .07$; total fruit: $\beta = 2.63$, $p = .06$). Frequency of breakfast consumption was statistically significantly positively related to dairy score ($\beta = 0.04$, $p = .02$) and whole grains ($\beta = 0.04$, $p = .003$). All other component scores were not statistically significantly related to frequency of breakfast consumption.

Discussion

To our knowledge, this is one of a few studies to examine breakfast consumption among low-income, urban adolescents in recent years. Younger adolescents demonstrated higher HEI scores compared to older adolescents in this study. Although these findings are only trended toward significance ($p < .10$), they are consistent with previous studies that have concluded that adolescents' diets may worsen as they age (Jenkins and Horner 2005; Shepherd et al. 2006). This could be a result of increased autonomy with regard to choosing and purchasing foods. When observing differences between sexes, diet quality was lower in older boys and girls compared to younger boys and girls. For both age groups, girls demonstrated higher, but not statistically significantly so, HEI scores. In addition, while there were not significant differences in diet quality by sex within the specified age groups, younger girls demonstrated significantly higher HEI scores than older boys. This may suggest a relatively greater decrease in diet quality as girls in this sample become older, compared to the expected decrease among boys.

Over 4% of adolescents in this study skipped breakfast the entire week before they were surveyed, which is consistent with previous findings that 4% of children and adolescents habitually skip breakfast (Berkey et al. 2003; Resnicow 1991) but lower than other findings that indicated over 12% of urban adolescents skipped breakfast (Lawman et al. 2014; Ostachowska-Gasior et al. 2016). In a study that utilized a 4-day eating behavior survey and a 24-hour dietary recall to examine breakfast eating behaviors in a similar, but younger, sample of low-income African American children in New Jersey, Sampson et al. (1995) found that 22%–26% of children did not eat anything for breakfast. The data from this study showed that girls consumed breakfast less frequently than boys and that younger adolescents consumed breakfast more frequently than older adolescents, with some significant findings between various age–sex groups, which is consistent with previous research that indicated that breakfast skipping is more common among girls and older adolescents (Lawman et al. 2014; Ostachowska-Gasior et al. 2016; Rampersaud et al. 2005). Therefore, trends in

frequency of breakfast consumption among low-income, urban, predominantly African American adolescents observed in the present study are consistent with those seen on the national level.

We found that breakfast consumption was not associated with BMI percentile in this sample of low-income, African American youth when adjusted for sex, age, household income, race, and HEI total. However, this relationship did trend toward significance, which may warrant further research. Relationships between BMI and breakfast consumption have not been well established in the literature (Abalkhail and Shawky 2002; Boutelle et al. 2002; Kapantais et al. 2011; Lawman et al. 2014; Nuru and Mamang 2015; Ostachowska-Gasior et al. 2016; Resnicow 1991; Siega-Riz, Popkin, and Carson 1998; Sjöberg et al. 2003; Walker et al. 1982; Wolfe et al. 1994). In a recent publication assessing myths, presumptions, and facts about obesity, Casazza et al. (2013) delved into the presumption that breakfast consumption protects against obesity and found there was no difference in weight among those assigned to skip breakfast versus those assigned to eat breakfast (Astbury, Taylor, and Macdonald 2011; Casazza et al. 2013; Farshchi, Taylor, and Macdonald 2005). While the evidence analyzed by Casazza et al. (2013) focused only on adults, similar findings have been seen among children. Sampson et al. (2015), who observed a population similar to the one in this study, also found that weight status did not vary by breakfast behaviors. In our study, mean BMI-for-age percentile was highest (84.5) among those who consumed no breakfast in the past week, but no consistent pattern was seen as the next highest mean BMI-for-age percentile (72.5) was among those who consumed breakfast every day. Our findings contribute to the growing body of evidence that breakfast consumption may not be related to weight status.

We found a positive, significant relationship between HEI scores and breakfast consumption among adolescents in low-income, urban populations. This finding is consistent with previous studies that have examined relationships between breakfast consumption and overall diet quality among children and adolescents and have found that eating breakfast has been associated with better food choices (Lattimore and Halford 2003; Rampersaud et al. 2005; Nuru and Mamang 2015; Skinner et al. 1985). In a cross-sectional study, breakfast skipping resulted in substantial intake deficits of essential nutrients among low-income African American elementary school children (Sampson et al. 1995).

To further explore this relationship, we conducted post hoc analyses on the individual HEI component scores. Increased frequency of breakfast consumption was positively related to intake of dairy, whole grains, and fruit, as well as greens and beans. This finding is consistent with our post hoc analysis of the most commonly consumed foods at breakfast (data not presented). The reason for a relationship between frequency of breakfast consumption and greens and beans is unknown.

Limitations

Dietary data from this study were collected using a food frequency questionnaire, as opposed to the gold standard of three 24-hour recalls. However, the food frequency questionnaire has been validated and used in similar populations (Cullen, Watson, and Zakeri 2008). Due to the cross-sectional nature of this study, causal relationships cannot be

determined. In addition, the focus on a low-income, urban, predominantly African American adolescent population limits the generalizability of the findings. Despite these limitations, the study provides important information regarding frequency of breakfast consumption among low-income, urban adolescents, which has not been widely examined previously.

Implications for research and practice

In this setting, a relationship was not seen between BMI-for-age percentile and frequency of breakfast consumption, although the relationship trended toward significance. Thus, researchers aiming to improve weight status among low-income, adolescent populations should be cautious in targeting breakfast consumption as an effective intervention until further research with a more rigorous exploration of foods consumed at breakfast is conducted. However, a significant, positive relationship was seen between frequency of breakfast consumption and overall HEI scores. Specifically, frequency of breakfast consumption was associated with HEI component scores for dairy, whole grains, fruit, and greens and beans. These findings provide preliminary data for demonstrating the potential for breakfast consumption to improve overall diet quality among low-income, urban adolescent populations that are predominantly African American. Researchers should expand upon this current study and employ more rigorous methodologies to investigate these relationships further and demonstrate causality.

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Table 1Descriptive Characteristics of Low-Income, Urban Children ($n = 239$).

Gender, % (n)	
Female	51.1 (122)
Age, mean $\pm$ <i>SD</i>	11.9 $\pm$ 0.1
Race, % (n)	
African American	95.8 (229)
Mixed^a	2.5 (6)
Other	1.7 (4)
Ethnicity, % (n)	
Hispanic	3.4 (8)
Annual household income, % (n)	
\$0–20,000	48.4 (109)
\$20,001–\$40,000	37.8 (85)
\$40,001–\$60,000	8.9 (20)
> \$60,001	4.9 (11)
Declined to answer	6.2 (14)
BMI-for-age percentile, % (n)	
5%–< 85%	51.9 (122)
85%–< 95%	25.5 (60)
95%	22.6 (53)
Breakfast ^b consumption frequency, mean $\pm$ <i>SD</i>	5.0 $\pm$ 0.2
HEI score, mean $\pm$ <i>SD</i>	55.0 $\pm$ 0.6

Note. HEI = Healthy Eating Index; *SD* = standard deviation.

^aMixed = African American and some other race (i.e., white or American Indian).

^bDefined as anything eaten within 2 hours of waking.

Table 2

Frequency of Breakfast Consumption per Week and Diet Quality among Low-Income African American Youth in an Urban Setting by Age and Sex.

	Males aged 9–12 (<i>n</i> = 77)	Females aged 9–12 (<i>n</i> = 84)	Males aged 13–15 (<i>n</i> = 48)	Females aged 13–15 (<i>n</i> = 44)
Frequency of breakfast consumption ^a , mean ± <i>SD</i>	5.5 ± 0.2 [*]	4.9 ± 0.3	4.9 ± 0.4	4.3 ± 0.4 [*]
Healthy Eating Index score ^b , mean ± <i>SD</i>	55.8 ± 1.1	53.5 ± 1.5 ^{**}	57.7 ± 1.1 ^{**}	55.7 ± 1.5

Note. *SD* = standard deviation.

^aBreakfast is defined as any food consumed within 2 hours of waking; does not have to be traditional breakfast foods.

^bHealthy Eating Index scores are calculated using Block Kids Food Frequency Questionnaire.

^{*} Pairwise comparisons of group means are significantly different at *p* .01

^{**} pairwise comparisons of group means are significantly different at *p* .05.

Associations between Frequency of Breakfast Consumption and BMI and between Frequency of Breakfast Consumption and Healthy Eating Index Scores.

Table 3

	Crude			Adjusted		
	β	Standard error	<i>p</i> value	β	Standard error	<i>p</i> value
BMI ^a						
Frequency of breakfast consumption	-1.3	0.7	.07*	-1.3	0.8	.10*
HEI scores ^b						
Frequency of breakfast consumption	0.7	0.3	.01**	0.7	0.3	.01**

Note. BMI = body mass index; HEI = Healthy Eating Index.

^a Adjusted model includes age (continuous), sex (dichotomous; 1 = female; 0 = male), household income (dummy variable; 0 = \$0–\$10,000; 1 = \$10,001–\$20,000; 2 = \$20,001–\$30,000; 3 = \$30,001–\$40,000; 4 = \$40,001–\$60,000; 5 = \$60,001+), race (dichotomous; 1 = African American; 0 = not African American), HEI score (continuous).

^b Adjusted model includes age (continuous), sex (dichotomous; 1 = female; 0 = male), BMI-for-age percentile (continuous), household income (dummy variable; 0 = \$0–\$10,000; 1 = \$10,001–\$20,000; 2 = \$20,001–\$30,000; 3 = \$30,001–\$40,000; 4 = \$40,001–\$60,000; 5 = \$60,001+), and race (dichotomous; 1 = African American; 0 = not African American).

* Significant at *p* .10;

** significant at a *p* .01.

Table 4Associations between Frequency of Breakfast Consumption and Component HEI Scores ($n = 239$).

Component	B	Standard error	<i>p</i> value
Empty calorie score ^a	0.04	0.13	.52
Sodium score ^b	−0.05	0.08 ^g	.53
Refined grains score ^b	0.10	0.07 ^g	.13
Fatty acid score ^{b,d}	−0.82	0.68 ^g	.23
Seafood and plant protein score ^{b,c}	0.01	0.02 ^g	.72
Total protein score ^{c,f}	−0.25	0.99 ^g	.80
Dairy score ^{b,e}	0.04	0.02 ^g	.02 ^{**}
Whole grains score ^{b,e}	0.04	0.01 ^g	.003 ^{**}
Beans and greens score ^{b,e}	0.04	0.02 ^g	.07 [*]
Total vegetable score ^{c,e}	0.02	0.01 ^g	.15
Whole fruit score ^{c,f}	1.21	1.38 ^g	.38
Total fruit score ^{c,f}	2.63	1.38 ^g	.06 [*]

Note. Betas and standard errors cannot be interpreted directly due to transformations; however, the direction of the relationship and statistical significance can be interpreted as usual. All models adjusted and include age (continuous), sex (dichotomous; 1 = female; 0 = male), BMI-for-age percentile (continuous), household income (dummy variable; 0 = \$0–\$10,000; 1 = \$10,001–\$20,000; 2 = \$20,001–\$30,000; 3 = \$30,001–\$40,000; 4 = \$40,001–\$60,000; 5 = \$60,001+), and race (dichotomous; 1 = African American; 0 = not African American). HEI = Healthy Eating Index; BMI = body mass index.

^aHEI component score entered on a continuous scale of 0–20.

^bHEI component score entered on a continuous scale of 0–10.

^cHEI component score entered on a continuous scale of 0–5.

^dHEI component variable was square transformed.

^eHEI component variable was square root transformed.

^fHEI component variable was cube transformed.

^gRobust standard errors calculated as Huber-White sandwich estimators.

^{*}Significant at $< .10$;

^{**}significant at $< .05$.