PERSONAL SECTION

The economy, presidential election, and Middle Eastern affairs usually take the forefront in today's media. However, looming behind the news of rising and falling gas prices is a most alarming domestic issue, namely the obesity epidemic. There has been an occasional eye-opener, such as the documentary "Super Size Me," to force Americans to realize the enormity of this issue. Still, some Americans neglect to acknowledge the pounds accumulating directly onto their bodies. The number of obese citizens in the United States has increased at a frightening rate during the past several years because Americans obsess on fattening foods. A typical nutritional philosophy is the backbone of the problem: fast food is cheap, filling, and great tasting, so why not eat it? A lack of knowledge about the harmful effects of fattening foods has been the barrier to healthier food choices. Americans do not know that the increased consumption of high fat foods almost guarantees high rates of obesity. As an eating disorder, obesity heightens vulnerability to life-threatening conditions such as heart disease, diabetes, and respiratory problems.

I remember watching some family members and friends struggle to control their weight. Simple tasks that I took for granted were immense struggles for them. I watched as they did all they could to lose weight, but it seemed that no matter how strict their diet, they could never lose the weight to lead a healthier and more productive life. The day that I heard one of my classmates say that people are fat because they have no self-control was the day that I decided that I needed to make a difference. I made it a priority to do all that I can to treat and prevent this condition. More important, I wanted to spread my knowledge so that people could accept those who are obese and the emotional trauma it delineates.

This past summer, I worked as a research volunteer at the St. Luke's Obesity Research Center at Columbia University under my mentor Dr. Kathleen Keller. At the research center, I was assigned to work on a project to assess the possible genetic causes of obesity. After I began to compile a review of literature, I came across some articles about certain eating behaviors that may be causes or effects of obesity, such as dietary restraint or disinhibition. I presented this article at a lab meeting, and then asked my mentor if I would be allowed to approach my research from this perspective using certain questionnaires that were already a part of the original research plan. After she supported my idea, I continued to read about eating behaviors and I found that African-American women, even more so than men, are especially vulnerable to obesity. I decided that I would research ideal eating behaviors for this gender group. This led me to my research objectives: (1) to determine the relationship between dietary restraint and reported fast food preferences, (2) to determine the relationship between dietary disinhibition and reported fast food preferences, and (3) to determine if there are differences in fast food preference and Body Mass Index scores for different eating behavior combinations.

My experience has proven to be extremely useful in ways beyond the obvious. For example, I have learned how to write a professional research paper and how to present my research to different audiences. I have learned how to confidently speak in public and work among professional adults. With every presentation that I make or paper that I write, I feel that I am truly making a difference in my respective field of research. I recommend that all students participate in scientific research, whether it is at the high school or the university level. It truly is an invaluable experience that leads directly to the development of skills that will provide benefits far beyond the limits of the lab or the field.

RESEARCH

In recent years, the prevalence of obesity in developed countries has escalated from a public health problem to an epidemic. Studies that focus on the prevalence of obesity within different ethnic groups reveal that African-Americans are more likely to suffer from obesity-related health problems than any other population within the United States (Flegal et. al. 2002). Within the African-American population, obesity is considerably more common among females than in males (American Obesity Association 2002). In 1999-2000, 50.8% of African-American women were considered obese, which is significantly higher than the percentage of men (28.8%) that fall into this category (Center for Disease Control and Prevention 2002). However, the mechanisms associated with higher rates of obesity in African American women have not been elucidated.

Overconsumption of high-fat diets is a prominent contributor to the development of obesity. Fat is the most energy dense of the nutrients, with twice as many calories per gram as protein and carbohydrates; therefore, a high fat diet increases susceptibility to obesity (Food and Agriculture Organization 2003). High fat foods are also palatable, affordable, and widely available, making consumption of these foods accessible to most everyone in the United States (Drewnowski 1990; Warwick & Schiffman 1992). Because the average African-American diet is higher in fat than those of other ethnic groups, this may be one factor contributing to the high prevalence of obesity in this population (Eyler et. al. 2004).

The factors that contribute to higher intakes of high-fat foods in African-Americans are largely unknown. Cultural factors may play a role. Previous research has shown that concerns about body weight are heavily influenced by cultural context (Contento et. al. 2005). For example, African Americans tend to accept larger body sizes and feel less guilt about over-eating

(Cicciarello-Andrews 2007). African- Americans are less preoccupied with dieting than other ethnic populations. However, other studies suggest that women, in general, attempt to control their eating (Contento et. al. 2005). Regardless of race, 40%-70% of women in the United States are dissatisfied with their body size and report dieting to control their weight (Rodin et. al. 1985; Brownell 1991; St. Jeor 1993). On the whole, the dieting and eating behaviors of African-American women, a subgroup that identifies with an ethnic group that values larger body types, has not been well characterized.

Dietary restraint, or the tendency to consciously control weight gain, is a cognitive measure that may be important in determining risks for obesity, especially among women (Contento et. al. 2005). Females as young as five years of age have been documented exercising some degree of dietary restraint, while males have been reported to begin restraining themselves at a much later age (Carper et. al. 2000; Braet et. al. 1997). These statistics suggest that women exercise greater cognitive control over their food intakes than do men. As females increase in age, factors such as peers' opinions, food experiences, and body image have a lasting impact on dietary choices and may cause a greater inclination to restrain (French et. al. 2001; Cusatis et. al. 2000; Feunekes et. al. 1998; Cusatis et. al. 1996). Dietary restraint has also been associated with binge eating and impulsive eating, which may make this behavior a prominent cause of obesity for those who lack the ability to continuously control their diets (Polivy & Herman, 1985). It is not clear whether dietary restraint leads to *more* or *less* healthful food choices; however, the natural inclination to restrain one's eating may be a key contributor to making some women vulnerable to obesity.

While most studies suggest that cognitive dietary restraint is negatively correlated with energy and dietary fat intakes, disinhibition of control, or the loss of control of eating through

emotions or impulse, is positively associated with energy intake (Lawson et. al. 1995; Lindroos et. al. 1997; Keim et. al. 1996; de Castro 1995). However, this trend has been more consistently observed in women than men (French et. al. 1994). Past studies also suggest that there may be a casual link between dietary restraint and disinhibition, suggesting that at least in some women, dietary restriction may lead to a loss of control over eating (ie. dietary disinhibition) (Tuschl et. al. 1990). In accordance, a study examining Latina women revealed significant positive relationships between these two constructs (Contento et. al. 2005). Other studies have found no relationships between the constructs, especially among those women who are successfully restraining their intakes (Westenhoefer 1991; Lowe 1993; Lowe et. al. 1988; Westenhoefer et. al. 1993). Thus, the effects of dietary restraint on the quantity and quality of food choices are largely contradictory and require further investigation particularly in African-American women, a group for whom data on how restraint affects obesity are lacking. If this relationship can be better established, it might be possible to use dietary restraint and disinhibition, two reliably measured behaviors, as predictors of overeating, and possibly obesity.

There are three specific objectives of this study: (1) to determine the relationship between dietary restraint and reported preferences for fast foods in a subgroup of predominantly low-income, African-American women; (2) to determine the relationship between dietary disinhibition and reported preferences for fast foods in this population; (3) to determine if there are differences in fast food preference and body mass index in subgroups that are a) both low restraint and low disinhibition, b) low restraint and high disinhibition, c) high restraint and low disinhibition, and d) high restraint and high disinhibition. The overall goal of this research is to determine ideal eating behaviors to minimize prevalence of obesity and related health problems in a subgroup of the population that is highly vulnerable to obesity and its related co-morbidities.

Methods

Experimental Design

This study had a cross-sectional design in which participants were involved in a one hour study session. In this paper, the main focus is the relationship between reported level of eating restraint, body weight measures, and reported preferences for fast foods. Anthropometric measurements were also taken to calculate BMIs (kg/m^2). Participants were also asked complete taste tests to measure fat taste discriminability as well as bitter taste sensitivity to 6-n-propylthiouracil (PROP), and they donated a saliva sample for DNA processing at the CD36 allele, a candidate fat taste receptor (not reported in this paper). PROP status was tested for its potential as a marker for other taste and chronic health measures. Upon completion of the study, participants were compensated with $25 as well as reimbursement for all travel expenses. This study was approved by the Institutional Review Board of St. Luke's Roosevelt Hospital, and Research Authorizations were collected from each subject in adherence to HIPAA regulations.

Study participants

Two-hundred forty four (n=244) African American adults participated in this research study and 131 women were selected out of the cohort. Participants were recruited through online advertisements and flyers placed throughout the St. Luke's Hospital Center. Due to the test site's location in Harlem and Morningside Heights, most participants were from these areas and were of a low-income demographic. To be eligible for the study, subjects were required to be of African or Caribbean descent and between ages 18 and 65. Participants also needed to be healthy, not dieting, not on any medication that would affect their taste functions, and not heavily smoking. Participants were ineligible if they smoked more than one pack of cigarettes per week and did not meet all of the requirements listed above. Participants were asked to not eat two

hours before their participation in the study. The participants came to the test site at their scheduled times and participated in the study after providing informed written consent. A description of the sample is provided below.

	Range	Frequency	Mean	Standard Deviation
Sex				
Male		0.00%		
Female (n=131)		100.0%		
Ethnicity (n=131)				
African-American (n=118)		90.1%		
Caribbean (n=9)		6.9%		
Other (n=4)[a]		3.1%		
BMI (n=129)[b]	16.2-57.9		28.9	7.4
Underweight/Healthy (n=41)		31.8%		
Overweight (n=39)		30.2%		
Obese (n=49)		38.0%		

Table 1. Subject Characteristics. Displays sex, ethnicity and BMI characteristics for the 131 female subjects. [a]Other is typically defined as a mix between African-American and Caribbean. [b]Two subjects did not have sufficient information to determine BMI score.

Questionnaires to Assess Food Preferences

Participants were given an 83 item Food Preference Questionnaire to assess preferences for fat-containing foods. Participants were asked to report their preferences for 83 foods by marking on a 170 millimeter line scale, anchored by the extremes "Dislike Extremely" and "Like Extremely," to indicate how much they liked each of the 83 foods on the questionnaire. To determine the preference for each food, the participant's score was measured (in mm) from the left anchor on the scale, such that higher numbers depict greater preferences for a food. Fast foods (ex: Burger King, KFC, McDonalds, Popeye's, Taco Bell and Wendy's) were included as individual items. Average fast food preference was computed by determining the summed preferences for all foods in this group and dividing by the total number of fast foods.

Dietary Restraint and Disinhibition

The Three Factor Eating Questionnaire (TFEQ) was used to measure participants' dietary restraint and disinhibition (Stunkard & Messick, 1985). The TFEQ is a validated questionnaire that has a total of 50 true/false and multiple choice questions that can be scored to assess three subscales: restraint, disinhibition, and hunger. The hunger subscale was not used for this report. An example of a statement testing for a restrained eater is, "I deliberately take small helpings as a means of controlling my weight," while an example of a statement testing for disinhibition is, "Sometimes when I start eating, I just can't seem to stop." Depending on participants' answers to the questions, points were given towards restraint or disinhibition based on a pre-determined and previously validated scoring system (Stunkard & Messick, 1985). Restraint scores range from 0-21 and disinhibition scores range from 0-16. Participants were categorized as highly restrained eaters if their scores were 10 or greater, and non-restrained if their scores were less than 10. Participants were categorized as highly disinhibited if their scores were 8 or greater, and non-disinhibited if their scores were less than 8. Both summed restraint/disinhibition scores and categorical classifications were used in final analyses.

Anthropometrics

Participants had their weights and heights measured on a standard balance beam scale and stadiometer, respectively. Measurements were recorded to the nearest 0.25 pound/inch. Using SPSS (version 16.0, 2005, SPSS Inc, Chicago, IL), English measurements were converted to metrics and BMI was calculated with the formula kg/m^2. Participants were classified as "normal weight" if their BMIs were less than 25, "overweight" if their BMIs were between 25-29.9, and "obese" if their BMIs were greater than or equal to 30. Waist circumference was measured in the standing position, immediately above the iliac crest. Measurements were

recorded to the nearest 0.25 inch on a tape measure. All measurements were taken by trained research staff.

Taste Sensitivity Tests

PROP status is a marker of general taste sensitivity and is associated with food preferences (Tepper 2001) so it was an important covariate to assess in this study. Participants were given solutions of 0.10 M NaCl (standard) and 0.32 mmol/L PROP and instructed to sip and spit the solutions one at a time and rate each on the Labeled Magnitude Scale (LMS). The LMS is a standardized vertical analog scale that ranges from "Barely Detectable" at the bottom anchor to "Strongest Imaginable of any Taste Sensation," at the top (Green et. al. 1993). To determine taste response, distances were measured in millimeters from the bottom anchor such that higher scores signify greater taste sensitivity. Results from this taste test have previously been published in this lab concerning the positive association between PROP taste sensitivity and fat taste discriminability (McLean, 2008). In the present study, PROP taster status was used as a covariate in analyses.

As part of the primary purpose of this study, fat taste discriminability was assessed by two taste tests using Italian salad dressings (Good Seasons ® Kraft, Northfield, Illinois). Seven different salad dressings that ranged from 5% - 55% fat content-by weight were tested to determine participant's ability to discriminate differences in fat content in two taste tests. One test measured participants' abilities to assess fat content, oiliness, and creaminess. The second test measured participants' abilities to discriminate pairs of salad dressings as the same or different. Scores for the two tastes tests were tabulated based on an established scoring system. The results from this test will not be reported in the present study.

Statistical Analyses

Statistical analyses were completed using SPSS (Version 16.0, SPSS Inc., Chicago, Illinois). Descriptive variables obtained from questionnaires, such as age and BMI, were coded numerically and food preference ratings were entered as continuous scores. All data were analyzed by SPSS for Windows Version 16.0. Restraint and disinhibition scores were calculated according to the Three Factor Eating Questionnaire Score Sheet, as previously described. Pearson's correlation coefficients were computed to determine the associations between dietary restraint/disinhibition and preferences for fast foods. For the third objective, each possible pair of eating behaviors were assigned numbers 1-4 depending on the following classification: (1) low restraint and low disinhibition, (2) low restraint and high disinhibition, (3) high restraint and low disinhibition, (4) high restraint and high disinhibition. One-way ANOVA were used to assess for differences in reported fast food preferences and BMIs across the four eating behavior groups listed above. The Tukey's test was used for post-hoc tests where appropriate. All data are reported as means +/- SD and a significance value of $p<0.05$ was used for all analyses.

Results

Descriptive Characteristics

Subjects' ages were well-distributed in the range of 18 to 66 years old with a mean age of 34.7 ($\pm$ 12.5) years. Mean Waist Circumference was 25.0 in ($\pm$6.6). Mean Body Mass Index score was 28.9 $\pm$ 7.4. Mean restraint and disinhibition scores were 8.3 ($\pm$ 5.1) and 7.1 ($\pm$ 3.8), respectively. The average preference for fast food among the subjects was 96.2mm $\pm$ 42.9mm out of 170mm total. Descriptive Results are shown in Table 2.

Variable	Minimum	Maximum	Mean	Standard Deviation
Subject Age (n=130[a])	19.0	66.0	34.7	12.5
Waist (in) (n=131)	25.0	59.5	36.3	6.6
BMI (n=129 [b])	16.2	57.9	28.9	7.4
Restraint Score (n=121[c])	0.0	19.0	8.3	5.1
Disinhibition Score (n=124[d])	0.0	16.0	7.1	3.8
Mean Preference for Fast Foods (mm) (n=128[e])	0.0	170.0	96.2	42.9

Table 2: Descriptive Characteristics of Participants. [a]One subject did not report age. [b]Two subjects did not provide sufficient information to determine BMI score. [c]Ten subjects did not provide sufficient information to determine restraint score. [d]Seven subjects did not provide sufficient information to determine disinhibition score. [e]Three subjects did not provide sufficient information to determine average fast food preference.

Association Between Average Fast Food Preference and Restraint/Disinhibition

Only data from female participants were included in these analyses. Participants' restraint and disinhibition scores were normally distributed within their respective ranges. Restraint scores had a significant negative relationship with fast food preference ($r=-0.03$; $p<0.001$), while disinhibition scores had a significant positive correlation ($r=0.19$; $p<0.05$). Results are displayed for these two relationships in Figures 1 and 2.

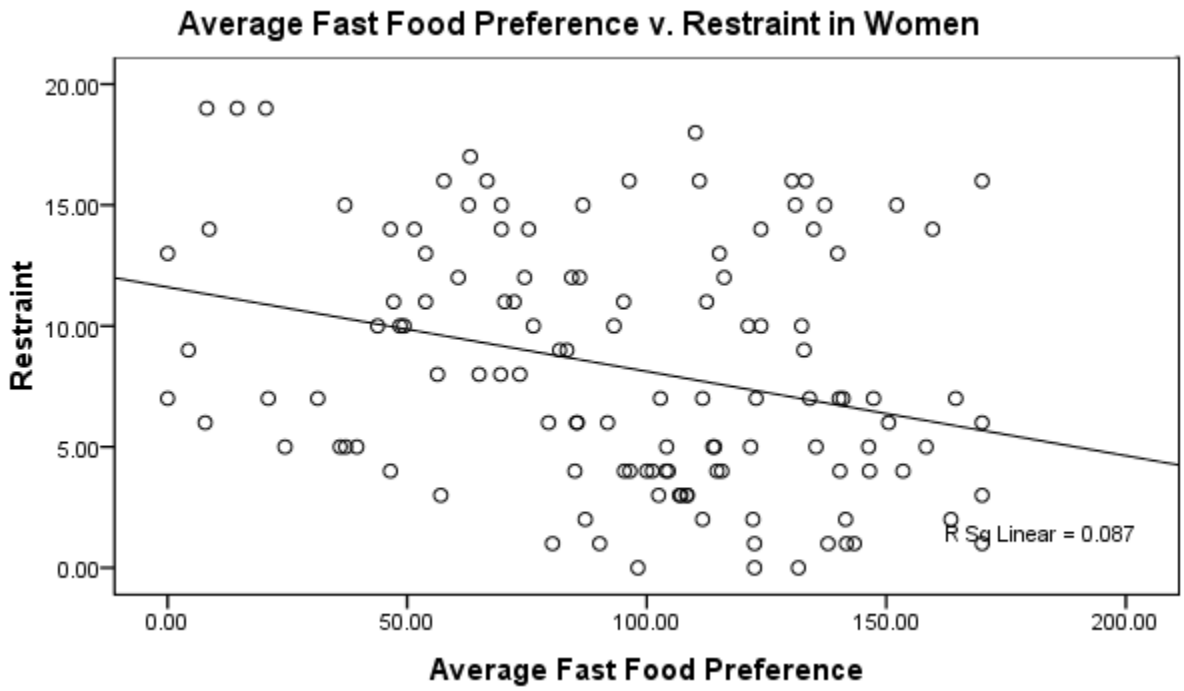

Figure 1. Average Fast Food Preference v. Restraint in Women. Average Fast Food Preference, on the x-axis, was correlated with participants' restraint scores, on the y-axis to determine if this variable is related in this population. The line of best fit is drawn. Results were significant at ($p<0.001$).

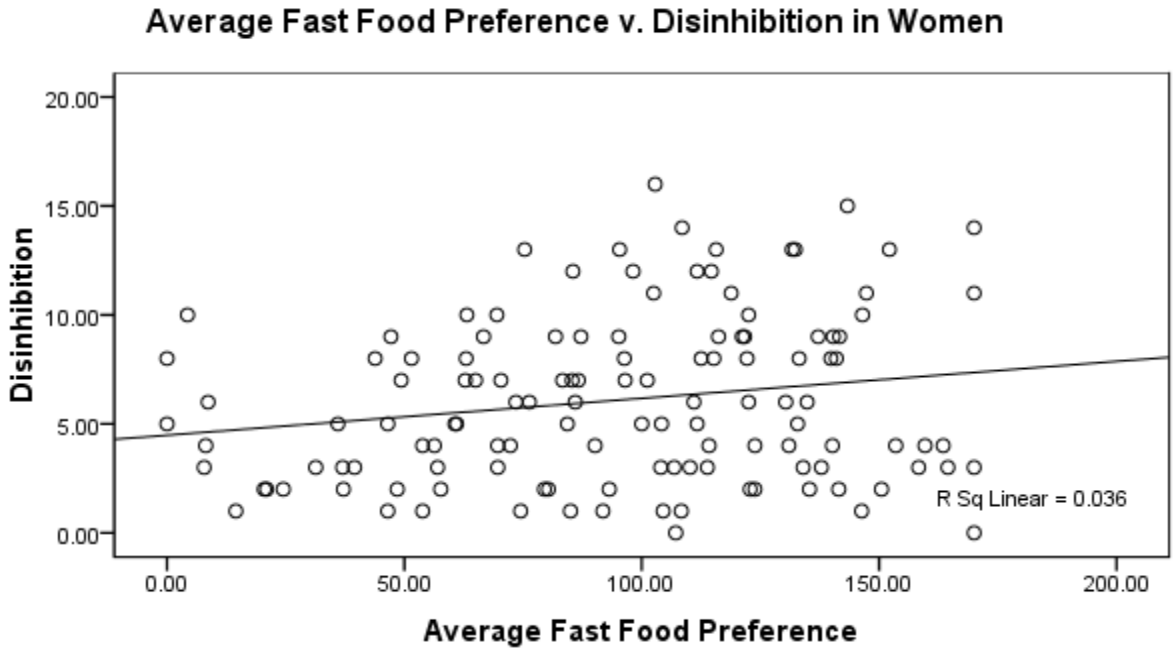

Figure 2. Average Fast Food Preference v. Disinhibition in Women. Average Fast Food Preference, on the x-axis, was correlated with participants' disinhibition scores, on the y-axis to determine if this variable is related in this population. The line of best fit is drawn. Results were significant at ($p<0.05$).

Fast Food Preference is Dependent on Restraint and Disinhibition

Women were grouped into the following: (1) low restraint and low disinhibition (n=45), (2) low restraint and high disinhibition (n=22), (3) high restraint and low disinhibition (n=33), and (4) high restraint and high disinhibition (n=18). These groups were made based on the cut-offs that classify an eater as restrained or disinhibited described previously. The mean fast-food preferences for each of these four groups are shown in Figure 3 below. The lowest total fast food preference was reported by the high restraint and low disinhibited group {$F(3,113 = 4.01; p<0.01)$. Tukey's post-hoc tests revealed that this group had lower fast food preferences than the low restraint and high disinhibition and the high restraint and high disinhibition groups.

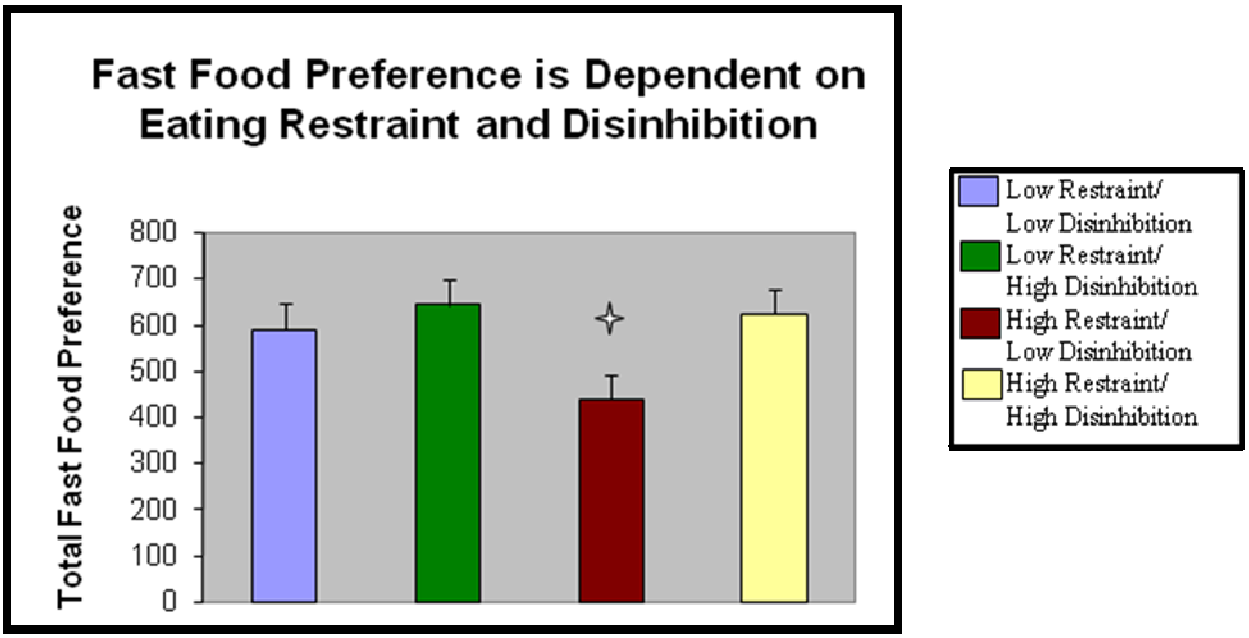

Figure 3. Fast Food Preference is Dependent on Eating Restraint and Disinhibition. The graph shows total reported fast food preference as a function of restraint and disinhibition scores. Women are divided into 4 groups: (1) low restraint - low disinhibition (n=45), (2) low restraint - high disinhibition (n=22), (3) high restraint - low disinhibition (n=33), and (4) high restraint- high disinhibition (n=18). ✧The high restraint - low disinhibition group represented by reported significantly lower preferences for fast foods than groups 2 and 4 (the low restraint - high disinhibition group and the high restraint - high disinhibition group). $(F(3,113)=4.01; p=0.009)$, as demonstrated by Tukey's post-hoc test.

BMI is Dependent on Restraint and Disinhibition

Mean BMI scores were also compared across the four eating behavior groups. There was a significant difference in the mean BMI scores between the high restraint/high disinhibition group and the low restraint/low disinhibition group. The mean BMI for the low restraint/low disinhibition group was 26.6 and, according to Tukey's test, this was significantly lower than the mean BMI of 32.1 in the high restraint and high disinhibition group. All other means were not significantly different. The results are displayed below in Figure 4.

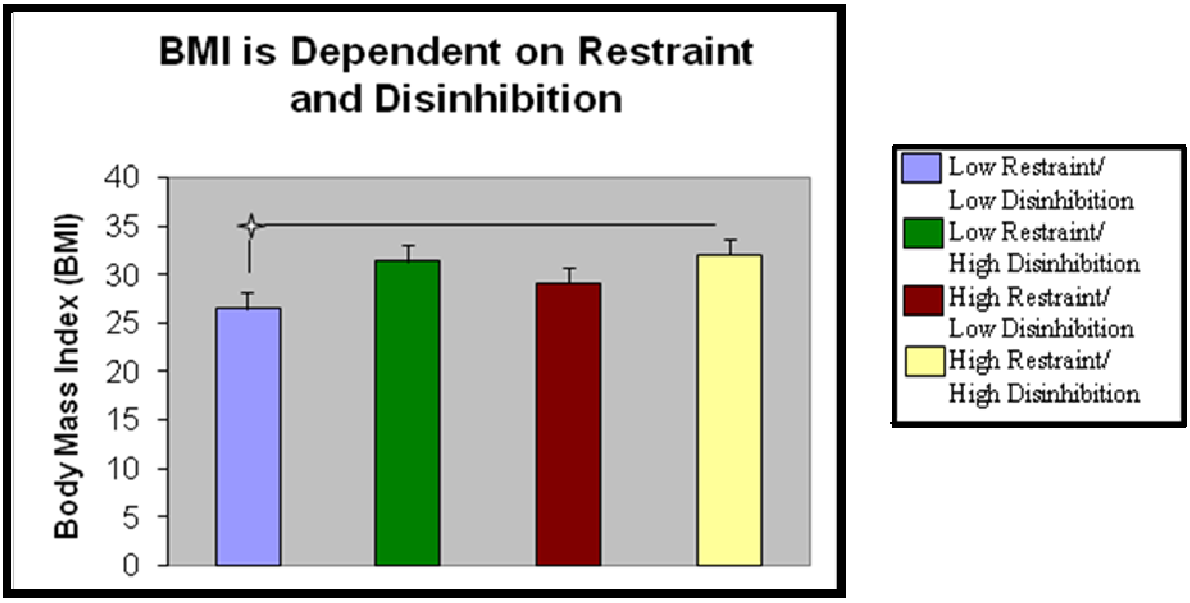

Figure 4. BMI is Dependent on Restraint and Disinhibition. The figure shows body mass index as a function of restraint and disinhibition scores. ✧Women who reported low restraint and low disinhibition were significantly leaner (mean ± SD) (BMI = 26.6 ± 6.6) than women who were high restraint and high disinhibition (BMI = 32.1 ± 5.9) $F(3,114) = 3.3$; $p=0.02$, according to Tukey's post-hoc analysis.

Discussion

The long-term goal of this research is to better understand the eating patterns associated with increased risk for obesity in African-American women, a population extremely susceptible to obesity-related comorbidities. Specific objectives of this study were to determine if two eating behaviors that can be reliably and quickly assessed, dietary restraint and disinhibition, predict

fast food preference and obesity in African-American women., These relationships were assessed by bivariate correlations to display the general association between these two variables. Additionally, the study aimed to determine if there were significant differences in average fast food preferences and BMIs among four different eating behavior groups: (1) low restraint and low disinhibition, (2) low restraint and high disinhibition, (3) high restraint and low disinhibition, (4) high restraint and high disinhibition. The assessment of these eating behaviors may help predict who will be most vulnerable to the development of obesity. The results of this study indicate that eating behaviors, both restraint and disinhibition, do indeed have associations with both fast food preference and obesity in this population of low-income African-American women. Dietary restraint was negatively associated with fast food preference, while disinhibition was positively associated. In addition, restraint and disinhibition interacted to have differential influences on both fast food preference and BMI. The high restraint and low disinhibition group had the lowest combined preference for fast foods, while the low restraint and high disinhibition group had the highest preference. Assessment of these behaviors, and their interactions, may help elucidate complex dietary behaviors associated with obesity.

While restraint and disinhibition scores were not associated with one another, the interactions between the two yielded interesting associations to obesity risk (assessed by BMI). Participants with low restraint and low disinhibition were 4 BMI units leaner than participants with high restraint and high disinhibition. The high restraint and high disinhibition group also had nearly the highest combined preferences for fast foods. This group may be particularly vulnerable to the development of obesity. Future investigations should determine if increased preferences for high fat fast foods may be one reason.

This research produced several novel findings. First, the relationships between fast food preferences and dietary restraint and disinhibition have not previously been studied. Other studies related fast food intake to dietary behaviors using food frequency, but because these measures can be biased, food preference may actually be a more meaningful indicator. These results support previous studies that restrained eaters consume low amounts of fats and sugars, and disinhibited eaters intake high amounts of fats and sugars (Lawson et. al. 1995; Lindroos et. al. 1997; Kein et. al. 1996, de Castro 1995). This is the first study to report these associations in African-American women who were predominantly from a low-income demographic, so results are notable. Because food preferences do not always predict food intake, future studies along this regard are warranted.

Another novel finding of this research was that the average fast food preference for African-American women with high restraint and low disinhibition was significantly lower than that of any other eating behavior combination. Higher disinhibition scores, combined with either low or high restraint, were associated with much higher fast food preferences. This suggests that high disinhibition, which can also be termed as emotional or external eating, is a highly predictive factor in determining fast food preference. This makes sense because fast foods are high in fat, sugar, and sodium, and may be the food of choice when one is eating on the run, in response to food cues from the environment. Palatable high fat foods, also activate the body's reward system, so they are often chosen when someone is stressed or disinhibited in their eating (Adam et. al. 2007). It is interesting to note though that higher restraint scores did not seem to lessen the effects of dietary disinhibition of fast food preference. This is the first study that suggests that disinhibition, rather than restraint, is the most important factor in determining food

preferences that are associated with obesity, and future investigations of the interactive effects of these two behaviors are warranted.

The significant difference in BMI scores between participants with low restraint and low disinhibition and participants with high restraint and high disinhibition presents another important finding. These data support the results of a previous study done among Latina women, where it was found that women who restrain themselves have higher BMIs (Contento et. al. 2007). This is contrary to what dietary restraint should theoretically do (ie. restrain or reduce intake). This suggests that although some women may be restrained, they also may have tendencies to overeat, and may in fact give in to these tendencies at times. The fact that previous studies as well as the current study found this in both ethnic populations, it is possible that ethnicity may mediate the relationship between dietary restraint and obesity. Both restraint and disinhibition interacted to influence BMI scores in this population, although further studies are warranted to better understand how these two behaviors act simultaneously within individuals.

There were both strengths and weaknesses in this study. The vulnerable population studied is from one ethnic origin, so the genetic variability due to race in this population is limited. Additionally, the low income demographic makes fast food a relevant preference to assess as fast food is widely available and affordable (Drewnowski 1990). Anthrompometrics were measured by a trained research staff, and were not self-reported, ensuring accurate BMI scores. Fast food preferences were self-reported and these measures can therefore be biased. Another potential weakness is the low number of subjects in some eating behavior groups (eg. high restraint and high disinhibition, n=18). This is due to incomplete questionnaires.

The results from this study indicate that certain eating behaviors do have a significant impact on preferences for fast foods and BMI scores. These novel findings suggest that

disinhibition, an eating behavior that is often overlooked in considering healthful or unhealthful food choices, may play a prominent role in the development of obesity, even more so than dietary restraint. Effects of dietary disinhibition on dietary choices and behaviors need to be studied to a greater extent in the future. Although the results of this study do not eliminate the controversy surrounding the constructs of restraint and disinhibition, they do elucidate variables that require further scrutiny to better understand why African-American women are so vulnerable to obesity.

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