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Examining Eating Rate in Women Recruited From Low-Income Sites

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EXAMINING EATING RATE IN WOMEN RECRUITED FROM LOW-INCOME

SITES

BY

ANNE THERESE EDWARDS

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE

REQUIREMENTS FOR THE DEGREE OF

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ANNE THERESE EDWARDS

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ABSTRACT

Obesity is a major health problem in the United States. Food insecurity is related to obesity, especially in women. Obesity is associated with a fast eating rate (ER) and failure to reduce ER during meals. The purpose of this research is to measure ER in food insecure women in community settings utilizing a novel, mobile measurement system using laptop computers. Low-income women (n=20), ages 18-65 (mean±SD age= 46.5±13.7 years) with a body mass index (BMI) over 18.5 kg/m^2 (mean±SD BMI= 35.7±6.6 kg/m^2) were recruited from a food pantry and free clinic in Rhode Island. The United States Department of Agriculture (USDA) Adult Food Security Survey Module was used: participants scored in the secure (n=0), marginal (n=1), low (n=4), or very low (n=15) range. Scores of high and marginal were categorized food secure (n=1), and of low and very low as food insecure (n=19). Women were video recorded eating a test meal (400g, 842 kcal vegetable frittata), which was covertly weighed pre and post consumption. Eating rate (g/min), duration (min), energy intake (kcals), total intake (g), kcals/minute, bite size (g/bite), and quartile eating rate (bites/quartile) were calculated. Video recordings were divided into quartiles (Q1, Q2, Q3, and Q4) and bites/quartile was calculated. Thirteen video recordings were included: food secure (n=1) (mean±SD ER 53.9 g/min) and food insecure (n=12) (mean±SD ER 55.1±19.1 g/min). Quartile results found that Q1 eating rate was slower (n=7), faster (n=3), or the same as Q2 (n=2). Two patterns emerged: accelerated eaters with faster Q4 ER (n=6), or decelerated eaters with decreased Q4 ER (n=7). The novel methodology limited the study and modifications to methodology need to be made.

ACKNOWLEDGEMENTS

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PREFACE

This thesis was written in manuscript format in compliment with the University of Rhode Island's Graduate School Thesis Guidelines. This thesis contains one manuscript titled "Examining Eating Rate in Low-Income Women". This manuscript was written in the form suitable for submission for publication in the journal *Appetite*.

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Examining Eating Rate in Women Recruited From Low-Income Sites

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Examining Eating Rate in Women Recruited From Low-Income Sites

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ABSTRACT

Food insecure women are at greater risk of obesity than food secure women. Obesity is also associated with rapid eating rate (ER) and failure to reduce ER during meals. Measurement of ER has previously only been possible under laboratory conditions, limiting research. The purpose of this research is to measure ER in food insecure women in community settings utilizing a novel, mobile eating rate measurement system using laptop computers. Women (n=20), ages 18-65 (mean±SD age= 46.5±13.7 years) with a body mass index (BMI) over 18.5 kg/m^2 (mean±SD BMI= 35.7±6.6 kg/m^2) were recruited from low-income sites: a food pantry and free clinic in Rhode Island. Food security status was established using the United States Department of Agriculture (USDA) Adult Food Security Survey Module: participants were either in the secure (n=0), marginal (n=1), low (n=4), or very low (n=15) range. Women were discreetly video recorded with a laptop while eating a test meal (400g, 842 kcal vegetable frittata), which was covertly weighed pre and post consumption. Total ER (g/min; bites/min) was calculated. Video recordings showing bites per minute were divided into four time quartiles (Q1, Q2, Q3, and Q4) and bites/quartile was calculated. Due to technical difficulties, only 13 video recordings were included in data analysis: food secure (n=1) (mean±SD ER 53.9 g/min) and food insecure (n=12) (mean±SD ER 55.1±19.1 g/min).

Quartile results found that Q1 eating rate was slower than Q2 in over half of participants (n=7). Additionally Q4 eating rate was faster than Q2 and Q3 (n=6), suggesting an accelerated pattern. In conclusion, the novel methodology proved difficult and complex, limiting the study. Findings need to be confirmed with a larger sample.

INTRODUCTION

Obesity is a major health concern in the United States, and more than two-third of American adults are overweight or obese.[1] Obesity is associated with increased risk of diabetes mellitus, cardiovascular diseases, cancer, stroke, and other health problems.[2, 3] Obesity is the result of excess weight gain, from increased energy intake relative to energy expenditure.[4] Various factors, both controllable and uncontrollable, contribute to obesity.[2] Controllable factors include diet quality, food environment, eating rate, and food security.[5] Uncontrollable factors include race-ethnicity, gender, and genetics.[3]

An emerging area of research designed to reduce obesity risk involves slowing eating rate during meals. Eating rate can be measured using several methods. The gold standard for measuring eating rate involves using a Universal Eating Monitor (UEM), which is a laboratory instrument that uses a hidden scale to weigh the plate at fixed intervals during meals, enabling calculations of eating rate. Meals can also be video recorded, and eating rate can be back-calculated from reviewing the video recordings. Video recordings can be used to calculate eating rate quartiles; however, bite size per quartile cannot be measured from video recordings. The final method includes weighing the test food pre and post to calculate grams consumed as well as measuring the start and finish times to calculate meal duration in minutes. Average intake (grams or kilocalories), eating rate (kcals/min, bites/min, or grams/min) and bite size (grams/bite) can be calculated from this method.

Using such methodologies, past research shows that eating slowly leads to decreases in energy intake (total kilocalories).[6-9] Several eating rate interventions conducted at The University of Rhode Island in Kingston, RI were successful in

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significantly lowering eating rate from pre to post-intervention.[7, 8, 10-12] Each intervention

included education sessions designed specifically to reduce eating rate, including bite size

and bites per minute.[7, 8, 10] After several successful interventions, the research, was moved

to Providence, RI and women of all income and education levels were recruited.[10] The

intervention however was not successful despite its similarities to the previous studies.[10]

The researchers concluded that the participants, who reported as low-income, might have

been food insecure.[10] However, other factors besides food insecurity may have influenced

eating rate in this population and contributed to the unsuccessful intervention. There has

been no research to date involving establishment of eating rate patterns or conducting

eating rate interventions in low-income populations who are food insecure.

Low income is defined as earning less than 200% of the federal poverty

guidelines and food insecurity is defined as a reduction in the quality, variety, or

desirability with or without indications of disruptive eating patterns and reduced food

intake.[13-17] The United States Department of Agriculture (USDA) describes a range for

food security that categorizes individuals as either having high food security, moderate

food security, low food security, or very low food security.[13, 16] Previously the range was

food secure, food insecure without hunger, food insecure with moderate hunger, and food

insecure with severe hunger.[13] Food insecurity is a growing epidemic throughout

America, and Coleman-Jensen et al. concluded that in 2013, 14.3% of U.S. households

were food insecure.[17] In addition, research supports that food insecurity is associated with

increased obesity, especially among women.[13, 18-26] Higher rates of obesity among food

insecure women may be related to poor diet quality, increased consumption of low-cost

energy dense foods and sugar-sweetened beverages, limited access to healthy and

nutritious foods, limited access to supermarkets, increased stress and anxiety related to food cost and money, and lack of supplemental benefits.[5, 27-30]

The purpose of this research is to examine eating rate in food insecure women. Past research shows some overweight and obese women eat at a faster eating rate and as the meal progresses do not slow down but rather continue at a linear or constant eating rate.[31-33] Some normal weight women eat at a slower eating rate compared to overweight and obese women and further slow down in eating rate as the meal progresses and satiation begins.[31] No research to date has involved measuring eating rate in food insecure women. It is hypothesized that food insecure women will exhibit a faster average eating rate (grams per minute) when compared to food secure women. In addition, it is hypothesized that food insecure women's quartile eating rate (bites per quartile) will continue at a linear eating rate until meal completion.

METHODS

Research Design

    This was a cross sectional, descriptive study. Women from low-income sites were recruited to eat a test meal of vegetable frittata *ab libitum*, meanwhile eating rate patterns were covertly monitored via video recording. Research assistants reviewed the video recordings and back-calculated average eating rate (bite, grams, and kcals/min), average bite size, energy intake (total kilocalories), and meal duration (minutes). Data from each video were split into equal time length quartiles and bites/quartiles were measured directly from video recordings for analysis. This study was approved by Institutional Review Board (IRB) of the University of Rhode Island.

Location

    The study took place at the Rhode Island Free Clinic located in Providence, RI, and The East Bay Food Pantry located in Bristol, RI. The Free Clinic is located in the South Providence region, and serves a low-income population. The Free Clinic provides free comprehensive medical care that includes primary care, specialty care, labs and diagnostics, medications, wellness programs, and health education to over 2000 uninsured, working poor, or low-income patients. Patients are required to earn less than 200% of the poverty line, and must demonstrate income eligibility. The East Bay Food Pantry serves the East Bay area of Rhode Island, and participants are required to live in the this area. Participants are screened for eligibility, which is based on level of need. Individual income level, household income level, as well as household size, individual

assistance or household assistance, such as free school lunch assistance, Supplemental Nutrition Assistance Program (SNAP) benefits, and renter's assistance are assessed to determine need. Members are allowed to shop one scheduled Wednesday per month, where they can collect one weeks worth of groceries free of charge depending on each member's level of need and household size. In addition, cooking classes and educational classes are offered at the Food Pantry.

Subjects

A total of fifty women were expected to complete the study; however due to difficulties in the recruitment process only twenty women, out of approximately 100 women approached, volunteered to participate. Women were recruited from the Rhode Island Free Clinic during the months of March 2014 to September 2014, and from East Bay Food Pantry, between the months of September 2014 to March 2015. Flyers and posters advertising the study were posted at each location.

At the Rhode Island Free Clinic during patient appointments, medical personnel referred female patients to the study. Individuals were urged to contact The University of Rhode Island's Nutrition and Food Science Department's Energy Balance Laboratory for more information regarding the study, or were informed that they could drop by the Free Clinic on scheduled days between the times of 9 am and 12 pm to participate in the study.

Participants were recruited from East Bay Food Pantry each Wednesday from 10 am until 12 pm during the Food Pantry members allotted monthly visit. In addition, flyers were distributed throughout East Bay Food Pantry and advertised on handouts. As food

pantry members waited in line to check in with the pantry, they were approached about participating in the study.

Research assistants verbally administered the Free Brunch Study Screening Interview (appendix D), to each participant after she expressed interest in the study. Participants were required to be women over the age of 18 and could not be pregnant or taking a medication that affects appetite. Participants were asked to fast and refrain from smoking 8 hours prior to eating the test meal, which was advertised on flyers promoting the study. Participants were not initially screened for BMI.

Additionally participants were asked if they had an Electronic Benefits Transfer (EBT) card, as an indicator of receiving SNAP benefits. Reported demographics, general medical history, dietary and weight history, and self-reported eating rate (slow, medium, and fast) were collected. All participants reported receiving SNAP benefits, being EFNEP eligible, or reported using an EBT card.

In addition to the twenty participants who completed the study, two participants from East Bay Food Pantry were ineligible due to inadequate fasting time and one participant from East Bay Food Pantry was ineligible due to pregnancy. The two participants who were ineligible due to inadequate fasting time were invited to return at a later date to complete the study after adequately fasting however neither participant returned.

Anthropometric Measurements

Height was measured using a portable stadiometer (Seca 214 portable stadiometer; seca gmbh co.kg) and weight was measured using a digital scale

(Healthometer hdr900kd0; Sunbeam Products Inc). Height was converted to meters using the equation: participant height (in)/2.54. Weight was converted to kg using the equation: participant weight (lbs)/ 2.2. The research assistant calculated BMI, using the equation kg/m^2, from the measured height (m) and weight (kg).

Questionnaires

Participants were required to independently complete the validated 10-cm Visual Analog Scale (VAS)[34] (appendix E) for appetite variables to determine initial perceived hunger and satiety. At meal completion, participants completed a VAS for palatability (appendix F) of the meal and another VAS for appetite. After the post-meal completion VAS, participants completed four additional VAS's for appetite at 20-minute post meal completion, 20-minute post meal initiation, 45-minute post meal initiation, and 60-minute post meal initiation. A modified version of the Weight Related Eating Questionnaire (WREQ)[35] was completed post meal (appendix G). For the purposes of this study, the WREQ was modified to assess only two of the four factors: susceptibility to external cues and emotional eating. Routine restraint and compensatory restraint were not included in the questionnaire to reduce subject burden. Additionally, participants were required to complete The International Physical Activity Questionnaire Short Form (IPAQ-SF)[36-38] (appendix H), and the USDA 10-item, 3-stage U.S. Adult Food Security Survey Module[39] (appendix I). Each participant had the option to complete the questionnaires privately or with assistance. The VAS values, modified WREQ, and IPAQ-SF were not analyzed for the present study.

Test Meal

Each participant was served a plate with 400 grams of vegetable frittata, which provided 50 grams of carbohydrates, 50 grams of protein, 50 grams of fat, and a total of 842 calories (energy density= 2.1kcal/g). A glass of water (380g) and utensils were provided. The plate was covertly measured to the nearest .001 grams using a calibrated OHAUS digital food scale (Adventurer; OHAUS Corp, Parsippany, NJ) prior to being served and then again at meal completion, to determine total grams consumed. If the participant chose to have more frittata, 400 additional grams of frittata were provided; the participant was allowed to have unlimited amounts and the same procedure was used for each plate. No participant requested additional frittata. Total grams consumed were recorded. The participant was allowed to eat until she felt satisfied, and on average approximately 25% of the test meal remained at the end for each participant. Afterwards the participant remained in the room for 60 minutes from meal initiation. Upon completion of VAS instruments, the participant was provided with a twenty-dollar gift card to a local supermarket.

Free Clinic Protocol

After research assistants determined participant eligibility, the qualifying participant was escorted to a private screening room. There a research assistant verbally explained study details and the participant signed two consent forms, keeping one for her record (appendix B). Afterwards, the research assistant collected the anthropometric measurements of height and weight for BMI calculation.

While the participant was in the private screening room a second research assistant set up the laptop computer at a table four feet from the test meal location to covertly monitor the participant. The video was started while the participant was in the private screening room to avoid unwanted attention. Additionally, the test meal was heated and weighed prior to the participant's return.

The participant was then escorted to the test meal location. The pre-meal VAS for appetite was administered and the participant was served the test meal. A research assistant covertly monitored the participant's meal start and finish time and recorded it. After the test meal was completed, the participant completed the post-meal VAS for appetite and the post-meal VAS for palatability. The participant was escorted back to the private screening room to complete the modified WREQ, IPAQ-SF, and the USDA U.S Adult Food Security Survey Module, while a research assistant stayed behind to weigh the completed test meal. The participant remained in the private screening room, while a research assistant delivered the VAS instrument at each time point until study completion. At the Free Clinic, only two participants completed the test meal. A diagram of the Free Clinic test site located in Appendix K.

East Bay Food Pantry Protocol

Prior to screening participants, the laptop computer was set up at the corner of the table where participants would be eating, and recording was started. Research assistants started the video beforehand because multiple participants would eat during the recording time and research assistants did not have the time to start and stop with each participant.

Additionally, two or three participants could be eating at the same time and research assistants did not want to interrupt participants during the test meal.

Once the laptop was set up, research assistants would begin screening participants. After an eligible participant checked-in with the pantry, a research assistant escorted the participant to the testing area located in a private part of the employee only section. While the research assistant verbally explained the study and the participant signed two consent forms, another research assistant heated and weighed the test meal in an area separate to the participant to avoid attention. Afterwards anthropometrics were collected privately screened off to the side of the testing area. Due to limited space within the food pantry, anthropometrics were collected within the test meal area.

After the participant completed the pre meal VAS, the test meal was served. At this time, the research assistants would be preparing additional participants to begin the study. Due to multiple participants being screened at the same time and one research assistant tending to the test meals, recording the start and finish times was not possible. Therefore, the video recordings were used to record the start and finish time.

After the test meal was completed, the participant completed the post-meal VAS for satiety, the post-meal VAS for palatability, the modified WREQ, the IPAQ-SF, and the USDA U.S. Adult Food Security Screening Survey at the testing area. Due to limited space within the testing area, the participant was escorted back to the food pantry and supplied with a clipboard, pen, and timer. A second timer stayed with the research assistant, who would check-in with the participant whenever a VAS measurement needed to be completed. After all VAS instruments were completed, the participant was escorted back to the testing area to receive a gift card. Between two and three participants could

complete the study at one time, eating together at one table. A diagram of the East Bay

Food Pantry test site located in Appendix L.

Measures

Video Recordings

      Research assistants at the energy balance lab reviewed the video recordings for

each participant in order to calculate eating rate. Each video's time stamp was reviewed

to assess meal start and finish times for participants. Two research assistants reviewed

each video twice to calculate number of bites. A bite was defined as every time the

participant used the fork to pick up the test meal, brought the fork with a portion of the

test food to the mouth, and placed the fork within the mouth, and finished by chewing

and swallowing the test meal. Bites per minute were averaged for each participant's meal.

Additionally meal duration was divided into four equal time length quartiles for each

participant. Each quartile represented 25% of the test meal duration. A research assistant

reviewed each video twice to directly measure bites per quartile and the values were

averaged, as described previously.

Eating Rate Calculations

      Onsite a research assistant calculated total grams, using the equation: weight at

meal initiation (400g) – weight at meal completion = total grams. Additionally energy

intake (total kilocalories), was calculated using the equation:

$$\frac{\text{Total grams}}{400 \text{ grams}} = \frac{X}{842 \text{ kcal}}$$

Meal duration was calculated using the video recording's time stamp. Meal start was assessed as the very first time the participant used the fork to pick up a portion of the test meal. Meal finish was assessed as the last time the participant put the fork down on the test plate. Meal duration was recorded in minutes. Eating rate was calculated three different ways due to the diversity of approaches in scientific literature. First it was calculated as bites per minute (total bites counted in video/duration of video in minutes). Eating rate was also calculated by total grams/ meal duration (minutes) = grams per minute. Additionally kilocalories per minute was calculated using the equation: energy intake (kilocalories)/ meal duration (minutes). Eating rate was calculated from the pre and post method of weighing the test meal before and after and recording meal duration, not measured directly from the video recordings. The total number of bites throughout the meal duration was examined from reviewing the video recordings and from that average bite size was calculated using the equation: total grams/ total bites = gram per bite. Quartiles were used to examine the eating rate pattern across the test meal. Quartile eating rate was calculated as bites per quartile and was directly measured from video recordings. Quartile1 was considered the beginning of the meal and determined initial eating rate, quartile 2 and quartile 3 were mid-meal, and quartile 4 was the end of the meal and used to determine when eating ends. Eating rate, bites per quartile, were compared between quartiles 1 and quartiles 4 in order to examine eating rate differences from the start of the meal to the finish.

Food Insecurity

A research assistant scored each USDA Adult Food Security Survey Module using the USDA coding sheet (Appendix J). Each participant's raw score ranged between 0 and 10. Participants' raw scores placed them into one of four ranges: high food security (score of 0), marginal food security (score of 1-2), low food security (score of 3-5), and very low food security (score of 6-10). If participants scored high food security or marginal food security they were considered food secure. If participants scored low food security or very low food security they were considered food insecure.

Statistics

Statistical analysis were conducted using SPSS (IBM, 22.0. Armonk, NY). Data were examined for normality using skewness and kurtosis, Shapiro Wilk test, and by examining the histograms, Q-Q plots, and box plots. Skewness and kurtosis were examined by dividing the statistical value by the standard error and results between +/- 1.96 were considered normally distributed. Statistical values above 0.05 were considered normally distributed for the Shapiro Wilks test.

Planned comparisons between food insecure and food secure groups could not be performed because only one participant scored food secure. However, exploratory hypotheses were examined. Differences were established using chi-square analysis for categorical variables such as ethnicity, and independent t-test analysis for continuous variables, such as eating rate, energy intake, total grams, meal duration, kilocalories per minute, and quartile eating rate. Analysis of variance (ANOVA) was used to examine differences between the food security ranges (food secure, marginally food secure, low food secure, and very low food secure), and differences between self-reported eating rate

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(slow, medium, or fast). Differences in eating rate, the dependent variable, between the overall food security score groups (food secure vs food insecure), the independent variables, were expected to be examined using independent t-test analyses to establish differences for hypothesis 1. Differences between quartile eating rate for quartiles 1 and 4, the dependent variables, were expected to be examined using paired t-test analyses to establish if differences existed across the meal for hypothesis 2.

RESULTS

Anthropometrics and Demographics

Twenty females, recruited from low-income sites, who were over the age of 18 (46.5 ± 13.7) completed the study. Of those twenty, thirteen participants were included for data analysis. Five participants from East Bay Food Pantry were excluded from data analysis because the laptop computer used to video participants did not capture the test meals correctly. As previously stated, the laptop computer was set-up prior to the arrival of participants and video recording ran continuously. Upon later review, it was determined that the five participants sat outside of the video parameter and meal duration could not be determined. Without meal duration, back-calculating eating rate was not possible and only energy intake and total grams could be calculated. Additionally, one participant refused to be video recorded and eating rate could not be back-calculated. Lastly, one participant was excluded because the test meal duration was less than 1 minute. The participant's test meal consisted of 4 bites and the meal duration was 40 seconds. The participant was excluded because her test meal duration was an extreme outlier. The average meal duration for all 13 subjects was 5.5 ± 2.2 minutes (Table 3).

The majority of participants were overweight or obese with BMI averaging 35.7 ± 6.6 kg/m^2 (Table 1). Additionally, most were Non-Hispanic White women from the East Bay area of Rhode Island. All participants reported either receiving SNAP benefits and/or used an EBT card. Through analysis of the screening questionnaire, 7 participants (35%) had one or more children, and 2 participants (10%) had diabetes; no participant reported any major medical problems.

Only 1 participant scored food secure and 19 participants scored food insecure (Table 1). Of those thirteen participants included in data analysis, 1 participant (7.7%) scored marginally food secure, 2 participants (15.4%) scored low food secure, and 10 participants (76.9%) scored very low food secure. The 1 marginally food secure participant's average eating rate was 53.9 g/min, the 2 low food secure participants' average eating rate was 43.4 ± 20.0 g/min, and the 10 very low food secure participants' average eating rate was 57.4 ± 19.1 g/min.

For subjects self-reported eating rate (slow, medium, fast), the majority of participants reported a fast eating rate (Table 1). Of the thirteen participants included in data analysis, 8 (61.5%) reported a fast eating rate, 4 (30.8%) reported a medium eating rate, and 1 (7.7%) reported a slow eating rate. The average calculated eating rate was 56.5 ± 20.6 g/min for those who reported fast eating rates, 47.3 ± 12.2 g/min for those who reported medium eating rates, and 74.1 g/min for the one participant who reported a slow eating rate (Table 2). Due to lack of participants reporting a slow eating rate, ANOVA analysis was not conducted. There was no difference between participants who self-reported as medium or as fast eaters, those who reported as medium eaters had a similar calculated eating rate (g/min) compared to the fast eaters (t= -.807, p=0.438) (Table 2). There was a moderate effect size between self-reported medium and fast eaters' eating rate (g/min) (d=.061).

Calculated Average Eating Rate

Statistical comparisons between food insecure and food secure groups were not possible because only one participant was in the food secure range. The calculated means for each variable are provided in Table 3.

Eating Rate Q1 vs Q4

Each test meal was split into four equal time length quartiles and quartile eating rate as bites/quartile were calculated. Bites/quartile are presented in Figure 1. There were 7 participants whose quartile 1 eating rate appeared lower than quartile 2 and 3. Within the remaining 5 participants, 3 participants decreased in eating rate and 2 participants stayed the same between Q1 and Q2. Two patterns emerged when examining the figure, those who ate with an accelerated Q4 eating rate (n=6) and those who ate with a decelerated Q4 eating rate (n=7) (Table 4) (Figure 2). Both the accelerated Q4 and decelerated Q4 groups had similar calculated eating rate, meal duration, energy intake, total intake, kcals/min, and bite size (Table 4). Paired t-test analysis was conducted within each of the assessed groups comparing Q1 to Q4. Within the accelerated Q4 eaters, Q1 eating rate was significantly lower than Q4 eating rate (p=.002) (Table 5). Within the decelerated Q4 eaters, quartile 1 eating rate was not significantly different from quartile 4 (p=.190) (Table 5).

DISCUSSION

This was the first study to take eating rate measurement out of the lab and into a community setting. This novel methodology included covertly video recording participants onsite to calculate eating rate. Past laboratory research relied on a Universal Eating Monitor (UEM) to calculate eating rate[40-42], limiting research to a lab setting. By moving research out of the lab, it opens the field to more opportunities examining eating rate in a variety of settings to further broaden research. Throughout the study several limitations and difficulties presented themselves regarding this novel methodology. Ultimately problems with recruitment and methodology led to unexpected results and failure to answer the proposed hypotheses. However, new insights regarding this methodology were made.

The primary hypothesis was that food insecure women would exhibit a faster eating rate when compared to food secure women. The secondary hypothesis was that food insecure women would continue at a linear eating rate until meal completion whereas food secure would decrease eating rating over the course of the meal. However, neither the primary hypothesis, nor the secondary hypothesis could be tested due to several limitations and difficulties experienced throughout the study. Additionally, it is not clear whether or not the results found during this study were the result of the study population or methodology utilized during the study.

When examining the demographic data, the majority of participants were overweight or obese. Although BMI over 18.5 kg/m^2 or above was considered eligible for the study, only one participant who volunteered had a BMI categorized as normal weight. Additionally, the majority of participants scored with very low food security. These

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results are supported by previous research.[43-46] Studies conducted at food pantries found that participants who frequented food pantries were severely food insecure, had higher rates of obesity, had low levels of education, and suffered from severe poverty.[43-46]

Self-reported eating rate was collected and data were compared to observed calculated eating rate from the test meal. Since only one participant reported a slow eating rate her calculated eating rate could not be compared to those who reported as medium and fast eaters. Although there were no significant differences between self-reported medium and fast eaters, self-reported fast eaters did have a faster eating rate than self-reported medium eaters (Table 2). Additionally there was a moderate effect size. Future research with a larger sample size may find significance between groups.

Past research examining calculated eating rate in comparison to self-reported eating rate was tested using a test meal energy density of 1.66kcal/g. The energy density of this study was 2.1kcal/g. Therefore results from previous studies cannot be directly compared to this study. Petty et al. examined self-reported eating rate and calculated eating rate and found that self-reported slow eaters ate at 53.0 ± 5.4 kcal/min, medium eaters ate at 63.1 ± 5.2 kcals/min, and fast eaters ate at 83.9 ± 5.5 kcals/min.[47] Andrade et al. found that calculated eating rate for self-reported slow eaters was 26.1 ± 8.9 kcals/min and fast eaters was 43.5 ± 23.4 kcals/min.[7] More research using the same texture and type of test meal needs to be conducted to accurately test calculated eating rate and self-reported eating rate validity.

When comparing the observed eating results of this study to previous research, Almiron-Roig et al. examined eating rate (grams/min) in a 400gm (520 kcals) chili-carne and rice test meal in overweight women.[48] The average eating rate was 66 ± 23 g/min,

which was slightly faster than this study's 55 ± 18.3 g/min. The results are comparable and differences may be due to viscosity or texture differences between the two meals. There is strong evidence supporting texture and viscosity differences and energy intake; findings are consistent that solids and semi-solids have stronger effects on satiety than liquids.[49-52]

Additional studies include Sneddon et al. which examined eating rate in healthy college-aged women at the University of Rhode Island and served as a predecessor to this study.[8] The results found that calculated eating rate was 60.5 ± 70.75 g/min, which is slightly faster than the eating rate observed in this study.[8] Petty et al. found that calculated eating rate was 48.1 ± 15.1 g/min, slightly slower than the calculated eating rate from this study.[47] Sampson et al. also examined eating rate (kcals/min) in women recruited from Providence, RI.[10] The results found that calculated eating rate was 58.85 ± 21.0 kcals/min.

As stated previously, calculated eating rate between the food insecure group and the food secure participant could not be statistically tested. However, when examining the mean differences, the food secure participant had a similar eating rate and meal duration compared to her food insecure counterparts.

It should be noted that the one participant who scored food secure was the first participant to complete the study and following protocol a research assistant verbally administered the USDA Adult Food Security Survey Module. However, after verbally administering the questionnaire to the participant the research assistant noted the participant's obvious discomfort when answering such personal questions. Although the questionnaire is routinely administered verbally over the telephone protocol was changed

to give participants the option to complete the questionnaire independently. For the remainder of the study, all participants chose to complete the questionnaire independently, and all scored food insecure.

Several eating rate studies involve splitting test meal data into four equal time length quartiles to calculate eating rate per quartile [31-33, 53-55] When each test meal was divided into quartiles, quartile 1 eating rate (bites/quartile) was lower than expected for seven of the participants. For the remaining five, three had a higher quartile 1 eating rate and two had eating rates that stayed the same.

The results from this were unique in that even though the majority of participants were overweight or obese, this eating rate pattern did not follow the patterns previous established.[23, 31] As stated previously, overweight and obese individuals usually eat at a faster eating rate compared to normal weight individuals and do not slow down as the meal progresses. The results of this study show that the overweight and obese participants ate at a slower eating rate at the beginning of the meal than later in the meal.

Previous research shows that lower quartile 1 eating rate is often seen in women with disordered eating, specifically Bulimia Nervosa (BN), where there is a delay in eating rate at meal onset.[56, 57 58, 59] The results from this study were similar to eating rate studies involving women with BN; however, it was not clear if this was the result of the population or an artifact of the methodology used in this study. It was not possible to determine which variable may have caused quartile 1 to have a lower eating rate in some of the participants.

It would have been useful to talk with the participants and future research should include a qualitative component as well as a psychological component. The stress and

anxiety often associated with food insecurity affects many aspects of life.[60] Participants may not know where their next meal is coming from and the stress of having enough money for food each month could play a role in eating patterns and behaviors.

Additionally, participants may have suffered from Other Specified Feeding or Disordered Eating (OSFED) or Binge Eating Disorder, and this may be why participants followed a similar eating pattern to women with BN. Research suggests that food insecure individuals may binge eat during certain times of the month when food is more available, such as right after they received SNAP benefits.[21, 26, 61] Whereas other times of the month, food insecure individuals may skip meals.[21, 26] This cycle pattern of eating often leads to weight gain.[62] Therefore, a measurement for disordered eating should be considered in future research.

As stated previously, this was the first study to use video recordings to calculate eating rate within this population and limitations involving this methodology were examined. At The Free Clinic, recruitment relied on Healthcare professionals recommending female patients for the study and this was unreliable. This method of recruitment also relied on patients having to come back for a second visit since most appointments at The Free Clinic took place in the evenings. Originally 25 participants were expected from The Free Clinic and 25 participants were expected from East Bay. However, because patients did not return for a second visit, only two participants from The Free Clinic completed the study. Therefore even sample sizes from each location were not possible.

Additionally the study proved to be very invasive within the locations. At the Pantry, private space was limited and an area within the employee-only section was

partitioned off in order to provide privacy for the study participants. This proved burdensome on employees. As a result, cooperation from both employees and volunteers at East Bay declined as the study progressed.

At The Free Clinic, the onsite kitchen was used for meal testing. However, the kitchen was often scheduled for additional uses, limiting its availability for use in the study.

Additionally, it should be noted that of the thirteen participants, approximately half of the participants ate at a table with another participant. At The Free Clinic, only one participant ate at a time, but at the Pantry multiple participants could eat at one time. Therefore, the social aspect of eating as a group or having one or two others eating as well may have impacted the results.

Another difficulty presented throughout the study was participant time constraints. Participants were informed prior to signing the consent form that the study process would take an hour to complete. However, an estimated eight participants from East Bay who expressed interest in the study initially, declined after being unable to stay for an hour. Those participants were invited back to participate at a later more convenient time however no participant returned. Flyers around East Bay did advertise that the study required an hour's time; however, most participants were recruited onsite the morning of the test meal. At The Free Clinic participants were recommended prior and were aware of the time requirement; therefore it was not an issue.

A difficulty presented with the USDA Adult Food Security Survey Module was that majority of participants from the food pantry scored a raw score of 10. This is categorized as having very low food security and is associated with severe poverty.

Overall, this study helped elucidate areas that need to be considered in future study designs. For example, one participant refused to be video recorded. Technical difficulties caused five video recordings to be unusable. This was due to participants sitting out of video range. Research assistants had planned on manually calculating meal duration by recording meal start and finish time; however, due to limited staffing this was not possible. Therefore, meal duration relied on video recordings, and thus meal duration could not be assessed and back-calculating eating rate for those participants was not possible. Additionally, research assistants did not want to disturb participants by watching the test meal and often left the small private space to allow participants privacy and assist other participants completing VAS measurements.

In conclusion, many new insights into how effective this novel approach to measuring eating rate in a community setting were learned. Although many difficulties were presented during the study, the results were unique and future research with a larger sample size and psychological component could present more information regarding this population.

Table 1: Sample Demographics and Screening Interview Results (n=20)

Variable	Mean ± SD	
Age (years)	46.55 ± 13.7	
Height (meters)	1.65 ± 0.1	
Weight (kilograms)	97.6 ± 23.2	
Body Mass Index (kg/m^2)	35.7 ± 6.6	
Self- Rated Eating Rate		**n (%)**
	Fast	8 (61.5%)
	Medium	4 (30.8%)
	Slow	1 (7.7%)
Ethnicity		**n (%)**
	Caucasian non-Hispanic White	12 (60.0%)
	African American	5 (25.0%)
	Hispanic	2 (10.0%)
	American Indian	1 (5.0%)
	Asian	0 (0%)
	Other	0 (0%)
Grade-level Completed		**n (%)**
	No High School	2 (10.0%)
	Some High School	5 (25.0%)
	Completed High School	4 (20.0%)
	Some College/Technical School	4 (20.0%)
	Completed College/Technical School	0 (0%)
	Graduate School	0 (0%)
	Not Available	5 (25%)
Food Insecurity[a]		
	High Food Security[b]	0 (0%)
	Marginal Food Security[c]	1 (5.0%)
	Low Food Security[d]	4 (20.0%)
	Very Low Food Security[e]	15 (75.0%)

[a] Food Security measured using the USDA Validated Food Insecurity Questionnaire:
Raw Scores Range 0-10
[b] 0= High Food Security
[c] 1-2= Marginal Food Security
[d] 3-5= Low Food Security
[e] 6-10= Very Low Food Security

Table 2: Eating Rate, Meal Duration, Energy Intake, Total Intake, Kilocalories/Minute, Bite Size, and Quartile Eating Rate$^\Phi$ Between Self-Reported Eating Rate (Slow, Medium, Fast) (Mean ± SD)

	Slow (n=1)	Medium (n=4)	Fast (n=8)	P-Value$^\Psi$
Total Eating Rate (g^a/min^b)	74.1	47.3 ± 12.2	56.5 ± 20.6	0.438
Total Meal Duration (min)	3.4	7.3 ± 2.5	4.9 ± 1.8	0.081
Energy Intake (kcals^c)	530.5	631.0 ± 77.2	536.2 ± 122.1	0.192
Total Intake (g)	252	321.8 ± 22.0	251.5 ± 53.0	0.032*
Kcals/min	145	86.2 ± 30.8	140.3 ± 58.8	0.12
Average Meal Bite Size (g/bite)	25.2	14.1 ± 5.1	16.0 ± 9.0	0.704
Quartile 1 (bites/quartile)	2.4	2.9 ± .9	3.8 ± 1.6	
Quartile 2 (bites/quartile)	3.5	4.4 ± 1.4	4.3 ± 2.0	
Quartile 3 (bites/quartile)	1.2	4.0 ± .6	4.3 ± 2.0	
Quartile 4 (bites/quartile)	4.7	2.7 ± 1.6	3.9 ± 2.2	

$^\Phi$Eating rate split into four equal length quartiles and bites/quartile assessed
^{a} grams
^{b} minutes
^{c} kilocalories
$^\Psi$ Independent T-Test analysis used to test significance between reported medium and fast eaters
*Significance p<0.05

Table 3: Eating Rate, Energy Intake, Meal Duration, Total Intake, and Quartile Eating Rate$^\Phi$ During Test Meals For Food Secure, Food Insecure, and Total Groups (Mean ± SD)

	Food Secure[1] (n=1)	Food Insecure[2] (n=12)	Total Group (n=13)
Eating Rate (gm^a/min^b)	53.9	55.1 ± 19. 1	55.0 ± 18.3
Meal Duration (mins)	5.8	5.5 ± 2.3	5.5 ± 2.2
Energy Intake (kcals^c)	673.1	556.0 ± 110.7	565.0 ± 114.3
Total Intake (g)	319.7	269.3 ± 54.3	273.2 ± 53.9
Kcals/min	115.5	124.7 ± 56.6	124.6 ± 56.6
Mean Bite Size (g/bite)	10.0	16.6 ± 8.0	16.1 ± 7.9
Quartile 1 (bites/quartile)	3.4	3.4 ± 1.5	3.4 ± 1.4
Quartile 2 (bites/quartile)	4.8	4.2 ± 1.8	2.8 ± 1.7
Quartile 3 (bites/quartile)	6.8	3.8 ± 2.0	4.0 ± 2.1
Quartile 4 (bites/quartile)	6.8	3.6 ± 2.1	3.9 ± 2.2

$^\Phi$Eating rate split into four equal length quartiles and bites/quartile assessed
Food security measured using the USDA's validated Food Insecurity Questionnaire: Raw Scores Range 0-10
[1]Scores 0-2= food secure
[2]Scores 3-10= food insecure
[a] grams
[b] minutes
[c] kilocalories

Table: 4: Eating Rate, Energy Intake, Meal Duration, Total Intake, Kilocalories/Minute, Bite Size, and Quartile Eating Rate$^\Phi$ During Test Meals Between Accelerated Q4[1] and Decelerated Q4[2] Eaters (Mean ± SD)

Variable	Accelerated Q4 Eaters (n=6)	Decelerated Q4 Eaters (n=7)
Eating Rate (gm[a]/min[b])	56.2 ± 13.4	54.0 ± 22.8
Meal Duration (min)	5.0 ± 1.3	6.0 ± 2.8
Energy Intake (kcal[c])	574.5 ± 104.7	556.8 ± 123.6
Total Intake (gm)	268.6 ± 43.4	277. 1 ± 64.7
Kcals/minutes	128.6 ± 26.1	120.1 ± 72.7
Bite Size (g/bite)	16.5 ± 11.1	15.8 ± 4.5
Quartile 1 (bites/quartile)	3.3 ± 1.4	3.4 ± 1.5
Quartile 2 (bites/quartile)	4.3 ± 2.0	4.2 ± 1.6
Quartile 3 (bites/quartile)	4.2 ± 2.8	3.8 ± 1.4
Quartile 4 (bites/quartile)	5.4 ± 2.0	2.5 ± 1.3

$^\Phi$Eating rate split into four equal length quartiles and bites/quartile assessed
[1]**Accelerated Q4 eaters** = is defined as a participant who ate with a higher Q4 eating rate compared to Q1 and a higher or even eating rate compared to Q2, and Q3 eating rates
[2]**Decelerated Q4 eaters** = is defined as a participant who ate with a lower or even Q4 eating rate compared to Q2, and Q3 eating rates
[a] grams
[b] minutes
[c] Kilocalories

Table 5: Examining Within Group Differences Between Quartile 1 and Quartile 4$^{\Phi}$ in Accelerated Q4^{1} Eaters and Decelerated Q4^{2} Eaters$^{\Psi}$ (P-Value)

		Quartile 4
Accelerated Q4 Eaters	**Quartile 1**	.002**
Decelerated Q4 Eaters	**Quartile 1**	.190

$^{\Phi}$Eating rate split into four equal length quartiles and bites/quartile assessed

^{1}**Accelerated Q4 eaters** = is defined as a participant who ate with a higher Q4 eating rate compared to Q1 and a higher or even eating rate compared to Q2, and Q3 eating rates

^{2}**Decelerated Q4 eaters =** is defined as a participant who ate with a lower or even Q4 eating rate compared to Q2, and Q3 eating rates

$^{\Psi}$ Paired t-test analysis was conducted

*Significance p<0.05

**p<.01

Figure 1: Total Group (n=13) Quartile Eating Rate$^{\Phi}$ (Bites/Quartile)

$^{\Phi}$Eating rate split into four equal length quartiles and bites/quartile assessed

A= Accelerated Q4 eaters, which is defined as a participant who ate with a higher Q4 eating rate compared to Q1 and a higher or even eating rate compared to Q2, and Q3 eating rates

D=Decelerated Q4 eaters, which is defined as a participant who ate with a lower or even Q4 eating rate compared to Q2, and Q3 eating rates

Figure 2: Comparing Quartile Eating Rate$^{\Phi}$ (Bites/Quartile) Between Accelerated Q4 Eaters[1] (n=6) and Decelerated Q4 Eaters[2] (n=7)

$^{\Phi}$Eating rate split into four equal length quartiles and bites/quartile assessed
[1]**Accelerated Q4 eaters**, which is defined as a participant who ate with a higher Q4 eating rate compared to Q1 and a higher or even eating rate compared to Q2, and Q3 eating rates
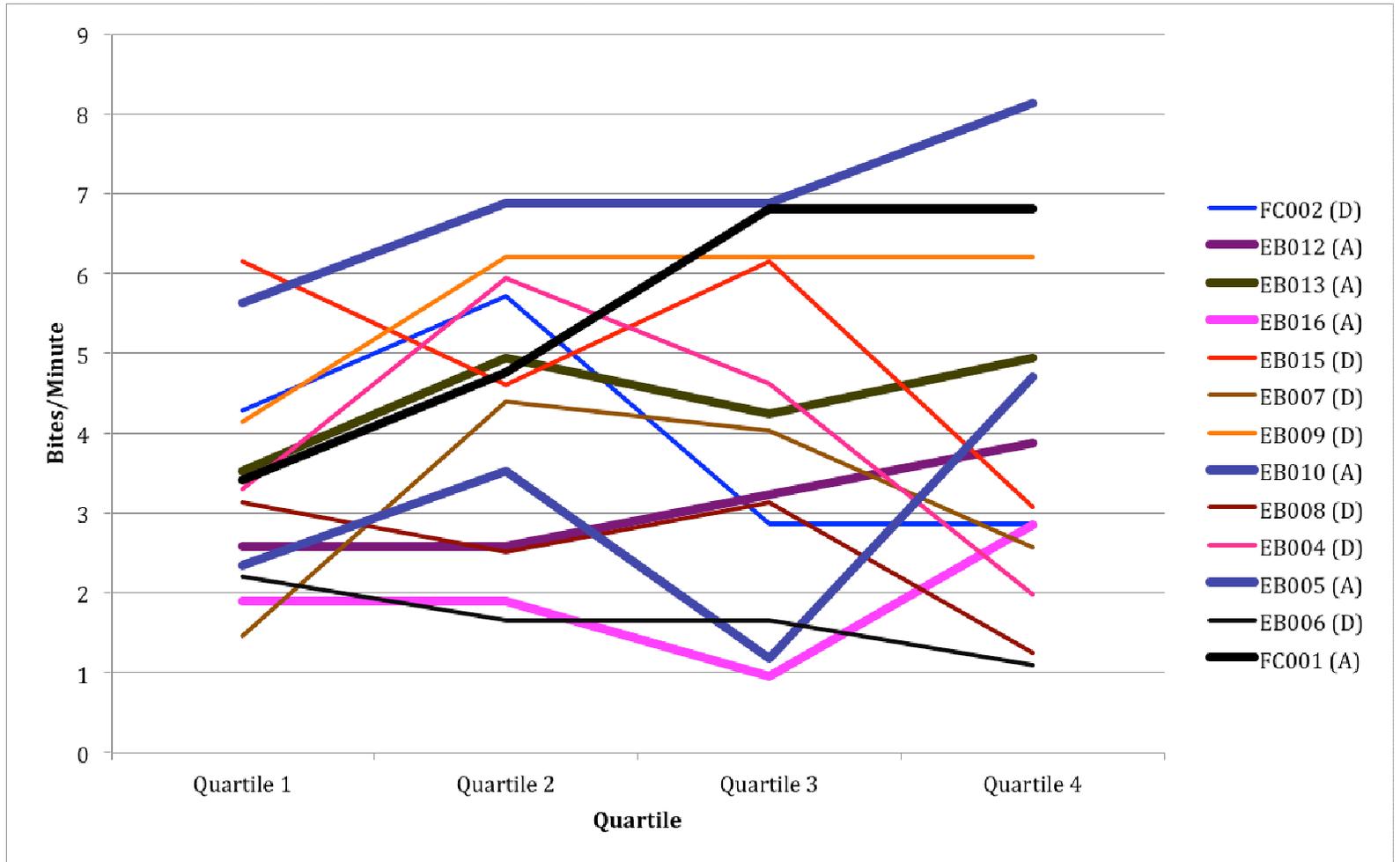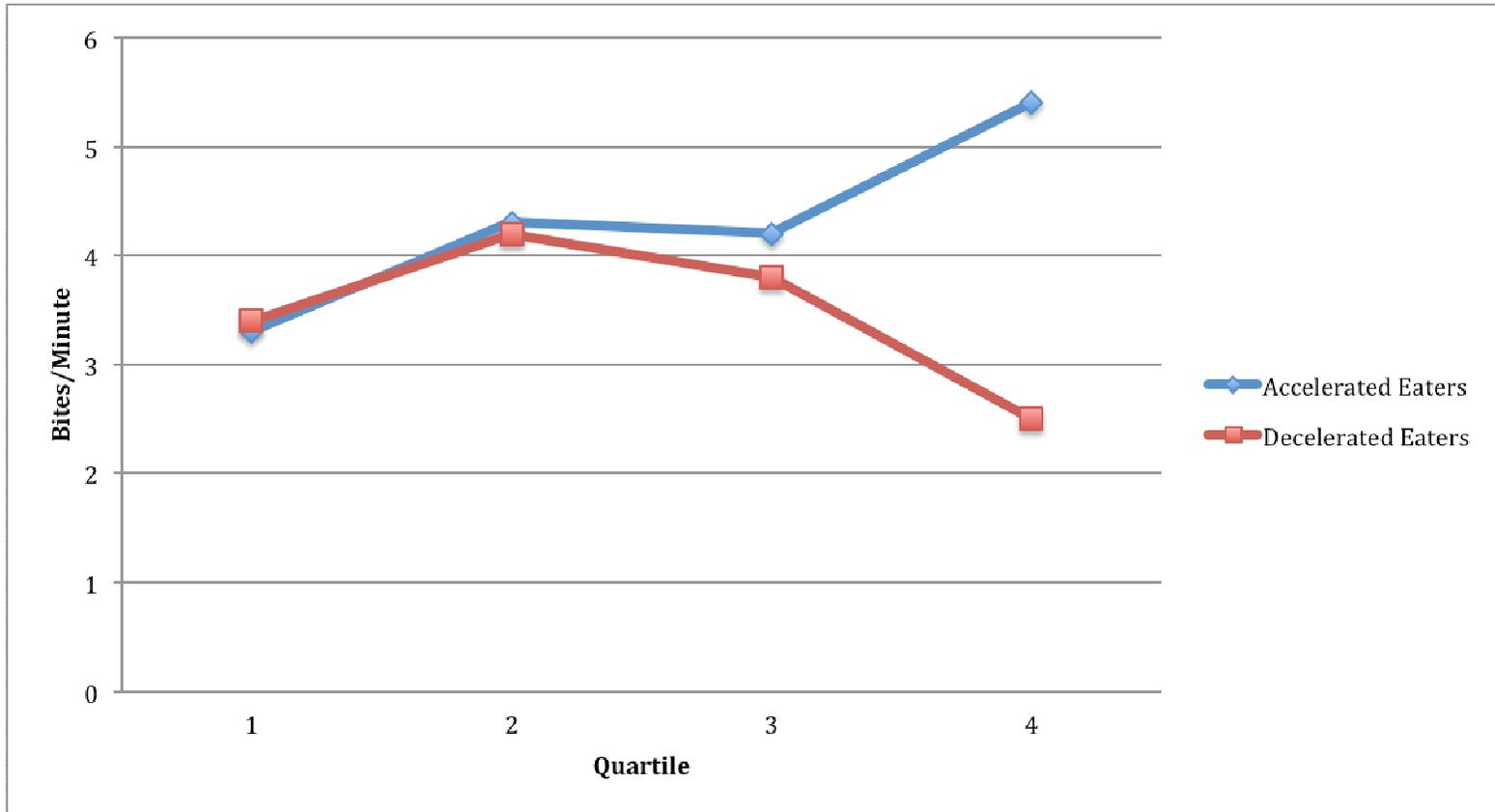[2]**Decelerated Q4 eaters**, which is defined as a participant who ate with a lower or even Q4 eating rate compared to Q2, and Q3 eating rates

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APPENDICES

Appendix A: Review of Literature

I. **Introduction**

Obesity is a prevalent health problem in the United States that results in increased risk for various health issues such as hypertension, hyperlipidemia, type 2 diabetes mellitus, chronic diseases, cardiovascular diseases, stroke, and even death.[1-4] Obesity rates in the United States continue to rise and have more than doubled in the last forty years.[2] Currently more than two thirds of all Americans are overweight or obese, and rates of extreme obesity, body mass index (BMI) over 40 kg/m^2, are on the rise.[2] In addition, past research established that disparities exist in obesity rates. Disparities such as race-ethnicity, gender, and genetics may contribute to obesity; however these factors are uncontrollable.[2] Controllable factors affecting obesity rates are diet quality, food environment, eating rate, and food security.[2]

Current literature established that differences between race and ethnicity exist in obesity prevalence.[2, 4-7] African American and Hispanic women are more likely to be overweight or obese than Caucasian white women, and Hispanic men are more likely to be overweight or obese than African American and Caucasian white men.[2] In addition, rates of extreme obesity are higher among women, particularly African American women.[2] Currently Hispanic young adults have the highest prevalence of obesity.[5] New research shows that prevalence remains stable among women and girls, but is increasing in both men and boys.[4] However obesity prevalence remains critically high among all genders and age groups and monitoring is still of upmost importance.[2]

Research suggests that there is an association between obesity and lower SES, especially in women.[8-12] The National Health and Nutrition Examination Survey (NHANES), collected data between 2005-2008, and found that 42% of women living below 130% of the poverty line were obese in comparison to 29% of women living above 350% of the poverty line.[3]

Food security also plays a role in obesity. Food insecure women are more likely to be overweight or obese than their food secure counterparts.[13-15] The higher rates of obesity in food insecure women may be due to poor food choices related to economic demands and lack of access to healthy food options.[13-15]

Poor food choices such as increased consumption of energy-dense foods such as refined grains, added sugars, and added saturated and trans fat are often associated with obesity in low-income populations.[16] Several factors affecting poor diet quality are that energy-dense foods cost less, are more convenient, and are more palatable.[16-19]

In addition, in low-income areas access to supermarkets can be limited.[16] Supermarkets may be several miles away and transportation may be limited or access to public transportation is poor. Low-income areas also tend to have more access to fast food and convenience stores, which may offer limited selection in fresh foods or lack healthy options.[16]

To help combat food insecurity, the Federal government provides several programs for low-income populations. The Supplemental Nutrition Assistance Program (SNAP) and its education program SNAP-Ed are programs available for low-income populations. The goal of SNAP is help provide sufficient means in hopes of alleviating

food insecurity and increasing access to healthy foods.[20] The goal of SNAP-Ed is to help improve diet quality by increasing nutrition knowledge.[21]

An important area of research involves programs to help alleviate obesity in the U.S. Although research in the area of eating rate and obesity is far more limited; substantial evidence suggest that eating rate can also play a role in obesity. Within meals, overweight and obese individuals exhibit a faster initial eating rate than normal weight individuals, as well as do not follow the normal biological satiation curve typically exhibited by normal weight individuals.[22, 23]

Currently there is mixed research involving the effectiveness of eating rate interventions and reduced energy intake.[24-26] However, with more research eating rate interventions may become an effective tool in weight loss and obesity prevention. The limited eating rate interventions in low-income populations proved unsuccessful, suggesting that low-income populations that are food insecure differ in eating rate when compared to food secure populations.[25] To date there is no research published that examines eating rate in food insecure individuals. By examining eating rate patterns in food insecure individuals it may provide insight into creating an effective intervention for decreasing eating rate in food-insecure populations, resulting in increased weight loss and decreased obesity prevalence.

II. Obesity- Health Epidemic

What is obesity?

The World Health Organization (WHO) defines obesity as excessive or abnormal fat accumulation that poses a health risk.[27] Obesity is often the result of a lack of physical

activity or exercise and the consumption of excessive calories. Food environment, genetics, and certain conditions may also play a role in obesity. Currently, the standard for characterizing obesity by The Center for Disease Control (CDC) is by BMI. A BMI over 25.0 kg/m^2 is categorized as overweight, and a BMI over 30.0 kg/m^2 is categorized as obese[28]. As the obesity epidemic continues, new classes of extreme obesity, such as BMI over 40kg/m^2 and BMI over 45kg/m^2, have emerged.[5]

Complications associated with obesity

Obesity is associated with various health-related problems such as hypertension, diabetes, dyslipidemia, certain cancers, metabolic syndrome, and cardiovascular disease among others.

Nguyen et al. examined data from NHANES between 2003 and 2004 and established that hypertension, diabetes, dyslipidemia, and metabolic syndrome prevalence was related to obesity.[1] The results from the study found that the lowest prevalence of these health-related problems occurred in normal weight individuals, and prevalence increased as weight increased.[1]

In addition, cardiovascular disease is currently the leading cause of death in the United States.[29] Poirier et al. determined that obesity play a major role in cardiovascular disease.[30] More importantly it was determined that with weight loss patients reduced their risk of CVD, thus improving overall health and decreasing the risk of arrhythmia, pulmonary hypertension, stroke, coronary artery disease, heart attack, sleep apnea, vascular disease, and congestive heart failure.[30]

The relationship between obesity and type 2 diabetes is well established. For every 2.2lb (1kg) increase in weight the risk of diabetes is increased by 9%.[31] Sullivan et al. examined the relationship between obesity, physical inactivity and diabetes and determined that both obesity and physical inactivity are associated with prevalence of diabetes.[31]

Flegal et al. examined obesity-related deaths in the United States.[32] After collecting data from NHANES and using follow-up data, the results showed that obesity was associated with CVD-related deaths as well as deaths related to kidney disease, diabetes, and obesity-related cancers.[32] Obesity continues to be a major health problem in the United States, and research determined that obesity plays a major role in many other major health-related issues in the United States. In addition, prevention of obesity is proven to help improve many health-related issues such as cardiovascular disease, prevalence of type 2 diabetes, certain cancers, and many other health-related issues. Therefore, obesity prevention should be at the forefront of disease prevention and primary prevention in the United States.

Prevalence of obesity in U.S

According to the World Health Organization (WHO), 69% of all Americans are overweight and 35% are obese.[2] Throughout the obesity epidemic obesity rates have risen greatly; fortunately, new research shows that rates among women remain stable, although still critically high.[2] When obesity prevalence is broken down by gender, 66.5% of women are overweight compared to 71.6% of men, and 36.5% of women are obese compared to 33.7% of men.[2] In addition, 64.6% of Caucasian white women, 82.1% of

African American women, 34.4% of Asian women, and 76.2% of Hispanic women are overweight.[2] Furthermore, 33.7% of Caucasian white women, 56.7% of African American women, 11.4% of Asian women, and 43.3% of Hispanic women are obese.[2] Lastly, 17.1% of women are grade 2 obese and 8.3% of women are grade 3 obese.[2] Specifically 15.5% of Caucasian white women, 29.4% of African American women, 2.9% of Asian women, and 19.6% of Hispanic women are grade 2 obese; 7.4% of Caucasian white women, 16.5% of African American women, 1.4% of Asian women, and 7.4% of Hispanic women are grade 3 obese.[2]

III. Factors affecting obesity in women

Socioeconomic Status (SES)

The causes of obesity can be simplified into two categories: environmental factors and genetic factors; however both of these categories are quite complex and can be broken down further.[7] Genetic factors do play a major role in obesity; however environmental factors are believed to contribute more to the rapid increase in obesity rates throughout the past forty years.[7] Environmental factors include socioeconomic status, diet quality, access to healthy foods, food prices, and food insecurity.[7] Other factors contributing to higher rates of obesity in the poor are growths in fast food chains, which serve energy-dense foods at low prices giving individuals maximum calories for less money.[33] In addition, advances in technology have made workplaces more sedentary, resulting in less energy expenditure.[33]

Research suggests that higher rates of obesity are related to lower SES, especially in women.[11, 12, 16, 17, 19] Socioeconomic status is defined by several factors including

income level, education completed, and occupation.[12] Related to education, research shows that in 2000, 26% of high school dropouts, 22% of high school graduates, and 15% of college graduates were obese.[11] In addition, 23% of women with family incomes above 400% of the poverty line were obese compared to 40% of women in low-income families.[11]

Baum et al. examined the relationship between age and SES on obesity growth.[11] Data were collected from the National Longitudinal Study of Youth (NLSY), and investigated obesity throughout childhood into middle adulthood.[11] The results concluded that obesity is related to childhood SES and increases with age.[11] On average BMI is expected to increase .12kg/m^2 per year; however lower SES are predicted to have a .74kg/m^2 above their high SES counterparts.[11] In addition, for every additional year of education BMI is reduced by .20kg/m^2; these results were more significant for women than men.[11] The results from this study concluded that BMI is predicted to increase each year from childhood into adulthood; however, there are disparities in BMI growth and BMI is indirectly related to SES.[11]

Koebnick et al. examined different populations in a cross-sectional study to determine if certain population groups were more likely to be overweight or obese.[5] California residents ages 20-39 years old were recruited and BMI, demographics, and electronic health records were collected from each participant.[5] The results found that 61.5% of young adults were overweight or obese, and Hispanics were more likely to be overweight and obese.[5] In terms of extreme obesity, women were more likely to be extremely obese and African Americans had the highest rates of extreme obesity when

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compared to other populations.[5] There were no differences found between men and women in obesity prevalence, only prevalence of extreme obesity.[5]

Ljungvall et al. determined that there were similar levels of obesity across all income levels and determine that the obesity epidemic has affected the entire American population.[6] However differences among women's race and ethnicity and obesity, as well as differences between education level do exist.[6] Ljungvall et al. determined that African American women were more likely to obese when compared to their white and Hispanic counterparts.[6] In addition, women who did not graduate high school or with less than 12 years of schooling were more likely to be obese and severely obese.[6]

Diet quality

Low-income populations often do not have the means to afford high quality foods that are low energy density.[17] A review conducted by Darmon et al. stated that low energy dense diets, high in whole grains, lean meats, fish, fresh fruits, and fresh vegetables, were typically consumed by higher SES populations.[17] On the other hand, diets high in high energy dense foods such as refined grains, added sugars, and added fats were often consumed by lower SES populations.[17] Micronutrient intakes were negatively affected in lower SES, resulting in poor diet quality; however, both macronutrient and total energy intakes were not affected by SES.[17] Darmon et al. concluded that diet quality is affected by age, sex, occupation, education level, income levels.[17] In addition, it was concluded that there is a positive relationship between SES and food quality.[17]

Drewnowksi et al. examined obesity and diets with regards to social inequalities and found similar results as previously stated.[16] A direct relationship between obesity and

poverty was established, especially among women.[16] Drewnowski et al. also found that energy-dense foods typically cost less than nutrient dense foods; in fact, in a survey of supermarkets in Seattle, Washington, Drewnowksi et al. established that fresh produce was ten times more expensive than vegetable oil and sugars.[16] In addition, soft drinks cost approximately 30 cents for 240 calories, whereas orange juice from concentrate cost 143 cents for 240 calories.[16] The most cost effective foods included fats, oils, refined grains, beans, and potatoes, and shelf stable foods cost far less than their perishable counterparts at the expensive of added sugars and preservatives.[16]

Mello et al. examined the relationship between low-income, food insecure participants and dietary behaviors within the population.[14] The study recruited 1,874 patients from low-income health clinics, health fairs, and local social services agencies. Participants were required to be over the age of 18, able to read Basic English, could not be pregnant, and were assessed using a Food Habit Questionnaire (FHM).[14] The FHM was scaled with low scores reflecting lower fat intakes.[14] The FHM consisted of 35 questions, on behavioral categories related to fat intake, upon which participants were scored.[14] Participants who scored with having four or less fat behavioral categories were deemed ineligible for the study for following what researchers considered a healthy diet.[14] Fruit and vegetable consumption was measured using a Food Frequency Questionnaire (FFQ); however, participants were not excluded from the study based on fruit and vegetable intake.[14] In addition to the FHM and FFQ, food insecurity, and various other measures were administered via telephone interviews with participants.[14] Low-income food insecure individuals consumed fewer vegetables and fresh fruit, had a higher-fat intake, and consumed more energy-dense foods than food secure individuals.[14]

The authors suspected that energy-dense foods are perceived as having more caloric value with less cost and waste when compared to low energy-dense foods.[14] Nonetheless, the food insecurity questionnaire used had not been validated in low-income individuals and researchers believed the questions were not fully understood by participants.[14]

Cortés et al. examined how nutrition education and assisted supermarket tours affect food-purchasing trends in low-income Latinos.[19] The study was a pilot study in the Boston, Massachusetts area where Spanish-speaking participants were recruited.[19] After recruitment, 20 families partook in the study.[19] Baseline demographics, food purchasing, and consumption were measured; afterwards participating families received three-five home visits for nutrition education and a supermarket tour.[19] Observations during home visits, follow-up questions, and supermarket receipts were analyzed after the study.[19] The results found that participating families significantly decreased both total calories consumed and amount of money spent at the supermarket.[19]

Wolongevicz et al. examined the relationship between diet quality and obesity using data from the Framingham Nutrition Studies.[18] Participant data were collected from the Framingham Offspring and Spouse Study (FOS).[18] Participants diets' were assessed using 3-day food records and the validated global diet index, the Framingham Nutrition Risk Score (FNRS), which assigned each participant a nutritional risk score.[18] The results found women with the highest nutritional risk score were 1.76 times more likely to be overweight or obese than those who scored with a low nutritional risk score.[18] In addition, researchers found that total energy intake, fiber intake, alcohol consumption, and vitamin E intake were all negatively associated with obesity.[18] On the other hand, protein was positively associated with obesity.[18] They concluded that participants with

increased nutritional risk scores had diets lower in energy, carbohydrates, and micronutrients; however, they had increased total fat intake compared to their low nutritional risk score counterparts.[18]

Assess to healthy foods

A number of studies published examine the relationship between obesity and lack of access to nutrient-dense foods. Several factors behind this reasoning are lack of supermarkets in close proximity, lack of access to public transportation, and increased access to fast food and convenience store.[34-36]

Dubowitz et al. examined food environments and used data from the Women's Health Initiative Clinical Trial (WHI).[35] Data collected from the WHI were used to assess whether or not access to supermarkets or small grocery stores and convenience stores played a role in obesity.[35] Women were recruited from both urban and suburban populations, across all race and ethnicities and a total of 60,775 women's data were analyzed.[35] The results found that there was a positive association between obesity and increased availability of convenience stores and fast food restaurants, while there was a negative association between obesity and increased availability of supermarkets.[35] Supermarkets offered a large variety of foods of all qualities, and offered more nutrient-dense foods when compared to the small grocery stores and convenience stores.[35] Lastly, consumption of food from fast food restaurants was associated with increased calorie consumption, increased fat consumption, and higher BMI.[35]

Lovasi et al. viewed public records to determine trends in obesity and physical activity.[36] Characteristics examined were quality and upkeep of residential and

commercial buildings, transportation infrastructure, and available parks and open spaces.[36] The results found that when comparing access to a supermarket verses a small grocery store or convenience store, there was less obesity and hypertension when individuals lived in closer proximity to a supermarket and increased obesity, hypertension, and diabetes when individuals lived in closer proximity to a small grocery store or convenience store.[36] In addition, there was less obesity in areas with "walkable" areas, parks, open spaces, and access for residents to walk to food stores.[36]

Eating Rate

A number of studies have examined patterns in eating rate in various populations. Guss et al. found that eating rate, defined as number of bites per minute, measured using a Universal Eating Monitor (UEM) varied by BMI.[22] Normal BMI (18-24.9) individuals were compared to overweight and obese BMI (25-40) individuals.[22] The results concluded that normal BMI individuals followed what is considered a "biological satiation curve", meaning they started with a normal initial motivation to eat, which is defined as a rapid eating rate.[22] However, as the meal progressed the normal BMI group gradually decreased eating rate as normal inhibition and satiety senses increased.[22] The overweight and obese BMI group showed hypermotivation when compared to the normal BMI group in that the initial eating rate was considerably higher than the normal BMI group at baseline.[22] In addition the overweight and obese BMI group showed disturbed satiety, which was defined as a failure to reduce eating rate in response to inhibitory signals.[22]

Zandian et al. found that overweight and obese individuals followed a linear eating rate pattern.[23] The study recruited 47 normal weight females, with a mean BMI of 22.2 from a college campus.[23] The results found that decelerated eaters initially consumed more than linear eaters, but gradually declined as the meal progressed, and linear eaters had increased overall consumption.[23]

Laessle et al. examined the differences between normal weight and obese individuals in regards to initial eating rate, spoonful size, and deceleration of eating in a laboratory setting.[37] The study recruited 47 normal weight participants with a mean BMI of 22.9, and 49 obese participants with a mean BMI of 32.7 from a college campus.[37] Participants were required to fast for 10 hours prior to arriving in the lab.[37] Upon arrival, participants were given half a ham sandwich, to ensure they had the same stomach fullness.[37] Researchers controlled for stress levels, and established that there were no significant differences between stress levels.[37] Participants ate chocolate pudding, and were recorded using a UEM.[37] The results showed that obese individuals mean initial eating rate was significantly higher than their normal weight counterparts.[37] In addition, obese individuals averaged a larger portion of pudding consumed each bite; however, researchers found no difference in rate of deceleration during the progression of the meal between groups.[37]

Food insecurity

What it is?

The United States Department of Agriculture (USDA) describes a range for food security. Those who report a reduction of quality, variety, or desirability with or without

indications of disruptive eating patterns and reduced food intake are considered food insecure.[38, 39] There are ranges for food insecurity: high food security, moderate food security, low food security, and very low food security.[40] Previously the ranges were food secure, food insecure without hunger, food insecure with moderate hunger, and food insecure with severe hunger.[39, 40] Previous research may categorize food insecurity into the old categories, however this has since changed.[40, 41]

As of 2013, 14.3% of households in the U.S. (17.5 million households) were food insecure.[39] Approximately 5.6% of households (6.8 million households) were considered very low food insecure.[42] This means that roughly 49 million people in the U.S. are food insecure.[42] In Rhode Island 14.4% of households were considered food insecure and out of that 4.6% were very low food insecure.[42]

What factors contribute to Food Insecurity?

Many believe that income is the sole contributing factor to food insecurity; however, other factors do contribute.[43] Income level is a major factor in food insecurity, with lower income populations typically more food insecure than higher income populations.[41, 44] However, other factors such as time constraints can also contribute to food insecurity.[45, 46] Lower education levels and little food knowledge or a reduction in self-efficacy can also play a role.[47-49] Additionally individuals who are either separated or divorced may be at higher risk of food insecurity.[39, 46] Other factors may also include living with disability.[50] Lastly, state taxes, state wages, and cost of living can impact differences in food insecurity state by state.[51]

How can Food Security be assessed?

Food security status is multifaceted, multi-staged, and complex so assessing it relies on several indicators.[40] Food conditions, experiences, and behaviors are all examined in order to determine severity.[40] Various questions in the USDA Food Security Survey Module address situations such as anxiety that households or individuals experience of not have enough food or money, experiencing running out of food, household or individual perceptions of food inadequacy, substituting with lower quality foods, and reduction in food intake to help assess food security status. Additionally the survey uses a three stage approach to help determine severity.[40] The first stage consists of experiencing anxiety that the food budget or food adequacy is inadequate and having to make modifications. The second stage involves a reduction in food intake in adults in the household, and the final stage involves a reduction in food intake in children in the household, with the adult perceiving the situation as dramatic.

The United States Department of Agriculture Economic Research Service (USDA-ERS) provides several surveys to help assess food security status.[40] The U.S. Household Food Security Survey Module (HFSSM) is an 18-item module that assess both adult and child food security status.[40] The U.S. Adult Food Security Survey Module is a 10-item module that assesses only adult food security status.[40] The 6-item short form of the Food Security Survey Module is a quick way to assess food security status.[40]

Why is it important?

Food insecurity is associated with obesity, especially in women, and other health problems such as hypertension, hyperlipidemia, diabetes, nutrient deficiency, depression,

lower nutrient intakes, increased risk of birth defects, and mental health issues.[15, 52-55] Food insecure individuals, especially children, also at risk of deficiencies in iron, vitamin A, B complex vitamins, magnesium, calcium, and zinc.[15, 56, 57]

Emerging evidence suggests a correlation between food insecurity and obesity in women.[13, 44, 58, 59] Adams et al. examined the prevalence of food insecurity in Non-Hispanic White (NHW), African American, and Hispanic women in California. Additionally the study examined the relationship between prevalence of food insecurity and risk of obesity. The study found that risk of obesity and prevalence of food insecurity varied among races.[13] For NHW women, the prevalence of food insecurity increased the risk of obesity.[13] However, the risk of obesity did not increase further as the severity of food insecurity increased.[13] For African American and Hispanic women the prevalence of food insecurity increased the risk of obesity and the risk of obesity increased further with increased severity of food insecurity.[13] Therefore, African American and Hispanic women who were food insecure without hunger were 1.5 times more at risk for obesity and those who were food insecure with hunger were 2.8 times more at risk for obesity.[13]

Olson et al. examined the relationship between food insecurity in women of childbearing age (ages 20-39) and BMI.[60] Participants were separated into four groups: food secure (47%), household food insecure (25%), individual food insecure (17%), and households with child hunger (10%).[60] Researchers determined that the BMI's for participants who were living in "household insecure" homes, or the least severe food insecure had the highest BMI and BMIs were significantly higher than women in food secure households.[60] There were no significant differences in the more severe food insecure households (individual food insecure and households with child hunger),

concluding that food insecurity was associated with increased BMI, but as the severity of food insecurity increases, BMI did not increase further.[60]

Townsend et al. examined the relationship between food insecurity and BMI in over 9000 men and women.[44] The results found a relationship between food insecurity and BMI in women, but mot men. The prevalence of obesity increased with the prevalence of food insecurity in women.[44] The study found that 34% of the food secure were overweight, 41% of the mildly food insecure were overweight, 52% of the moderately food insecure were overweight, and 20% of the severely food insecure were oveweight.[44] Townsend et al. concluded that there was a significant relationship between obesity and food insecurity, with moderate food insecurity having the highest prevalence of obesity.[44]

Kaiser et al. also examined the relationship between prevalence of food insecurity and prevalence of obesity.[61] Low-income Latino women were recruited and examined for food insecurity in California.[61] Participants used the USDA Household Food Security Survey Module to assess food security status. The results showed that of participants with a normal weight BMI (BMI <25 kg/m^2): 47.7% were food secure, 34.6% were food insecure with no hunger, 15.4% were food insecure with moderate hunger, and 2.3% were food insecure with severe hunger.[61] Of the participants with an overweight BMI (BMI 25-29.9 kg/m^2): 37.3% were food secure, 45.5% were food insecure with no hunger, 15.0% were food insecure with moderate hunger, and 2.3% were food insecure with severe hunger.[61] Of the participants with an obese BMI (BMI >30 kg/m^2): 38.3% were food secure, 41.2% were food insecure with no hunger, 15.3% were food insecure with moderate hunger, and 5.3% were food insecure with severe hunger.[61] Kaiser et al.

concluded that food insecurity was significantly associated with obesity in Latino women.[61] Additionally as food insecurity severity increased, BMI did not and those in the food insecure with no hunger, or the least food insecure status, had the highest rates of obesity.[61]

Numerous research supports the relationship between obesity and food insecurity.[5, 13, 41, 44, 52, 56, 58, 60-63] However, most research suggests a bell shaped curve, populations with moderate or low food insecurity have the highest prevalence of obesity, whereas populations with very low food security do not have as high of an obesity prevalence.[13, 44, 60, 61] Franklin et al. concluded that food insecurity and obesity follow a U-shaped pattern, stressing that majority of obesity is found in the middle of the food insecurity range.[64]

IV. Intervention and prevention of obesity

As the obesity epidemic in the U.S continues, prevention of obesity become vital. Research shows that low-income populations are at a greater risk of obesity and obesity in low-income populations is associated with prevalence of food insecurity. Therefore, low-income populations are in need of programs that help alleviate food insecurity, which will hopefully allow low-income individuals make healthier decisions and have access to quality foods. The goal of SNAP is to supplement low-income populations with the means to help low-income populations improve dietary intake.[65] Programs such as SNAP-Ed and EFNEP aim to help low-income populations increase nutrition knowledge.[65] An emerging area of research involved with reducing the prevalence of obesity in food secure populations is eating rate interventions.[24-26, 66, 67] Research shows

that reductions in eating rate can effectively lower BMI; however no research exists involving food insecure populations and eating rate interventions.[22, 23, 26]

Supplemental Nutrition Assistance Program (SNAP)

The largest federally funded nutrition program in the U.S is the Supplemental Nutrition Assistance Program (SNAP).[65, 68-70] In 2014 $74 billion was allocated to SNAP to help lessen the burden of hunger here in the U.S.[71] In 2014 in the U.S. 46 million people (22 million households) participated in SNAP.[71] The average person received $125/month in SNAP benefits, and the average household received $256/month in SNAP benefits.[71] In Rhode Island, an average of 178 thousand people participated each month in SNAP during 2014.[71]

Mabli et al. examined the effectiveness of SNAP in improving food security status in both cross-over and longitudinal samples.[72] The cross-sectional design compared newly enrolled SNAP households to households who had been enrolled for around 6 months.[72] In the longitudinal design those newly enrolled SNAP households were followed up at 6 months.[72] The results of the cross-over design found that 65.5% of the newly enrolled SNAP households were food insecure.[72] Out of the group of households who had already been enrolled in SNAP for 6 months, only 58.7% were food insecure.[72] In the longitudinal design, the results found that out the 65.5% of newly enrolled SNAP households that scored food insecure, only 52.8% of remained food insecure at 6 months.[72]

Ratcliffe et al. found that chances of being food insecure improved by around 30% if households participated in SNAP.[73] Additionally, other research supports the

notion that SNAP is an effective tool in providing adequate means to improve dietary intake to low-income populations and helps alleviate food insecurity.[72-76]

The Expanded Food and Nutrition Program (EFNEP) is another federally funded program.[77] The goal of EFNEP is more education based, and focuses on assisting low-income individuals in gaining the knowledge, skills, and behaviors to lead a nutritionally sound life.[77] Auld et al. examined the effectiveness of EFNEP in improving diet quality in low-income populations.[77] The results found that 95% of participants made improvements in at least one food group and 90% improved a food-related behavior.[77]

Eating rate interventions

Although eating rate intervention literature is limited, it is an emerging area of research. According to the American College of Sports Medicine, self-management of meals such as eating rate are more effective in weight loss than those who do not self-monitor.[78]

Martin et al. examined whether or not slowing eating rate was associated with reduced food intake in overweight males and females.[79] Participants consumed a variety of meals consisting of various macronutrient contents, and eating rate and meal intakes were measured using a Universal Eating Monitor (UEM).[79] The results showed that when eating rate was slower, males consumed less food; however, when females reduced eating rate food intake remained the same and was not significantly different.[79] Therefore, Martin et al. concluded that decreased eating rate is a successful tool in reducing energy intake in men, but not in women.[79]

Spiegel et al. examined the results of lengthening meals on weight loss in 10 obese women.[80] Participants partook in a 41-week weight control program, in which participants lengthened meal time during weeks 1-28.[80] The results found that with increased meal length there was greater weight loss; however once meal length returned to baseline during weeks 29-41 meal length was no longer associated with weight loss.[80] Spiegel et al. concluded that slowing eating rate was associated with weight loss in obese women.[80]

Andrade et al. examined whether or not decreasing eating rate results in decreased energy intake.[24] Participants were recruited from a college campus, and were required to be healthy females.[24] Thirty females partook in the study, and were analyzed at two different test visits involving slowing and increasing eating rate during a test meal.[24] The results showed that there were significant decreases in energy intake during the slower eating rates and increases in meal satiation; therefore, slowing eating rate effectively reduced energy intake in women and may be an effective tool in weight management.[24]

Significance of project

As stated above, obesity is a major issue plaguing the U.S, and there are many factors affecting obesity. In addition, food-insecurity is a prevalent issue in the U.S as well. Research establishes that there is an association between obesity and food-insecurity, especially in food insecure women.[13, 15, 44, 52, 56, 60-64] One method for reducing obesity maybe is eating rate interventions, although much more work is needed. While short term studies have been proven to be successful in decreasing energy-intake, long term studies have not been completed.[24, 80] Past research conducted at the University of

Rhode Island involving eating was successful when the intervention took place on campus.[24] Students on campus typically are financially secure and are not food insecure. However, when the eating rate intervention was moved to Providence, Rhode Island and the study population was low-income, the intervention was not successful.[25] Researchers hypothesized that because the study population was low-income, they may have been food insecure, which caused the intervention to fail.[25] Although disturbances in eating rate regulation may be related to food insecurity, there are no studies examining the relationship between eating rate and food insecurity. Therefore, the purpose of this research is to examine eating rate in food insecure populations. If there are differences in eating rate between food secure populations and food insecure populations, eating rate interventions may be tailored to food insecure populations with the hopes to reduce obesity in that population.

V. Conclusion

In conclusion, as the obesity epidemic in the U.S continues new strategies are needed to help fight it. Unfortunately, many of obese Americans are also low-income and food insecure.[13, 16, 41, 44, 60] Therefore, expensive weight loss programs are not possible for many Americans who are suffering from obesity and the many obesity-related health issues that accompany it. Inexpensive programs are needed in order to reach across all of the population and income groups. One way to help solve this is through simple eating rate interventions. In addition, past eating rate interventions have proved successful in slowing eating rate and reducing energy intake.[24, 80]

In fact, research shows that overweight and obese women appear to have deficits with eating rate regulation.[22, 23] They exhibit an increased eating rate at baseline and either continue in a linear pattern throughout the meal or at an increased eating rate, resulting in higher total intake compared to the normal pattern of decreasing eating rate as the meal progresses. [22, 23] However, there is no research examining eating rate in food insecure populations.

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Consent Form

You have been invited to take part in a research project described below. The researcher will explain the project to you in detail. You should feel free to ask questions. If you have more questions later, Geoffrey Greene, the person mainly responsible for this study, will discuss them with you. You can contact him at the Department of Nutrition and Food Science, 112 Ranger Hall, Kingston, RI. You must be a woman who is eligible for the Expanded Food and Nutrition Education Program (EFNEP) or Supplemental Nutrition Assistance Program-Education (SNAP-Ed), be moderately overweight based on measurement of your height and weight, be 18 -48 years old and must be fasting (no food or drinks except water) since midnight before the study and can't be allergic to eggs or milk to be in this research project or have health problems that might interfere with participation in this study.

Description of the project*:*
You have been asked to participate in a research study looking at appetite changes following a test meal (brunch).

What will be done*:*
The study will involve one visit of about one hour and fifteen minutes. At that visit, you will have the study explained and agree to participate, be weighed and measured and, if found eligible will be given a frittata for brunch and will complete questionnaires before and after the meal. You must remain in the room for one hour after starting the meal to complete questionnaires about your appetite at 20, 40, and 60 minutes after you start eating. A video recording of the test meal will be made to ensure consistency and quality control in instructions. You must be fasting (no food or drinks except water) since midnight before the meal and cannot smoke or use tobacco or engage in exercise after midnight. At the visit:
- Your height, weight, and waist circumference measurements will be taken.
- You will be asked to rate your appetite on a questionnaire.
- You will eat brunch and can consume as much of the meal as you would like so that you feel comfortably full.
- You will be asked to rate your appetite after finishing your meal, then 20, 40 and 60 minutes after starting the meal. You will also be asked to rate how the meal tasted.
- While you are waiting to rate your appetite after the meal, you will complete additional questionnaires about your diet, physical activity, and personal and family health history.
- You will receive a $20 gift card for a local supermarket as well as a free packet of nutrition information.

Risks or discomfort:
There are no known risks for the study.

Benefits of this study*:*
This study will help to us understand more about the relationship between food and appetite in women who are eligible for the Expanded Food and Nutrition Education program to help us develop better programs in the future. There are no direct benefits to you.

Confidentiality*:*
Your participation in this study is confidential. All of your information will be coded by an identification number that cannot be traced to you. None of the results of this study including the video will identify you by name. Data access will be limited to study investigators. Data will be stored in locked file cabinets and password-protected computers at the Nutrition Department of the University of Rhode Island.

Decision to quit at any time*:*
The decision to take part in this study is up to you. You do not have to participate. If you decide to take part in the study, you may quit at any time. Whatever you decide will in no way penalize you. If you wish to quit, you simply inform research assistant of your decision. However, you must complete the study to receive your incentive.

Rights and Complaints*:*
This study is part of research being conducted by the University of Rhode Island. If you have any questions or if you are not satisfied with the way this study is performed, you may discuss your complaints with Dr. Geoffrey Greene at (401) 874-4028 or Dr. Kathleen Melanson (401) 874-4477, anonymously, if you choose. In addition, if you have questions about your rights as a research participant, you may contact the office of the Office of Research Integrity at 70 Lower College Road, University of Rhode Island, Kingston, Rhode Island, telephone: (401) 874-4328.

You have read the Consent Form. Your questions have been answered. Your signature on this form means that you understand the information and you agree to participate in this study.

_____   _____
Signature of Participant   Signature of Researcher

_____   _____
Printed Name   Printed Name

_____   _____
Date   Date

A video recording of the meal will be made to ensure consistency and quality control in instructions. Your signature below on this form means you agree to this videotaping.

_____   _____

Signature of Participant   Signature of Researcher

_____   _____
Printed Name   Printed Name

_____   _____
Date   Date

Please sign both consent forms, keeping one for yourself.

APPENDIX C

Study Test Meal Day Protocol

Preparations before subject's arrival:

Research Assistants (RA) should prepare folders with all questionnaires labeled with the subject number and two copies of the consent forms. RAs should arrive at the location one hour before the first appointment. This time will be spent cleaning the room and all surfaces (using antibacterial all-purpose cleaner) that will be used during the meal and meal preparation.

1. Turn on the scale at least 20 min prior to calibration and turn on computer to be used to video the meal. Make sure the camera is properly positioned to record only the meal and the face of the participant (or anyone else in the room) will not be recorded. Prepare the video with subject number, date, time and location.

2. 20 min before subject's arrival:

   a. Take the food and water out of the cooler (the scale is sensitive to temperature)

   b. Calibrate the scale

3. 10 min before subject's arrival:

   a. Record the weight of the food on data collection sheet, press O/T, and measure170g of food (record the exact value on data collection sheet)

   b. Press O/T. Fill 1 cup with water to the top line. Put it on the scale and record the exact value of the cup filled with water on data collection sheet.

When subject arrives:

1. Review procedures and verify age, health, and compliance with test conditions (no food or beverage except water since midnight, no tobacco use or exercise). Have subject void bladder and perform anthropometric measurements. Record on data collection sheet. Calculate BMI and determine eligibility. If not eligible thank subject, provide with nutrition education material and dismiss her. If eligible continue.

2. Go over informed consent document with subject. Make sure that investigator and subject sign **BOTH** forms.

3. Heat brunch for 5 min.

4. Have the subject complete VAS satiety (t=0) sheet by marking a line (not a circle) at the appropriate point on VAS sheet. Be sure to record the clock time on VAS sheet.

5. While subject is completing VAS sheet, take the brunch out of the microwave. Make sure the plate is warm. Turn on video recorder.

6. Put the food in front of the subject and instruct them to eat and drink as much as she wants to the point of comfortable satiation (not too full, but no longer hungry). Tell the subject that she will be required to stay in the lab for 1 hr after the first bite.

When meal begins:

1. Record the time when the subject takes the first bite. Start the timer at this same point. Record the clock time on data collection sheet.

2. Monitor the subject but do not be obvious that this is what you are doing.

Upon meal completion:

1. Record the time shown on the timer on data collection sheet and turn off video.

2. Administer VAS (satiety, palatability) sheets for meal completion.

3. Remove the plate and cup and put them on opposite sides of room. If there are more than one volunteer being tested, make sure volunteers are separated and away from leftover plates. If another room is available move the first volunteer to the second room to complete remaining questionnaires and VAS.

4. Inform subject of the clock time that she needs to remain in the room and that she will be asked to answer questionnaires while waiting.

5. Calculate the 20 min post meal completion time point and record on VAS sheet. Set timer as a reminder.

6. Administer 20 min post meal initiation VAS satiety sheet.

7. Administer 45 min post meal initiation VAS satiety sheet

8. Administer 60 min post meal initiation VAS satiety sheet.

9. During this time, ask items from the additional questionnaires and record answers.

      a. US Adult Food Security Survey Module (core items)

      b. Weight Related Eating Questionnaire

      c. IPAQ

10. Subject receives 20 dollar gift card and signs the payment verification and receipt this must be cosigned by researcher. Subject receives nutrition education materials.

After the subject leaves the lab:

1. Measure the food and water leftovers and record the exact weights on data collection sheet.

2. Record anything that was unusual on data collection sheet (Ex. subject didn't like the meal, cleaned the plate, was feeling sick, didn't follow instructions)

3. File subject's folder, back up video on a memory stick, and clean-up.

APPENDIX D

Screening Interview

ID Number:_____   Date:_____

1. DEMOGRAPHICS

Birthday_____

Do you receive or have been eligible for SNAP or EFNEP benefits. Or have an EBT card?

	YES	NO

Ethnicity

Hispanic	YES	NO
Non-Hispanic	YES	NO

Race

American or Alaskan Native	YES	NO
Asian	YES	NO
African American or Black	YES	NO
Native Hawaiian or Pacific	YES	NO
White	YES	NO
Other	YES	NO

Please specify other _____

Highest grade level completed

Some high school

Completed high school

Some college/technical school

Completed College/technical School

Graduate school

Number of family members in household _____

Number of dependent children in household _____

2. GENERAL MEDICAL HISTORY

Do you have any medical problems?   YES   NO
Please explain
_____

Do you take any prescribed or over-the-counter medication?   YES   NO
Please specify
_____

3. ANTHROPOMETRICS

Height: _____   Weight:_____   BMI:_____

4. DIETARY AND WEIGHT HISTORY

When was the last time you ate or drank?
_____

Do you have any problems eating frittatas (eggs, milk, cheese, and vegetables)?
                                              YES   NO

Would you describe yourself as a fast, slow, or medium-paced eater?
_____

Have you smoked or used tobacco since midnight?   YES NO

Have you exercised this morning   YES NO

Please s_____
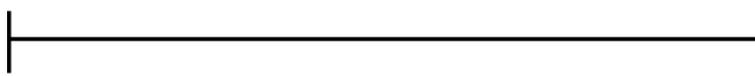
Eligible for study   YES NO

Visual Analog Scales for Appetite

Energy Balance Lab Satiety Rating Scale

Subject #/ ID	Condition ID	Visit #	Date

Clock Time:_____(meal initiation)

1.   How hungry are you right now?

```
├─────────────────────────────────────────┤
```

Not at all   **Extremely**

2.   How satisfied (satiated) are you right now?

```
├─────────────────────────────────────────┤
```

Not at all   **Extremely**

3.   How much could you eat right now?

```
├─────────────────────────────────────────┤
```

Nothing   **Vast Quantities**

4.   How thirsty are you right now?

```
├─────────────────────────────────────────┤
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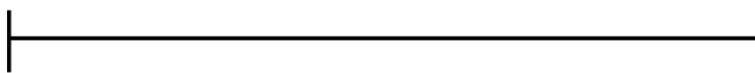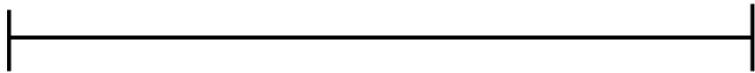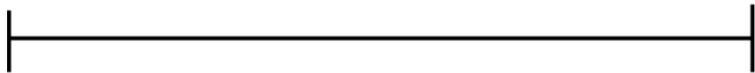
Not at all   **Extremely**

Subject #/ ID	Condition ID	Visit #	Date

Clock Time:_____(meal completion)

1.   How hungry are you right now?

|—————————————————————————————|

Not at all   **Extremely**

2.   How satisfied (satiated) are you right now?

|—————————————————————————————|

Not at all   **Extremely**

3.   How much could you eat right now?

|—————————————————————————————|

Nothing   **Vast Quantities**

4.   How thirsty are you right now?

|—————————————————————————————|

Not at all   **Extremely**

Subject #/ ID	Condition ID	Visit #	Date

Clock Time:_____(20 min. after meal initiation)

1.   How hungry are you right now?

|—————————————————————————|

Not at all   **Extremely**

2.   How satisfied (satiated) are you right now?

|—————————————————————————|

Not at all

              Extremely

3.   How much could you eat right now?

|—————————————————————————|

Nothing   **Vast Quantities**

4.   How thirsty are you right now?

|—————————————————————————|

Not at all   **Extremely**

Subject #/ ID	Condition ID	Visit #	Date

Clock Time:_____(20 min. after meal completion)

1.   How hungry are you right now?
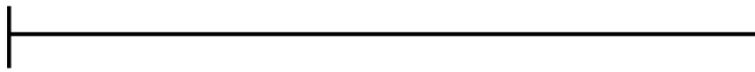
├───┤

Not at all   **Extremely**

2.   How satisfied (satiated) are you right now?

├───┤

Not at all   **Extremely**

3.   How much could you eat right now?

├───┤

Nothing   **Vast Quantities**

4.   How thirsty are you right now?

├───┤
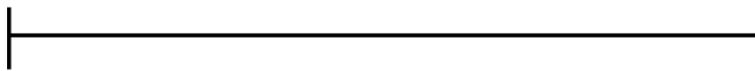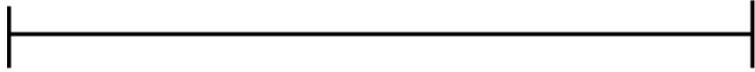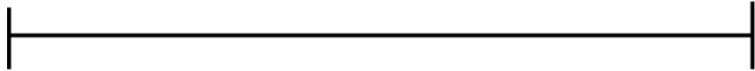
Not at all   **Extremely**

Subject #/ ID	Condition ID	Visit #	Date

Clock Time:_____(40 min. after meal initiation)
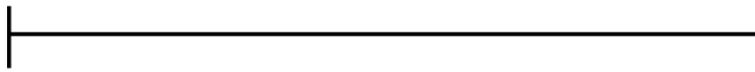
1.   How hungry are you right now?

|————————————————————————————|

Not at all   **Extremely**

2.   How satisfied (satiated) are you right now?

|————————————————————————————|

Not at all   **Extremely**

3.   How much could you eat right now?

|————————————————————————————|

Nothing   **Vast Quantities**

4.   How thirsty are you right now?

|————————————————————————————|
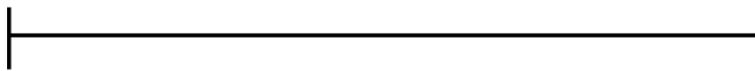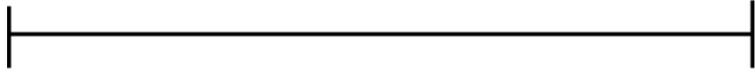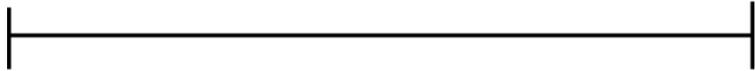
Not at all   **Extremely**

Subject #/ ID	Condition ID	Visit #	Date

Clock Time:_____(60 min. after meal initiation)

1.   How hungry are you right now?

├─────────────────────────────────┤

Not at all   **Extremely**

2.   How satisfied (satiated) are you right now?

├─────────────────────────────────┤

Not at all   **Extremely**

3.   How much could you eat right now?

├─────────────────────────────────┤

Nothing   **Vast Quantities**

4.   How thirsty are you right now?

├─────────────────────────────────┤

Not at all   **Extremely**

Visual Analog Scale for Palatability

Energy Balance Lab Meal Palatability Scale
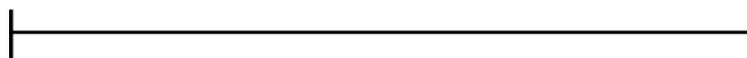
Subject #/ ID	Condition ID	Visit #	Date

1.   How pleasant did you find this meal to be?

|—————————————————————————|
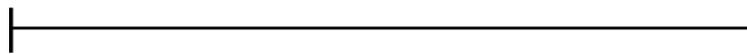
Not at all   **Extremely**

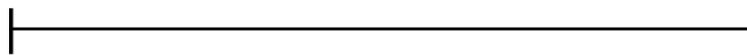2.   How salty did you find this meal to be?

|—————————————————————————|

Not at all   **Extremely**

3.   How much did you like the texture and
            consistency of this meal?

|—————————————————————————|

Not at all   **Extremely**

4.   How bitter did you find this meal to be?

|—————————————————————————|

Not at all   **Extremely**

5.   How tasty did you find this meal to be?

|—————————————————————————|
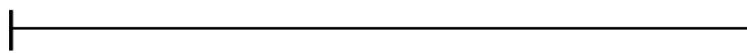
Not at all   **Extremely**

APPENDIX G

Modified Weight Related Eating Questionnaire (WREQ)

1. **I tend to eat more when I am anxious, worried, or tense.**

___1= Not at all; ___2=Slightly; ___3=More or Less;___4=Pretty Well;___5=Completely

2. **When I feel lonely I console myself by eating.**

___1= Not at all; ___2=Slightly; ___3=More or Less;___4=Pretty Well;___5=Completely

3. **I tend to eat more food than usual when I have more available places that serve or sell food.**

___1= Not at all; ___2=Slightly; ___3=More or Less;___4=Pretty Well;___5=Completely

4. **I tend to eat when I am disappointed or feel let down.**

___1= Not at all; ___2=Slightly; ___3=More or Less;___4=Pretty Well;___5=Completely

5. **If I see others eating, I have a strong desire to eat too.**

___1= Not at all; ___2=Slightly; ___3=More or Less;___4=Pretty Well;___5=Completely

6. **Some foods taste so good I eat more even when I am no longer hungry.**

___1= Not at all; ___2=Slightly; ___3=More or Less;___4=Pretty Well;___5=Completely

7. **I often eat so quickly I don't notice I'm full until I've eaten too much.**

___1= Not at all; ___2=Slightly; ___3=More or Less;___4=Pretty Well;___5=Completely

8. When I am offered delicious food, it is hard to resist eating it even if I've just eaten.

___1= Not at all; ___2=Slightly; ___3=More or Less; ___4=Pretty Well; ___5=Completely

9. I eat more when I'm having relationship problems.

___1= Not at all; ___2=Slightly; ___3=More or Less; ___4=Pretty Well; ___5=Completely

10. When I'm under a lot of stress, I eat more than I usually do.

___1= Not at all; ___2=Slightly; ___3=More or Less; ___4=Pretty Well; ___5=Completely

APPENDIX H

International Physical Activity Questionnaire (IPAQ)

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the **last 7 days**. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Think about all the **vigorous** activities that you did in the **last 7 days**. **Vigorous** physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think *only* about those physical activities that you did for at least 10 minutes at a time.

1.   During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, digging, aerobics, or fast bicycling?

_____**days per week**

☐   No vigorous physical activities   ➡   *Skip to question 3*

2.   How much time did you usually spend doing **vigorous** physical activities on one of those days?

_____**hours per day**

_____**minutes per day**

☐   Don't know/Not sure

Think about all the **moderate** activities that you did in the **last 7 days**. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

3.   During the **last 7 days**, on how many days did you do **moderate** physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.

_____**days per week**

☐   No moderate physical activities   ➡   *Skip to question 5*

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4. How much time did you usually spend doing **moderate** physical activities on one of those days?

_____**hours per day**

_____**minutes per day**

☐   Don't know/Not sure

Think about the time you spent **walking** in the **last 7 days**. This includes at work and at home, walking to travel from place to place, and any other walking that you might do solely for recreation, sport, exercise, or leisure.

5. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time?

_____**days per week**

☐   No walking ➞ *Skip to question 7*

6. How much time did you usually spend **walking** on one of those days?

_____**hours per day**

_____**minutes per day**

☐   Don't know/Not sure

The last question is about the time you spent **sitting** on weekdays during the **last 7 days**. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.

7. During the **last 7 days**, how much time did you spend **sitting** on a **week day**?

_____**hours per day**

_____**minutes per day**

☐   Don't know/Not sure

This is the end of the questionnaire, thank you for participatin

USDA Adult Food Security Survey Module

UNITED STATES DEPARTMENT OF AGRICULTURE FOOD INSECURITY QUESTIONNAIRE

Optional USDA Food Sufficiency Question/Screener: Question HH1 (**This question is optional. It is not used to calculate the Adult Food Security Scale. It may be used in conjunction with income as a preliminary screener to reduce respondent burden for high income households).**

HH1. [IF ONE PERSON IN HOUSEHOLD, USE "I" IN PARENTHETICALS, OTHERWISE, USE "WE."]

> Which of these statements best describes the food eaten in your household in the last 12 months: —enough of the kinds of food (I/we) want to eat; —enough, but not always the <u>kinds</u> of food (I/we) want; —sometimes <u>not enough</u> to eat; or, —<u>often</u> not enough to eat?

> [1] Enough of the kinds of food we want to eat
> [2] Enough but not always the <u>kinds</u> of food we want
> [3] Sometimes <u>not enough</u> to eat
> [4] <u>Often</u> not enough to eat
> [ ] DK or Refused

Household Stage 1: Questions HH2-HH4 (**asked of all households; begin scale items).**

[IF SINGLE ADULT IN HOUSEHOLD, USE "I," "MY," AND "YOU" IN PARENTHETICALS; OTHERWISE, USE "WE," "OUR," AND "YOUR HOUSEHOLD."]

HH2. Now I'm going to read you several statements that people have made about their food situation.   For these statements, please tell me whether the statement was <u>often</u> true, <u>sometimes</u> true, or <u>never</u> true for (you/your household) in the last 12 months—that is, since last (name of current month).

> The first statement is "(I/We) worried whether (my/our) food would run out before (I/we) got money to buy more." Was that <u>often</u> true, <u>sometimes</u> true, or <u>never</u> true for (you/your household) in the last 12 months?

> [ ] Often true
> [ ] Sometimes true
> [ ] Never true
> [ ] DK or Refused

HH3. "The food that (I/we) bought just didn't last, and (I/we) didn't have money to get more." Was that <u>often</u>, <u>sometimes</u>, or <u>never</u> true for (you/your household) in the last 12 months?

> [ ] Often true
> [ ] Sometimes true
> [ ] Never true
> [ ] DK or Refused

HH4. "(I/we) couldn't afford to eat balanced meals." Was that <u>often</u>, <u>sometimes</u>, or <u>never</u> true for (you/your household) in the last 12 months?

> [ ] Often true
> [ ] Sometimes true
> [ ] Never true
> [ ] DK or Refused

Screener for Stage 2 Adult-Referenced Questions: If affirmative response (i.e., "often true" or "sometimes true") to one or more of Questions HH2-HH4, OR, response [3] or [4] to question HH1 (if administered), then continue to *Adult Stage 2;* otherwise skip to *End of Adult Food Security Module.*

NOTE: In a sample similar to that of the general U.S. population, about 20 percent of households (45 percent of households with incomes less than 185 percent of poverty line) will pass this screen and continue to Adult Stage 2.

Adult Stage 2: Questions AD1-AD4 (asked of households passing the screener for Stage 2 adult-referenced questions).

AD1. In the last 12 months, since last (name of current month), did (you/you or other adults in your household) ever cut the size of your meals or skip meals because there wasn't enough money for food?

> [ ] Yes
> [ ] No (Skip AD1a)
> [ ] DK (Skip AD1a)

AD1a. [IF YES ABOVE, ASK] How often did this happen—almost every month, some months but not every month, or in only 1 or 2 months?

> [ ] Almost every month
> [ ] Some months but not every month
> [ ] Only 1 or 2 months
> [ ] DK

AD2. In the last 12 months, did you ever eat less than you felt you should because there wasn't enough money for food?

       [ ] Yes
       [ ] No
       [ ] DK

AD3. In the last 12 months, were you every hungry but didn't eat because there wasn't enough money for food?

       [ ] Yes
       [ ] No
       [ ] DK

AD4. In the last 12 months, did you lose weight because there wasn't enough money for food?

       [ ] Yes
       [ ] No
       [ ] DK

Screener for Stage 3 Adult-Referenced Questions: If affirmative response to one or more of questions AD1 through AD4, then continue to *Adult Stage 3;* otherwise, skip to *End of Adult Food Security Module.*

NOTE: In a sample similar to that of the general U.S. population, about 8 percent of households (20 percent of households with incomes less than 185 percent of poverty line) will pass this screen and continue to Adult Stage 3.

Adult Stage 3: Questions AD5-AD5a (asked of households passing screener for Stage 3 adult-referenced questions).

AD5. In the last 12 months, did (you/you or other adults in your household) ever not eat for a whole day because there wasn't enough money for food?

       [ ] Yes
       [ ] No (Skip AD5a)
       [ ] DK (Skip AD5a)

AD5a. [IF YES ABOVE, ASK] How often did this happen—almost every month, some months but not every month, or in only 1 or 2 months?

       [ ] Almost every month
       [ ] Some months but not every month
       [ ] Only 1 or 2 months
       [ ] DK

APPENDIX J

USDA Adult Food Security Survey Module Coding Sheet

END OF ADULT FOOD SECURITY MODULE
User Notes

(1) Coding Responses and Assessing Household Adult Food Security Status:
Following is a brief overview of how to code responses and assess household food
security status based on the Adult Food Security Scale. For detailed information on
these procedures, refer to the *Guide to Measuring Household Food Security, Revised
2000,* available through the ERS Food Security in the United States Briefing Room.

Responses of "yes," "often," "sometimes," "almost every month," and "some months
but not every month" are coded as affirmative. The sum of affirmative responses to the
10 questions in the Adult Food Security Scale is the household's raw score on the scale.

Food security status is assigned as follows:
- Raw score zero—High food security among adults
- Raw score 1-2—Marginal food security among adults
- Raw score 3-5—Low food security among adults
- Raw score 6-10—Very low food security among adults

For some reporting purposes, the food security status of the first two categories in
combination is described as food secure and the latter two as food insecure.

(2) Response Options: For interviewer-administered surveys, DK ("don't know") and
"Refused" are blind responses—that is, they are not presented as response options but
marked if volunteered. For self-administered surveys, "don't know" is presented as a
response option.

(3) Screening: The two levels of screening for adult-referenced questions are provided
for surveys in which it is considered important to reduce respondent burden. In pilot
surveys intended to validate the module in a new cultural, linguistic, or survey context,
screening should be avoided if possible and all questions should be administered to all
respondents.

To further reduce burden for higher income respondents, a preliminary screener may be
constructed using question HH1 along with a household income measure. Households
with income above twice the poverty threshold AND who respond <1> to question
HH1 may be skipped to the end of the module and classified as food secure. Using this
preliminary screener reduces total burden in a survey with many higher income
households, and the cost, in terms of accuracy in identifying food-insecure households,
is not great. However, research has shown that a small proportion of the higher income
households screened out by this procedure will register food insecurity if administered

the full module. If question HH1 is not needed for research purposes, a preferred strategy is to omit HH1 and administer Adult Stage 1 of the module to all households.

(4) 30-Day Reference Period: The questionnaire items may be modified to a 30-day reference period by changing the "last 12-month" references to "last 30 days." In this case, items AD1a and AD5a must be changed to read as follows:
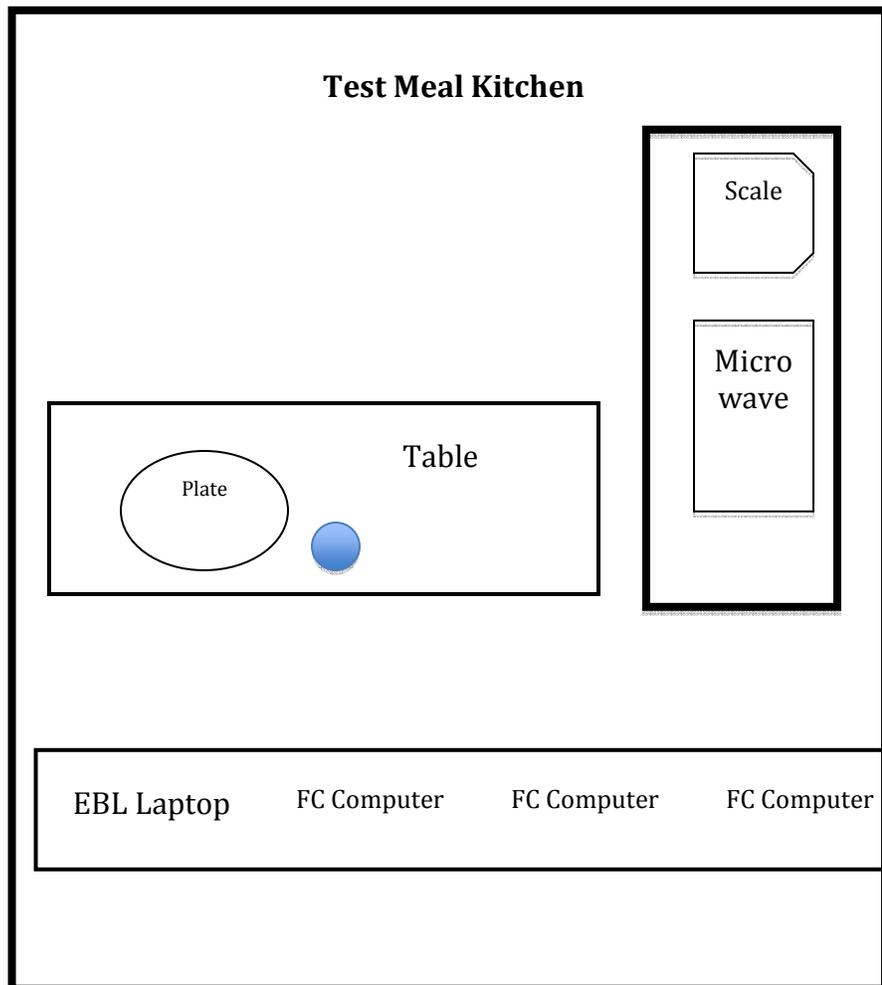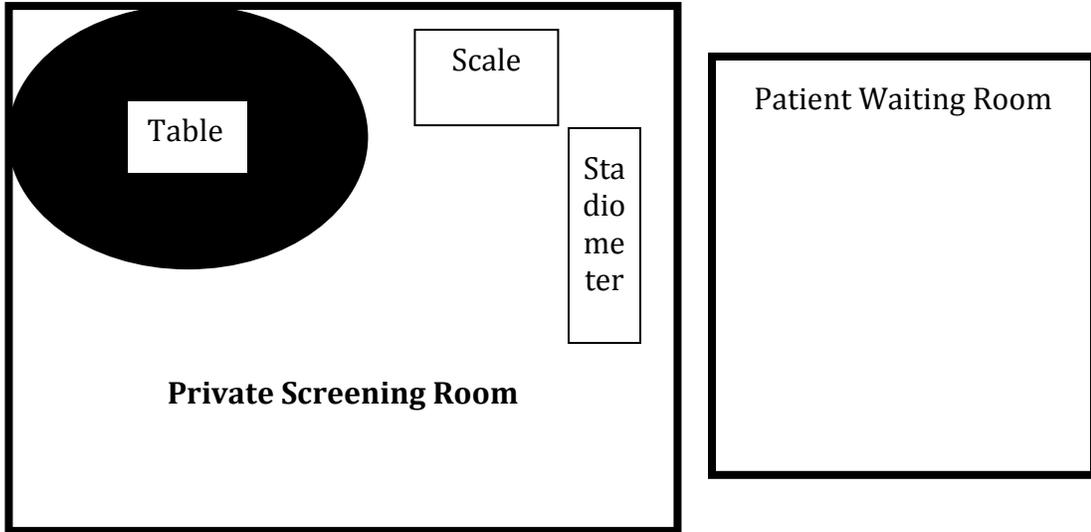
AD1a/AD5a. [IF YES ABOVE, ASK] In the last 30 days, how many days did this happen?

       _____ days

    [ ] DK

Responses of 3 days or more are coded as "affirmative" responses.

Free Clinic Diagram

Scale

Table

Sta
dio
me
ter

Private Screening Room

Patient Waiting Room

Test Meal Kitchen

Scale

Micro
wave

Table

Plate

EBL Laptop   FC Computer   FC Computer   FC Computer

East Bay Diagram

Kitchen Pantry

Employee Only Section

Microwave

Scale

Wall

EBL
Laptop

Scale

Stadiometer