EXECUTIVE FUNCTION AND NEGATIVE EATING BEHAVIORS IN SEVERELY OBESE AFRICAN AMERICANS

Objective: African Americans are disproportionately impacted by severe obesity. Low socioeconomic status and psychosocial risk factors help to explain this disparity; however, few studies have examined the role of negative eating behaviors or the influence of executive function on negative eating behaviors in this population. The objective was to examine the association between executive function (ie, inhibition and set shifting) and negative eating behaviors in severely obese African Americans.

Participants: Forty-seven African Americans who met criteria for severe obesity participated.

Design and Setting: Data were analyzed from a cross-sectional study entitled Stress and Psychoneuroimmunological Factors in Renal Health and Disease. The mean age of participants was 45.7 years (SD=10.8) and the mean educational attainment was 13 years (SD=2.1).

Main Outcome Measures: Participants completed the Wisconsin Card Sorting Task, the Stroop Color-Word Test, and the Eating Behavior Patterns Questionnaire.

Results: Correlation results suggested poorer inhibition was associated with greater self-reported emotional eating and snacking on sweets. Subsequent hierarchical regression analyses confirmed the inverse relations between inhibition, emotional eating, and snacking on sweets, after controlling for age, sex, years of education, and depression.

Conclusions: Reduced inhibition may be an important risk factor for negative eating behaviors and subsequent obesity in this population. Interventions aimed at increasing inhibition and self-regulation in this at-risk group are warranted. (Ethn Dis. 2014;24[3]:328–334)

Key Words: Eating Behaviors, African Americans, Obesity, Executive Functioning, Inhibition, Set Shifting

Obesity is an epidemic in the United States, with an estimated 35.5% of adults classified as obese in 2009–2010. The prevalence of severe obesity has also increased, with approximately 14.4% of the adult population meeting this criterion (body mass index ≥35 kg/m²). While rates of obesity have climbed for all racial/ethnic groups, African Americans are disproportionately impacted. Nearly 70% of African American men and over 82% of African American women are classified as overweight or obese, and among obese African Americans, 26% are classified as severely obese. Several factors that may account for this disparity include lower socioeconomic status (SES), sedentary lifestyle, chronic stress, psychological mood states, emotional eating, lack of access to quality medical care, and reduced availability of healthy food choices.

Another risk factor for overweight and obesity is negative eating behavior. Negative eating behaviors are loosely defined in the way they are operationalized – eating that is characterized by high fat, high sugar, and/or low nutrient-based consumption – and linked to weight gain. For example, mindless eating, where one overeats without awareness of satiety, is positively associated with obesity. Fast food, increased consumption of simple sugars, skipping breakfast, and nighttime eating are also associated with increased weight as well as obesity. Moreover, studies have suggested that other socioeconomic factors, such as increased access to fast foods, contribute to poorer eating behaviors, particularly among African Americans. Other evidence has shown that biological factors, such as genetic susceptibility to obesity, are linked to emotional and uncontrolled eating.

There is a paucity of research examining the influence of executive function on independent risk factors for obesity (eg, negative eating behaviors). Executive functions are higher order neurocognitive processes that enable individuals to initiate and arrest actions, inhibit and modify behaviors when necessary, and adapt to environmental changes. The association between obesity and decrements in executive function has been well studied. Findings have suggested that obese individuals have reduced decision making and problem solving capacity, reduced mental flexibility, and poor inhibitory ability. Furthermore, understanding the influence of executive function may elucidate how certain behavioral processes (eg, negative eating behaviors) increase the risk for obesity. Specifically, executive inattention, impulsivity, and inflexibility may underlie the behavioral processes that increase the risk for becoming overweight or obese.

Previous research has found a relationship between executive function and impulsive behaviors, such as compulsive gambling, sex addiction, and substance abuse. In addition, there have been documented associations between executive function and eating disorders. For example, the executive functions inhibition and set shifting play a critical role in negative eating behaviors prevalent in anorexia nervosa and bulimia. Inhibition involves withholding an automatic or impulsive response to a stimulus to produce an alternative...
The objective of our study was to examine relationships among the executive processes inhibition and set shifting and negative eating behaviors in severely obese African Americans.

Participants
A community-based sample of 214 African Americans participated in the parent study. Exclusion criteria included current physical, emotional, or drug abuse, and a previous psychiatric diagnosis. The inclusion criterion was a BMI >35 kg/m², for a final N of 47.

Measures
The Stroop Color and Word Test (Stroop) is a measure of inhibition. The task consists of reading words in a list that are color names, naming the colors of Xs that are printed in another list, and for the color word task, naming the colors words are printed in while ignoring the colors written. The color word task tests inhibition, the ability to suppress the urge to perform a primary response in order to attend to a response that is secondary. The Stroop interference score reflects degree of inhibition and was calculated using the Golden method for use in the analyses.

The Wisconsin Card Sorting Test (WCST) is a measure of set shifting. This test requires individuals to demonstrate cognitive flexibility to react to changing patterns in a set of displayed stimulus cards. The test requires individuals to adjust to a new pattern once it has changed. Individuals with greater set shifting ability are able to adjust to newly presented patterns and avoid perseverative errors. A perseverative error occurs when an individual continues to sort cards based on a previously correct pattern. In addition to perseverative errors, individuals must also avoid making non-perseverative errors, or errors that are unrelated to a pattern. For the current study, a computerized version of the WCST was administered. The number of perseverative and non-perseverative errors was utilized in the analysis.

The Eating Behavior Patterns Questionnaire (EBPQ) was designed to assess eating behaviors related to fat intake among African American women, but has been administered to African Amer-

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ican men as well. It is composed of items that make up five negative eating behavior domains and one positive domain: emotional eating, snacking on sweets, haphazard planning, meal planning, cultural/lifestyle behaviors, and low fat eating. Internal consistency of the six EBPQ domains is sound, with Cronbach’s alpha coefficients ranging from .70 to .88. Construct validity was demonstrated with several domains correlating significantly with measures of total energy and total fat intake, and several macro- and micro-nutrients derived from the Meharry Food Frequency Questionnaire. Examples of emotional eating items are “my emotions affect how and what I eat,” and “I eat for comfort.” Examples of snacking on sweets items are “I am a snacker” and “I eat cookies, cakes.” These two domains of the EBPQ were selected for the analysis.

Depressive symptoms were assessed as a covariate using the Beck Depression Inventory-II (BDI-II). The BDI-II is a well-validated 21-item self-report measure used to determine the severity of depression with scores highly correlated with a clinical diagnosis of depression.

Data Analysis

Data were analyzed using SPSS version 20.0. All variables in the analysis were checked for normality. The WCST non-perseverative errors variable was positively skewed and normalized using a log transformation. Initial associations between emotional eating, snacking on sweets, inhibition and set shifting variables were assessed with zero-order correlations. Significant zero-order pairs were then subjected to hierarchical linear regression. In order to account for multi-collinearity, separate hierarchical linear regression models were run to assess associations between executive function and eating behavior domains after controlling for age, sex, education, and depression. Covariates were selected based on their association with executive function. Predictors in the regression models were Stroop interference scores and WCST perseverative and non-perseverative error scores, and outcomes included emotional eating and snacking on sweets. In the first model of each regression, covariates were entered in order to account for their known association with executive function. In the second block, executive function variables were added to assess additional variance explained in eating behavior after accounting for covariates.

RESULTS

The sample was 57.4% female and 42.6% male. The mean age of participants was 45.7 years (SD=10.8) with a mean of 13 years of education (SD=2.1). Mean BMI was 43.3 kg/m² (SD=7.6). Approximately 46% of participants had an income of ≤$20,000 per year, while 2% had an income ≥$80,000 per year. About 68% of the sample was unmarried. Depression within the sample, based on the BDI-II was relatively low. Sample characteristics are reported in Table 1. Descriptive statistics for study measures are summarized in Table 2.

Zero-order Correlations

Correlations revealed that emotional eating and snacking on sweets were inversely associated with Stroop interference. There were no statistically significant relationships between either WCST variable and the eating behavior variables. Zero-order correlations are summarized in Table 3.

Regression Analyses

Based on correlation findings, only two regressions were run, using Stroop interference score as the predictor variable. For emotional eating as an outcome, the first block of the regression that included age, sex, years of education, and depression was non-significant (F=1.452, P=.238) and accounted for 14.6% of the variance in emotional eating (Table 4). In the second block, the addition of the Stroop interference variable was again non-significant (F=2.194, P=.079) and explained an
Table 2. Descriptive statistics for executive functioning variables and eating behavior variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean (SD)</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emotional eating</td>
<td>30.31 (6.65)</td>
<td>18–43</td>
</tr>
<tr>
<td>Snacking on sweets</td>
<td>16.81 (4.48)</td>
<td>6–26</td>
</tr>
<tr>
<td>WCST perseverative errors</td>
<td>22.06 (9.85)</td>
<td>4–44</td>
</tr>
<tr>
<td>WCST non-perseverative errors</td>
<td>23.19 (15.61)</td>
<td>3–91</td>
</tr>
<tr>
<td>Stroop interference score</td>
<td>−2.93 (12.92)</td>
<td>−28.11–36.10</td>
</tr>
</tbody>
</table>

WCST, Wisconsin Card Sorting Test.

Discussion

The objective of our study was to examine relations among inhibition, set shifting, and negative eating behaviors in severely obese African Americans. To our knowledge there were no prior studies that examined these relations in African Americans, a group disparately affected by obesity. Our results showed that poorer inhibition was associated with greater self-reported emotional eating.

For snacking on sweets as an outcome, the first block of the regression that included age, sex, years of education, and depression was non-significant (F = 5.40, P = 0.070) and accounted for 6% of the variance in snacking on sweets (R² = 0.06) (Table 5). In the second block, the addition of the Stroop interference variable was non-significant (F = 2.70, P = 0.197) but explained an additional 11.8% of the variance in snacking on sweets (R² = 0.178). After accounting for covariates, the association between Stroop interference and snacking on sweets was significant and negative (β = −0.402, P = 0.037), indicating that poorer inhibition was associated with more snacking on sweets.

Inhibition and Negative Eating Behaviors

Our findings linking inhibition to emotional eating and snacking on sweets were similar to prior evidence that found poorer inhibition contributes to impulsive eating and negative eating behaviors, such as eating to assuage negative emotions, excessive consumption of snacks, and consumption of large quantities of high fat and high sugar foods. These findings are particularly salient given that African Americans are more likely to reside in lower SES communities, experience unique chronic stressors, and emotional strain, which are risk factors that contribute significantly to emotional eating and obesity.

Relatedly, reduced availability of healthy food options and poor neighborhood food environments contribute to greater consumption of unhealthy food. In addition to these well-documented barriers to healthy eating for African Americans, our findings suggest that reduced inhibition may be a salient risk factor for negative eating behaviors and subsequent obesity in this at-risk population. Moreover, it is possible that reduced inhibition may compound the tendency to eat poorly in already compromised eating environments. An examination of the association between inhibition and negative eating behaviors in this population in various environments may help to elucidate the specific situational and contextual factors for which reduced inhibition contributes to poor eating. On the other hand, reduced inhibition may behave as a proxy for poor self-regulation among severely obese African Americans.

Potential Role of Self-regulation

Our findings linking inhibition to emotional eating and snacking on sweets were consistent with prior research that indicated negative eating behaviors may be avoided through increased self-regulation and ability to inhibit desires. These findings are specifically related to the notion that individuals who are able to inhibit their urges to engage in negative behaviors may have adapted their own self-regulation techniques more efficiently. Among severely obese African Americans in our sample, the association between inhibition and negative eating behaviors may be suggestive of limitations in effective self-regulation. This conclusion should be approached cautiously, however, because self-regulation was not directly assessed in the study.

Table 3. Zero-order correlations for executive function and eating behavior variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Emotional Eating</th>
<th>Snacking on Sweets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stroop interference</td>
<td>−0.336</td>
<td>−0.357</td>
</tr>
<tr>
<td>WCST perseverative errors</td>
<td>−0.159</td>
<td>0.236</td>
</tr>
<tr>
<td>WCST non-perseverative errors</td>
<td>−0.179</td>
<td>0.036</td>
</tr>
</tbody>
</table>

WCST, Wisconsin Card Sorting Test.

a P < 0.05.
Further research is necessary to determine the relations among inhibition, self-regulation, and negative eating behaviors.

Non-significant Findings for Set Shifting

Inhibition was associated with emotional eating and snacking on sweets while set shifting was not. Poorer set shifting ability has previously been associated with overeating and inflexibility in adopting healthier patterns of behavior; however, it was not related to negative eating behaviors in our sample. It is plausible that eating behavior is not influenced specifically by set shifting ability or that the measure of set shifting selected for this study was not ideal. Previous literature has identified that individuals with bulimia, another population with disordered eating, perform poorer on tasks of inhibition, but not set shifting. Emotional eating and snacking on sweets represent impulsive behaviors, and as such, may be more automatic and not require the level of higher order processing that is characterized by set shifting.\(^5\) Another explanation for non-significant findings may be a failure of the WCST to capture the type of attentional shifting that is required to shift from emotionally-driven eating behavior to more restrained eating, or from snacking on sweets to selection of healthier food options. The WCST requires immediate shifting of attention when a novel stimulus is presented. However, eating behaviors are driven by a number of variables in addition to attention, such as availability of healthy food options and hunger, that suggest a more complex system is at work. The WCST is a well-known measure of set shifting, however, several studies have questioned whether it is a pure measure of executive functioning. Imaging and event-related potential evidence has documented that the WCST activates areas of the brain outside of the traditional frontal areas (ie, parietal lobe) known to be associated with executive functioning\(^5\) and may not reliably discriminate frontal lobe dysfunction.\(^5\)

CONCLUSIONS AND LIMITATIONS

Little is known about the role that executive function plays in eating behaviors in African Americans, a high-risk population for obesity and related morbidities in the United States. Findings from our study are an early step in understanding these relations. In addition to the psychosocial and environmental factors that predispose African Americans to obesity, our findings suggest that a reduced ability to inhibit may promote negative eating behaviors and compound obesity risk. While cognitive training interventions have largely targeted memory improvement, a plausible next step is to determine if executive function can be enhanced within this population through cognitive training, and determine if any benefits translate to greater ability to inhibit negative eating. Moreover, interventions that help obese individuals to adapt their self-regulation techniques in unhealthy psychosocial and environmental contexts may provide additional benefits.

Our study was limited to self-reported eating behaviors. The addition of dietary recalls is needed to comple-
ment self-reports. Both food lists and qualitative narratives that detail daily food choices and eating behaviors would strengthen our understanding of this topic. Studies that incorporate experimental methods and imaging technology are also needed to help determine if frontal areas responsible for executive function are activated during specific eating behaviors. These methods will help to elucidate the role of executive function in emotional eating and snacking on sweets. Our study was also limited by its cross-sectional design, which did not allow us to examine causation. Additionally, the number of executive function measures available in the study limited the breadth of executive processes that could be examined. Inhibition is a multi-faceted construct, and only interference inhibition is assessed by the Stroop. Future studies should include a larger battery of executive measures.

REFERENCES
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AUTHOR CONTRIBUTIONS

Study design and concept: Sims, Bennett, Levy, Callender, Campbell
Acquisition of data: Sims, Ali, Levy, Callender, Campbell
Data analysis and interpretation: Sims, Bennett, Mwendwa, Ali, Levy, Callender, Campbell
Manuscript draft: Sims, Bennett, Mwendwa, Ali, Levy, Campbell
Statistical expertise: Sims, Mwendwa, Levy, Campbell
Acquisition of funding: Levy, Callender, Campbell
Administrative: Bennett, Levy, Callender, Campbell
Supervision: Levy, Campbell

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