Abstract

Background: Currently (≥32.4%) of Alabama’s adult population is obese and historically little changes has occurred in the overall prevalence. Therefore, there is an immediate need for investigation into nutritional and environmental factors contributing to obesity causation. Through present study we aimed to; (i) determine prevalence of processed food consumption compared to fresh, whole foods, (ii) elucidate the associations between dietary groups and body mass index categories with increased consumption of processed foods and increased frequency of cravings and, (iii) to elucidate environmental factors possibly contributing to sustaining obesity.

Methods: Blended dietary assessments were disseminated from November 2014 through May 2015 among citizens. We randomly selected (84) males and (153) females; group means and standard deviations; [age 29.80 ± 14.27; meters 1.70 ± 0.117; kilos 77.67 ± 19.69]. SPSS® statistical software package, version twenty-two was used to analyze study data.

Results: Overall, we found that (40.0%) of participants in the healthy diet group reported an increased frequency of consuming processed foods. There was greater association of food cravings among normal-underweight group (44.0%) compared to other BMIs. Additionally, (>80.0%) of participants reported not having access to fresh food on daily basis and (>85.0%) consider healthy foods too expensive.

Conclusion: Collectively, our findings suggest the experience of food cravings in combination with an over abundant access to highly processed foods along and high cost points for healthy foods, potentially stand as major biological and local environmental factors contributing to sustaining overweight and obesity within Alabama.

ABBREVIATIONS

ADPH: Alabama Department of Public Health; ASOTF: Alabama State Obesity Task Force; ASU: Alabama State University; BMI: Body Mass Index; FFQ: Processed Food Frequency Category; SD: Standard Deviations; TF: Top Five Foods Category; VSL: Visual Selections Category

INTRODUCTION

Curtailing obesity prevalence is vital to overall human health and to the solvency of state-level health care systems, as attributable socioeconomic costs are projected to exceed $950 billion by 2030 [1]. Additionally, despite annual consumer expenditures of $45 billion on weight loss products and millions of state dollars spent on outreach campaigns, obesity is the second leading cause of preventable death in the United States [2,3]. Since the time of human existence, dietary regime has been the greatest factor associated with obesity causation. Now even more so in modern day, as the consumption of manufactured foods have replaced the fresh, primarily plant based diet once consumed by prehistoric ancestors [4]. Such drastic shifts in diet have equated to a larger portion of human populations being at risk for obesity and other concomitant diseases, regardless of the individuals’ preexisting genetic disposition for disease development [5].

In May 2004, the Alabama Department of Public Health (ADPH) and teams at University of Alabama in Birmingham established the Alabama State Obesity Task Force (ASOTF) [6]. Despite the ongoing prevention efforts of these organizations, obesity
prevalence has remained high with >30% of the adult population currently obese. Additionally, prevalence has shown only slight declines as Alabama now ranks eighth among the most obese of United States [7]. Meetings with (ASOTF) officials and a review of scientific literature lead to the necessity and development of present study as we surmised a major reason for the sustained prevalence of obesity, is that processed foods constitute the main proportion of residents’ diets and that factors other than limited food access are diving and reinforcing poor eating habits [8,9,10]. As such, for present study we specifically aimed to; (i) determine prevalence of processed food consumption compared to fresh, whole foods, (ii) elucidate the associations between dietary groups and body mass index (BMI kg/m²) weight categories with increased consumption of processed foods and increased frequency of cravings, and (iii) to elucidate community-level environmental factors possibly contributing to sustaining both overweight and obesity. Here we present findings from analysis of our blended nutritional surveys as well as present findings of several environmental factors unique to the state with potential to directly contribute to sustaining obesity within Alabama.

MATERIALS AND METHODS

Study Setting: Present study took place within Alabama, which is located in the southern region of the United States. According to 2014 U.S. Census statistics, the state (n=4,849,377) is characterized by predominately Caucasian (70.0%) and African American race (27.0%), followed other races by which Hispanic race accounted for (>1.0%) of the population. Rural and urban counties are characterized by marked differences in socioeconomics profiles with increased poverty in rural areas affecting (21.0%) of residents, compared to (16.2%) poverty found in the urban counties. Overall, (30.0%) of Alabama residents live rurally and approximately 19 of 67 counties included in an area located centrally and across the state, known as the Black Belt Region (Figure 1). This area is characterized by substantially limited access to health information, daily access to fresh, whole foods, (iii) elucidate community-level environmental factors possibly contributing to sustaining both overweight and obesity. Here we present findings from analysis of our blended nutritional surveys as well as present findings of several environmental factors unique to the state with potential to directly contribute to sustaining obesity within Alabama.

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foods and experiences even harsher economic conditions than other rural counties outside of the Black Belt Region [11].

**Study Population & Model:** Without regard to BMI, race, or sex, only adult residents of Alabama≥19 years of age were accepted into the study. Fundamentally, our research model was founded upon a methodology known as “citizen science” with incorporation of a cross-sectional epidemiological, nutrition survey based design [12,13,14,15]. On July 30, 2014, study received approval from Alabama State University (ASU) Institutional Review Board, Dr. Tyson Platt; approval number 2014CSMT002A. Surveys were randomly distributed among and collected from Alabama residents November 2014 through May 2015. Upon receipt, consent form and survey were separated. Each survey was given lab ID code consisting of consecutive number in line of intake and the day-month the consent form was signed (e.g., 158-12/29).

**Public School Menus:** Alabama public school breakfast and lunch menus were downloaded directly from elementary, middle, junior high and high school websites. Items were collected for the months of November-December 2014 and January 2015. Meal service statistics are not currently available for the 2013-2014 school years. However a total of (n=129,123,361) meals were service statistics are not currently available for the 2013-2014 school years. However a total of (n=129,123,361) meals were served to students and staff during the 2012-2013 school year specifically; (n=36,946,502) breakfast, a total of (n=90,186,259) lunches and (n=1,990,600) after school snacks [16].

**Validation of Survey Assessment & Format:** Specific survey questions used in present study were selected from nationally known nutrition surveys, the majority of which included: (i) the 2013-2014 Centers for Disease Control and Prevention National Health and Nutrition Examination Survey; (ii) Harvard University Health Professionals Follow-up Study Questionnaire; and (iii) Dish-based Semi-quantitative Food Frequency Questionnaire for Assessment of Dietary Intakes [17,18,19,20,21]. Survey questions and related responses were then divided into six assessment categories to assemble the final blended nutritional assessment, which was administered in present study. Survey categories included; demographics, top eateries and top grocery stores, top foods (TF) category, processed food frequency (FFQ) section and a visual category (VSL). The purposes and details for each are summarized in (Table 1). Ultimately, using a blended design allows for expanded investigations into specific diets, factors driving eating behaviors within the individual and environmental dynamics within targeted communities supporting poor eating habits [22].

**Data Transformation:** A standard qualitative-quantitative approach with item coding system was used for transforming participant responses and public school menu data [23,24,25].

**Coding of Food Items:** Using a “degree of difference line scale,” all food items reported in the (TF), (VSL), (FFQ) survey categories as well as those in school breakfast and lunch menu items, were first coded as either a processed food or a non-processed food. As shown in (Figure 2), food items were then further unitized using a ten-point increment scale based upon the overall degree of food processing or food freshness (not being processed) of the item (e.g., double bacon cheeseburger had greater negative score than a candy bar; raw fruits and vegetables had higher positive value than steamed vegetables). Within a survey category, a perfect score of (+/-100) was given if the participant reported a whole, fresh food (e.g., strawberries) or a highly processed food (e.g., bacon double cheese burger). Essentially, using negative values (-100 to 0) to indicate processed foods and positive values (100 to 0) to represent fresh or minimally prepared foods, variations in the food quality of reported items can be investigated. The greater the value on either side of the 100-point scale the greater the degree of food processing or freshness [26].

**Determination of Dietary Groups:** Participants were grouped by their BMI category as well as categorized into either a Westernized (processed food) or healthy (minimal to no processed food) diet group. To determine the group, all coded food items reported by the individual in the (TF), (VSL) and (FFQ) categories were first summed, the sum providing a total food score for each category. As shown in (Figure 3), the perfect negative score for each survey category (TF), (VSL) and (FFQ) was determined by multiplying the total number of question per category (x100) and using the negative value (e.g., TF category (n=20) questions x100=2000; FFQ (n=21 questions) x100=2100; VSL (n=5 visual) x100=500). Using the perfect negative scores we derived a target value for each category which was the perfect negative scoreless 20.99%. If the participants’ food score for any of the three target survey value, categories which implied was >80.0% of the foods reported in the category were processed, the category was coded as (1=processed). Alternately, if the category food score was <target value, the category was coded as (0=not processed). The sum of the three categories, which ranged from (0-3), was used to

<table>
<thead>
<tr>
<th>Table 1: Summary of Blended Nutrition Assessment Categories.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Characteristics of Survey Categories</td>
</tr>
<tr>
<td>Participant Demographics</td>
</tr>
<tr>
<td>Top Food Eaters</td>
</tr>
<tr>
<td>Top Grocery Stores</td>
</tr>
<tr>
<td>Top Five Foods (TF) Category: A dietary recall which asked participants to select commonly consumed foods from a provided list or to enter any choices not already included.</td>
</tr>
<tr>
<td>Food Groups: included; meats (n=24) choices, starches (n=16) choices, vegetables (n=24) and fruits (n=24) choices.</td>
</tr>
<tr>
<td>Food Frequency Section (FFQ): Captured the frequency of consumption of (n=21) specific processed foods including; (water, sweet tea/coffee, sodas, energy drinks, pre-made fruit juice, sports drinks, power shakes, fast food, TV dinners, processed meats, bacon, fries, sweet cereal, white bread, chips, pancakes, candy bars, pies-donuts, processed cheese, mayonnaise-creamy dressings).</td>
</tr>
<tr>
<td>Frequency Choices: Ranged from (never, monthly, 1-2/week, 3-4/week, 5-7/week, 8-10/week, &gt;11/week)</td>
</tr>
<tr>
<td>Visual Section (VSL): Required participants to select the foods they would eat from an array of (3-4) images.</td>
</tr>
<tr>
<td>Five Broad Categories: including; lunch, dinner, dessert, snack food and a visual depiction of the food type in their home at time of survey completion.</td>
</tr>
</tbody>
</table>

Table 2: Summary of Study Population Demographics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>(n)%</th>
<th>Characteristic</th>
<th>(n)%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
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<td>Location</td>
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<tr>
<td>Female</td>
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</tr>
<tr>
<td>Male</td>
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<td>35.4</td>
<td></td>
</tr>
<tr>
<td>Age Group</td>
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<td>Race</td>
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<tr>
<td>19-22</td>
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<tr>
<td>23-29</td>
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</tr>
<tr>
<td>30-39</td>
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<td>12.2</td>
<td></td>
</tr>
<tr>
<td>40-59</td>
<td>34</td>
<td>14.3</td>
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</tr>
<tr>
<td>60-69</td>
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<td>2.1</td>
<td></td>
</tr>
<tr>
<td>70-90</td>
<td>5</td>
<td>2.1</td>
<td></td>
</tr>
<tr>
<td>BMI Category</td>
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<td>Obesity History</td>
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<tr>
<td>Overweight</td>
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<tr>
<td>Normal Weight</td>
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<tr>
<td>Underweight</td>
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<td>4.2</td>
<td></td>
</tr>
<tr>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

*Total study population (n=237). Means and (SD) of population demographics included; age [29.80, ±14.27], body mass index [26.72, ±6.67], kilograms [77.67, ±19.69], meters [1.70, ±0.12]. Overall, present study population included higher percentages of females (65.0%), Caucasian (33.7%) and African-American races (57.4%). Approximately (20.0%) of participants had an obese mother and or sibling and (7.2%) reported a medical condition causing weight gain. However, (>50.0%) of participants were overweight or obese.

![Example of Food Item Coding Based on Degree of Processing](image)

Figure 2 Degree of Difference Scale Showing Categorization and Coding for Food Items. Reported food items were categorized using a ten-point increment scale based upon the overall degree of processing or freshness (not being processed) of the item. Incorporating negative values (-100 to 0) to indicate processed foods and positive values (100 to 0) to represent fresh or minimally prepared foods, variation in the food quality of reported items can be investigated. Essentially, the greater the value on either side of the100-point scale, the greater the degree of food processing or freshness of the food.

determine participants’ dietary group with “healthy diet group” receiving scores of (0-1) and “Westernized diet group” scores of (2-3) [27].

Coding of Craving & Health Related Survey Questions:
Craving questions included in survey and corresponding values were obtained from Yale Food Addiction Scale and Epel Self-Report Index [28,29, 30]. Responses to these and other health related questions which included replies similar to (never occurs, somewhat occasionally occurs, regularly occurs and always occurs), were coded respectively as (0.05, 55.00, 79.90, 100.00). The positive or negative value for each question was determined based on the response and relationship to obesity causation or not being associated with causation, (e.g., eating when visually stimulated or always experiencing craving; negative code, having access to fresh food or never experiencing craving; positive code).

Statistical Analysis:
Descriptive statistical analyses were conducted using IBM® SPSS® Statistics software package version 22, supplied through Information Technology Department of Alabama State University.
STUDY RESULTS

Demographics

Participant demographics are summarized in (Table 2). Present study included a total of (n=237) individuals with (n=84) males and (n=153) females. The group was predominately of African American (55.7%) and Caucasian (31.2%) races, followed by Hispanic race with (1.7%) of study population. Means and standard deviations (SD) of participant demographics included; age [29.8, ± 14.3], meter [1.7, ± 0.12] and kilogram with [77.7, ± 19.7]. The overall mean BMI was [26.7, ± 6.7], which is representative of (52.0%) of the study population that was categorized as either overweight or obese. Approximately (20.0%) of participants had an obese mother and or sibling. Only (7.2%) reported a medical condition causing weight gain, however (>50.0%) of participants were overweight or obese. Reported medical conditions which may have caused an individual to gain weight or develop obesity included; hypothyroidism (n=6), post menopause (n=4), pregnancy (n=2), diabetes, endometriosis, asthma, Graves disease and lupus (n=1/disorder). A total of (63.0%) of participants were residents of Montgomery County. However, 25 of the 67 counties were represented here which included; Autauga, Chilton, Choctaw, and Conecuh, Dallas, Elmore, Greene, Henry, Houston, Jefferson, Lee, Lowndes, Macon, Marshall, Merengo, Mobile, Perry, Pike, Russell, Talladega, Tallapoosa, Washington and Wilcox.

AIM ONE RESULTS

Processed Food Consumption across Dietary Groups

A major factor with potential for driving increases in overweight and obesity within Alabama was illustrated here. A total of (68.4%) of the study population was categorized into the healthy diet group (n=161) compared to the West diet group (n=76). A one-way ANOVA on the food score totals associated with each of the two dietary groups revealed a statistical difference between the means; [F (1) =59.8, p= <0.001]. As shown in (Figure 4), the healthy diet group had a mean and (SD) of [-251.1, ± 563.0] and Westernized diet group [-795.6, ± 355.4]. Closer investigation into the quality of the foods reported by participants within each group, suggests the healthy diet group consumes more “minimally processed” foods (e.g., tuna salad, deli style turkey meat), than actual whole foods as recommended by the Centers for Disease Control daily nutritional requirement guidelines [31]. Food quality can be evaluated by comparing Y-axis values in (Figure 4). Fresh and or minimally prepared foods are represented along the (+) range numbers and processed foods are captured by (-) range values (see Figure 2 for reference).

Variance in Food Quality between Survey Categories

Overall, we found study participants selected (consume) more processed foods than non-processed foods. One-way ANOVA analysis [F (2) =312.2, p= <0.001], comparing the food scores of the survey categories (TF), (VSL) and (FFQ) indicated there was significant variation between the category means. The important aspect of this variation again, lies within the quality of the food. Depicted in (Figure 5), participants selected more minimally prepared and or fresh foods within the (TF) category as indicated by the (+) mean and (SD) of [542.2, ±382.3]. However, the quality of foods deteriorated across the (VSL); [-71.6, ±283.0], and (FFQ); [-425.7, ±565.6] categories as represented along the Y-axis in (Figure 5).
Variation in Food Quality between Healthy and Westernized Dietary Groups.

One-way ANOVA on food score totals associated with the “Healthy” and “West” diet groups revealed a statistical difference between the two group means; [F(1)=59.8, p=<0.001]; healthy group (n=161) with mean and (SD) of [-251.1, ± 563.0] compared to the West diet group, (n=76) with [-795.6, ± 355.4]. Overall, (68.4%) of the study population was categorized into the healthy group. Food quality can be evaluated by comparing Y-axis values, with fresh and or minimally prepared foods represented by (+) range numbers and processed foods by (-) range values (see Figure 4 for reference).

Figure 4 Variation in Food Quality between Survey Food Categories.

One-way ANOVA analysis [F(2)=312.2, p= <0.001], comparing the food scores of the survey categories Top Foods (TF), Processed Food Frequency (FFQ) and Visual Selections (VSL) revealed there was significant variation between the category means. Albeit, the important aspect of this variation lies again within the quality (processed verses non-processed) of reported foods. While participants selected more minimally prepared and or fresh foods than processed food within the (TF) category indicated by the (+) mean and (SD) of [542.2, ±382.3], the quality of foods deteriorated across the (VSL) [-71.6, ±283.0] and (FFQ) [-425.7, ±565.6] categories as represented by (-) means. The degree of processing or food quality is depicted along the Y-axis.

Figure 5 Variation in Food Quality between Survey Food Categories.

Comparing the means of food scores for participants categorized by BMI, we found the quality of foods within each weight group declined as the BMI increased. Specifically, the obese BMI group (n=62) had a total food score mean and (SD) [-194.0 ±769.1]; overweight BMI (n=61) was [-51.4, ±910.9]; and the normal-underweight combined BMI group (n=114), [+241.0, ±109.7]. Through the collective findings of aim one, we determined the overall quality of food across the study population is poor, with many participants consuming increased amounts of minimally processed to highly processed foods on a daily basis. These findings provide initial evidence that Alabama residents may also be over consuming processed foods and that
to varying degrees, Westernized diet type may be more prevalent within the state than previously expected.

**AIM TWO RESULTS**

**Association of BMI Groups with Increased Cravings**

Chi-squared test was used to investigate the association between BMI categories and factors with potential to drive eating behaviors such as food cravings, anxiety and depression; \( \chi^2(8) = 5.5, p > 0.05 = 0.70 \). The total percentages and number of individuals within each weight group (obese, overweight, normal-underweight combined) who reported experiencing high frequencies of cravings, anxiety and depression are summarized in (Table 3). As shown, across the BMI groups there was overall a greater number of participants who reported experiencing increased food cravings \( n=120 \) compared to increases in anxiety \( n=86 \) and or depression \( n=52 \). Unexpectedly, while \(<25.0\%\) of the obese and overweight populations both reported experiencing an increase in food cravings, the occurrence was more prevalent among the normal-underweight BMI with a total \( (55.0\%) \) of those participants reporting increased experiences. The significance of this finding is realized understanding the association between an increased BMI as well as the ability of consuming highly processed foods to induce food cravings, food addiction, and withdrawal syndrome and to drive eating behaviors. All occurrences well established through scientific research [32,33,34,35,36].

**Associations between Dietary Groups and Increased Craving Frequency**

The means and (SD) of the two dietary groups included; healthy diet group \([-251.1, ±563.0] \) and Westernized diet group \([-795.6, ±355.4] \). As shown in (Table 4), the West diet group overall experienced more food cravings \( (64.0\%) \), a higher frequency of anxiety \( (36.0\%) \) and depression \( (29.0\%) \). Eighty percentage of the West group also reported a higher frequency of eating when experiencing a craving compared to the healthy diet group, of which \( (64.0\%) \) reported the same. Overall, the healthy diet group was predominated by the normal-underweight BMI constituting \( (57.0\%) \) of the group. Interestingly, within the normal-underweight group, \( (20.0\%) \) of the participants reported an increased consumption of processed foods compared to the other BMI groups both with \( (10.0\%) \). Additionally, within the West diet group \( (32.0\%) \) of the normal-underweight BMI participants also reported an increased consumption of processed foods.

| Table 3: Association between Factors Potentially Driving Eating Behaviors & BMI Groups. |
|---|---|---|---|---|
| | Obese | Overweight | Normal/Underweight | Row Total |
| ↑Cravings for Food | (30) 31.7* | (34) 33.5 | (56) 54.8 | 120 |
| ↑Sweet Food Cravings | (34) 30.4 | (31) 32.1 | (50) 52.5 | 115 |
| ↑Salty Food Cravings | (29) 25.4 | (25) 26.8 | (42) 43.8 | 96 |
| ↑Frequency of Anxiety | (17) 22.7 | (23) 24.0 | (46) 39.2 | 86 |
| ↑Frequency of Depression | (14) 13.6 | (18) 14.5 | (20) 23.7 | 52 |

*Note: values in parentheses equals total conferences per variable; second equals row percentage. Chi-Squared; \([5.5; df= 8; p=0.70] \). Across the BMI groups, more participants reported experiencing increased food cravings \( n=120 \) compared to increases in anxiety \( n=86 \) and or depression \( n=52 \). Here we found normal-underweight group \( (>50.0\%) \), reported higher frequency of food cravings than obese and overweight BMI groups.

| Table 4: Summary of Cravings, Depression and Anxiety across Dietary Groups. |
|---|---|---|---|
| Healthy Diet Type | Westernized Diet Type |
| BMI Demographic | (n)% | (n)% | BMI Demographic | (n)% | (n)% |
| Obese | (36) 22.4 | (16) 9.93 | Obese | (25) 32.9 | (25) 32.9 |
| Overweight | (34) 21.1 | (16) 9.93 | Overweight | (27) 35.5 | (27) 35.5 |
| Normal/Under Weight | (91) 56.50 | (32) 20.0 | Normal/Under Weight | (23) 30.3 | (24) 31.6 |
| Cravings-Depression | (n)% | Group | Cravings-Depression | (n)% | Group |
| ↑Cravings for Food | (71) 43.8 | ↑Cravings for Food | (48) 64.0 |
| ↑Sweet Food Cravings | (69) 42.6 | ↑Sweet Food Cravings | (46) 61.3 |
| ↑Salty Food Cravings | (60) 37.0 | ↑Salty Food Cravings | (30) 40.0 |
| ↑Frequency of Anxiety | (57) 35.2 | ↑Frequency of Anxiety | (27) 36.0 |
| ↑Frequency of Depression | (32) 19.8 | ↑Frequency of Depression | (22) 29.3 |
| ↑Frequency of Eating When Experiencing Craving | (103) 63.6 | ↑Frequency of Eating When Experiencing Craving | (60) 80.0 |

**FFQ** Participants who reported increased consumption of processed foods. Healthy diet type means and standard deviations for dietary groups; healthy diet group \([-251.1, ±563.0] \) and Westernized diet group \([-795.6, ±355.4] \). Overall, the Westernized diet group experienced more food cravings \( (64.0\%) \), a higher frequency of anxiety \( (36.0\%) \) and depression \( (29.0\%) \) than healthy diet group. Eighty percent of the West group also reported a higher frequency of eating when experiencing a craving compared to the healthy diet group, of which \( (64.0\%) \) reported the same.
the two dietary groups, a total of (52.0%) of this BMI group reported consuming increased amounts of processed foods and referring back to (Table 3) a total (55.0%) of the normal-underweight group also reported an increased frequency of food cravings. This finding is of potential importance as it provides initial insight into reasons for the sustained overweight and obesity rates within Alabama. Prevalence persisting as food cravings begins to drive eating behaviors more so than BMI earlier in childhood and then into adulthood as the types of food products consumed expands.

AIM THREE RESULTS

Top Food Eateries & Grocery Stores

The top ten food eateries and grocery stores within Alabama selected by participants are shown in (Figure 6 and Figure 7). Participants reported (n=1133) eateries and (n=607) grocery stores. On average study participants spent $206.00 per month on food and or groceries. The map of Alabama shown in (Figure 1), depicts counties from where surveys were collected which are indicated by star icons, the most obese counties in the state indicated by check marks and counties with greatest number of fast food eateries indicated by flags. The over consumption of processed foods among study participants could be in part due to limited access to fresh, whole foods across the state. In 2010 within Alabama, >50% of all eateries served fast food with a total of (n=3286) establishments existing across the state. Targeted marketing of fast food and food products are cornerstone to sustaining of corporate profitability [37]. However, researchers have reported an increased susceptibility among African American and Hispanic races and obese individuals to portion sizing; customers are served nutrient poor food products that are sold at disproportionally lower prices than healthy foods [38,39,40]. Counties in Alabama with greatest number of fast food establishments include Jefferson (n=588), Madison (n=289), Mobile (n=254), Montgomery (n=166), Tuscaloosa (n=161), Shelby (n=120) and Lee (n=107). While the counties of the Black Belt region, which is predominated by African-American populations, on average have <10 fast food eateries per capita, >65% of all food establishments within this region serve fast food or are a food franchise [41].

FOOD ACCESS

Only (21.0%) of survey participants reported having access to fresh foods on a daily basis and (<30.0%) reported consuming

Figure 6 Top Ten Food Eateries Study Participants Most Commonly Patron.
A total of (n=1133) food eateries were provided by participants. As shown, the most commonly reported were fast food or food franchises serving very little nutritionally sound foods and fewer nutritional fresh foods. Here we find evidence that lower food price points implemented by such establishments coupled with increased cravings and food addictions associated with the consumption of processed food, work synergistically contributing an environmentally and biologically based obesity cycle within local communities.
A total of (n=604) selections of grocery stores were reported and the average amount spent per month on groceries was $206.00 per month. As shown, the top stores shopped are primarily suppliers of food products compared to whole foods. Only (3.0%) of study population reported regularly shopping at whole food retailer.

Jefferson County however has the greatest number of obese residents with (>65.0%) of the adult population being obese as well as the greatest number of fast food eateries in the state [42,43,44,45].

PUBLIC SCHOOL FOODS

Investigation into public school foods revealed that, overall minimally processed foods constituted the majority of breakfast and lunch meals. The means and (SD) for each of the food categories within breakfast and lunch meal groups are summarized in (Table 5). The low value (-) and (+) means of the individual food categories suggests that canned fruits and vegetables and ready-to-eat foods have replaced fresh, whole foods. Using a pivot table to determine the top foods served November-January 2015 revealed that many of the foods that serve as the main proportion of the meal are highly processed. Considering children are highly susceptible to food cravings, these findings become important concern as well as provide further support of our previous findings of increased processed food consumption across the study population [46,47]. Top three lunch meats included; (21.5%) chicken other than baked (e.g., chicken supreme, chicken potpie), (12.0%) casseroles (e.g. pasta bake, chicken-cheese casserole) and (10.0%) assorted pizzas. Lunch vegetable; green beans (13.1%), whole kernel corn (12.4%) and baked beans (10.1%). Top three lunch starches included; French fries (16.02%), mashed potatoes (9.3%) and sweet potato fries (8.3%). School lunch and breakfast were similar in top three fruits that included; fruit choice (41.4%), apple (7.3%) and canned fruit (6.47%). School breakfast meats included; breakfast pizza (15.0%), sausage patty biscuit (11.0%) and scrambled eggs with cheese (8.6%). Breakast starches included; cereal choice (>70.0%), oatmeal (7.02%), breakfast burrito and grits both tied at (4.2%).

PARTICIPANT OPINIONS

Summarized in (Table 6), (71.0%) of the study population reported their own weight as being an important concern as well as being an important concern with the obese-overweight group having more concern. The majority of the population (53.0%) reported that lower food costs were most important, while (60.0%) believed the nutritional value
of food to be more important. Lastly, (>80.0%) of participants also reported that obesity prevention within Alabama is most important.

**DISCUSSION**

1. The fundamental objective of present study was to gain preliminary insight into the diet type of Alabama residents as well as to assess biological factors, such as food cravings and environmental factors such as limited access to fresh foods, with potential to drive the eating behaviors of residents. While present study was limited in not being a traditional nutritional study investigating a particular aspect of diet, as an epidemiological based nutrition study, it was successful. Utilizing a blended assessment approach has previously proven to be an effective method for capturing a broader perspective of dietary habits of a target population, which is what we formally aimed to accomplish [48,49]. However, despite this limitation and that only (40.0%) of participants also reported that obesity prevention within Alabama is most important.

2. In present study, (52.0%) of the normal-underweight BMI group reported consuming increased amounts of processed foods. We also found a greater association of both increased sweet (53.0%) and salty food cravings (44.0%) within normal-underweight compared to other BMI groups. Overall, (>64.0%) of the study population reported eating when experiencing a craving, but the occurrence was greater in West diet group with (80.0%).

3. Limited access to fresh, whole foods is a factor in itself that has been associated with an increased risk of overweight and obesity development [50]. Greater than (>80.0%) of the study population reported not having access to fresh food on a daily basis and (>85.0%) consider healthy foods too expensive. The vast majority (85.0%) of participants believes obesity prevention and continued outreach is most within Alabama.

**CONCLUSION**

While obesity prevention may not initially appear as viable options for generating long-term state profits while improving the health of resident and community, there is potential for just such an occurrence. Economic estimates project that a (5.0%) reduction in obesity rate within Alabama over the next five years saves the state ≈$3.38 billion [51, 52].

Additionally, strategically placed rural and or urban community farms which are associated with community-student managed open market style grocery stores, have potential to generate ≈$2 billion in annual sales and >$198 million in state and local tax revenue [53,54,55]. However, going forward effective obesity prevention outreach requires a more concerted approach to understanding the dynamics of diet including the effects on gut micro biota, obesity and food access [56,57].

In conclusion, we have demonstrated the need for further investigation into the specific dietary regimes within Alabama as well as community level factors that affect and influence the dietary habits of residents. It is our hope that generated findings will springboard into further dietary studies within targeted populations.
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REFERENCES


5. Rob Knight: How our microbes make us who we are.


34. Kakkoschke N, Kemps E, Tiggesmann M. External eating mediates the relationship between impulsivity and unhealthy food intake. Physiol Behav. 2015; 147: 117-121.


