BASIC SCIENCE RESEARCH

The Fast Food and Obesity Link: Consumption Patterns and Severity of Obesity

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Abstract

Background Rates of extreme forms of obesity are rapidly rising, as is the use of bariatric surgery for its treatment. The aim of the present study was to examine selected behavioral factors associated with severity of obesity among preoperative bariatric surgery patients in the San Antonio area, focusing specifically on the effects of fast food consumption.

Methods We used ordered logistic regression to model behavioral and attitudinal effects on obesity outcomes among 270 patients. These outcomes were based on the severity of obesity and were measured on the basis of body mass index.

Results Our results indicated that, among the behavioral factors, fast food consumption exerted the largest influence on higher levels of obesity. These remained after controlling for several social and demographic characteristics.

Conclusions Our findings suggest that higher rates of fast food consumption are connected to the increasing rates of severe obesity. Given that morbid and super morbid obesity rates are growing at a more advanced pace than moderate obesity, it is necessary to explore the behavioral characteristics associated with these trends.

Keywords Severe/extreme obesity · Bariatric surgery · Fast food consumption

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Introduction

Obesity has become one of the foremost public health concerns in the USA in recent decades. According to the Centers for Disease Control, more than one third of US adults were classified as obese, with a body mass index (BMI) of 30.0 kg/m^2 or more, in 2009 [1]. Rates of obesity have increased among all sociodemographic groups [2, 3], and the most marked increases have been in the more severe designations of obesity, i.e., morbid obesity (BMI, 40.0–49.9 kg/m^2) and super morbid obesity (BMI, 50.0+kg/m^2) [4, 5]. Combined, this group (BMI≥40.0 kg/m^2) accounts for approximately 5.7% of the population [2]. These individuals are at least 100 lb overweight and experience serious health problems at much higher rates than normal weight individuals. Their numbers are on the rise and are growing at a much faster pace than those in the moderate obese classification. In fact, between 2000 and 2005, the rates of morbid obesity and super morbid obesity increased by 50% and 75%, respectively [4]. In comparison, the rate of obesity increased by 24% during the same period [4].

Recent studies have shown that these increases in extreme obesity rates are not specific to a certain population, but are rather an integral part of the weight distribution in the USA, and the more extreme the obesity, the higher the rate of growth [4]. Thus, the public health concerns associated with this growth are of extreme importance given that those who are obese in any form are much more likely to suffer from obesity comorbidities including type 2 diabetes, cardiovascular disease, hypertension, hyperlipidemia, asthma, sleep apnea, and stroke [1, 6]. Furthermore, the costs associated with obesity are on the rise and accounted for 27% of the increases in medical costs between 1987 and 2001 [1, 7]. The

affected population has the greatest need for weight loss therapy, and currently, the only effective treatment for extreme obesity is bariatric surgical intervention [6, 8–11]. The utilization of bariatric surgery as a treatment for the morbidly obese has increased dramatically since 1998. In a report published by AHRQ, the authors found that bariatric surgeries increased by 400% between 1998 and 2002 (13,386 surgeries were performed in 1998 and 121,055 were performed in 2002) [12]. More recently, it is estimated that 220,000 people in the USA had bariatric surgery in 2008.

While there is a vast amount of literature on the rates, associated risks, and costs related to severe obesity, there is relatively little work on the behavioral factors associated with morbid and super morbid obesity. Additionally, there is a great deal of work that focuses on trends in bariatric surgery as well as post-surgical weight loss outcomes. Our research seeks to examine the characteristics of the extremely obese who have sought out surgical intervention as a treatment for their obesity. We assess the behavioral and attitudinal characteristics of our sample while controlling for socio-demographic characteristics in an effort to link certain behaviors with an increased prevalence of more severe forms of obesity. We expand the current literature by focusing specifically on presurgical patients' behaviors as they relate to the incidence of extreme obesity.

Methods

Study Population

Our results are based on the responses of 270 patients collected prior to bariatric surgical intervention in the San Antonio, TX area. The surveys were administered to patients by medical staff from June 2009 to September 2010 and were provided to the researchers in deidentified format. The research has been approved by the Institutional Review Board at the University of Texas at San Antonio (see Appendix).

Statistical Analysis

We used ordered logistic regression to determine the risk of three obesity outcomes, i.e., obese, morbidly obese, and super morbidly obese. This model is best suited to address our outcome variable given that the spacing between outcomes, though ordered, is not uniform. Ordinal logistic regression assumes that the coefficients linking variable values to different outcomes will be the same across all the

outcomes [13]. For example, eating fast food will affect the likelihood of being obese (the lowest category), the same as it would affect the likelihood of being super morbidly obese. This is referred to as the proportional odds assumption or parallel lines assumption. Our model has been tested to ensure this assumption has not been violated, and thus, we are confident that the ordered logistic regression is most appropriate to determine the effects of our independent variables on the outcome. We assessed the influence of fast food consumption, dining behaviors, exercise, reasons for eating, and age at which respondent first reported overweight/obesity while controlling for gender, race/ethnicity, level of education, and self-reported social class. All analyses were performed using STATA version 10 (StataCorp LP, College Station, TX, USA).

Results

Each of the respondents had a minimum BMI of 30.00 kg/m^2; hence, our dependent variable is based on the severity of obesity. Table 1 presents the descriptive characteristics for the sample. We created three categories of obesity, namely, obese (BMI, 30–39.99 kg/m^2), morbidly obese (40.00–49.99 kg/m^2), and super morbidly obese (50.00+ kg/m^2). Approximately 54 patients were in the obese category, 149 in the morbidly obese category, and 67 in the super morbidly obese category. The largest racial/ethnic category is Hispanic, which accounts for approximately 49% of the sample. The average age for the entire group is 43.5 years, and males account for 23.7% of the sample. Some college/associate's degree is the most common response for education and represents about 50% of the sample. Working class was the modal response for social class and accounts for 34% of the group (among Whites, the modal response was lower middle at about 39%). Among the behavioral characteristics, it was observed that the average amount of exercise reported per week was 1.33 times (48.15% of the sample reported exercising at least once per week); 7.41% of the sample reported that they first considered themselves overweight/obese at or prior to the age of 10 years. The average rate of fast food consumption was 2.68 times per week (the modal response was once per week at a value of 23.70%). Finally, about 37% of the sample reported boredom as their primary reason for eating in general.

Ordered logistic regression was used to compare the outcomes across estimates in all categories, thus allowing for an analysis of how individual-specific variables affect the likelihood of observing a given outcome. The results are separated into three models on the basis of varying factors and confirm that several of the variables of interest have

Table 1 Sample characteristics: bariatric outcomes study sample, San Antonio, TX, 2009–2010

	Full sample (n=270)	Non-Hispanic White (n=115)	Hispanic (n=132)	Non-Hispanic Black (n=23)
Mean BMI (kg/m^2)	46.20	45.47	46.90	45.85
Obesity status, %				
Overweight/obese (30–34.99 BMI)	20.00	19.13	21.97	13.04
Morbid (40–49.99 BMI)	55.19	58.26	52.27	56.52
Super morbid (50.00+ BMI)	24.81	22.61	25.76	30.43
Mean age (SD)	43.51 (11.89)	47.01 (12.19)	40.84 (11.32)	41.39 (9.26)
Gender (male), %	23.70	26.09	24.24	8.70
Education, %				
<High school	3.33	0.87	5.30	4.35
HS grad	19.26	15.65	23.48	13.04
Some college	50.00	50.43	52.27	34.78
Bachelor's +	27.41	33.04	18.94	47.83
Social class (self-rated), %				
Upper ($200,000+)	2.29	4.59	0.77	0.00
Upper middle ($100,000–199,000)	16.03	22.02	10.00	21.74
Lower middle ($50,000–99,000)	30.15	38.53	26.15	13.04
Working ($30,000–49,000)	33.97	25.69	36.15	60.87
Lower (<$29,000)	17.56	9.17	26.92	4.35
Mean exercise/week (SD)	1.33 (1.64)	1.56 (1.80)	1.16 (1.55)	1.17 (1.19)
Early onset obesity, %	7.41	7.83	7.58	4.35
Mean fast food consumption/week (SD)	2.68 (1.89)	2.10 (1.58)	2.98 (1.91)	3.91 (2.23)
Mean rate of eating out/week (SD)	2.70 (0.79)	2.73 (0.72)	2.65 (0.82)	2.78 (1.00)
Reason for eating (boredom), %	36.67	37.39	38.64	21.74
Knowledge of proper nutrition (1=moderate to very)	22.96	32.17	17.42	8.70
Took immediate action	37.04	40.87	32.58	43.48

statistically significant effects on the severity of obesity. Table 2 presents the adjusted odds ratios (ORs) and the 95% confidence intervals (95% CIs) from the ordered logistic regressions. In model 1, the effects of background characteristics including age, sex, Hispanic ethnicity, level of education, social class, and early onset obesity (patients reported onset of overweight/obesity at age 10 or prior) are assessed. In model 2, social and behavioral factors including fast food consumption, frequency of eating out, reason for eating in general[1] (boredom is

presented), knowledge of healthy behaviors/eating habits, frequency of exercise (1=those who reported exercising at least once per week), and speed of reaction to obese status (1=took immediate action to address overweight/obesity) are assessed. Model 3 contains the results for all factors combined. Overall, it was found that several variables had a significant effect on obesity status.

In model 1, social class was the only variable that was statistically significant. For this variable (upper versus lower class status), the odds of super morbid obesity versus the combined morbid and obese categories are decreased by 61.1% for upper class respondents, all else constant. In model 2, the effects of behavioral characteristics were evaluated and fast food consumption, frequency of eating out, as well as frequency of exercise were found to be statistically significant. We focus specifically on the effects of fast food consumption, and the models confirm that, relatively speaking, this variable exerts the most influence on the severity of

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[1] The original survey asked respondents their reasons for eating in general and included hunger, loneliness, anxiety, happiness, boredom, anger, and frustration. The most common responses included hunger, loneliness, and boredom. Each of these responses was coded as a separate binary variable that was assessed in various models. Boredom was selected for the final model as it exerted some influence in the behavioral models.

Table 2 Background and behavioral effects (ORs and 95% CIs) on severity of obesity, estimated by ordered logistic regression

	Model 1[a], OR (95%CI)	Model 2[b], OR (95%CI)	Model 3[c], OR (95%CI)
Background variables			
Age	1.00 (−0.02, 0.02)		1.00 (−0.02, 0.02)
Gender (1=male)	0.77 (−0.82, 0.31)		0.85 (−0.76, 0.43)
Hispanic	0.86 (−0.64, 0.33)		0.67 (−0.91, 0.10)*
Level of education	1.13 (−0.21, 0.45)		0.90 (−.70, 0.48)
Social class (upper/middle=1)	0.39 (−1.63, 0.26)***		0.45 (−1.49, −0.11)***
Early onset obesity	1.82 (−.29, 1.49)		1.99 (−0.24, 1.62)*
Behavioral variables			
Fast food consumption		1.27 (0.09, 0.39)***	1.29 (0.10, 0.40)***
Frequency of eating out		1.40 (−0.004, 0.68)**	1.30 (−0.08, 0.61)*
Reason for eating (boredom=1)		0.65 (−0.92, 0.07)*	0.62 (−0.97, 0.04)*
Knowledge of proper nutrition		0.77 (−0.83, 0.31)	0.82 (−0.79, 0.40)
Exercise at least once per week		0.50 (−1.18, −0.21)***	0.50 (−1.20, 0.19)***
Immediately took action for weight		0.75 (−0.79, 0.20)	0.73 (−0.82, 0.20)
LR chi-squared	9.89	27.52	37.65
p value	0.129	0.000	0.000

Obesity was defined as having a BMI of 30 or greater

OR odds ratio, CI confidence interval

*$p<0.1$; **$p<0.05$; ***$p<0.01$

[a] Model 1 adjusted for background variables only

[b] Model 2 adjusted for behavioral variables only

[c] Model 3 adjusted for both background and behavioral variables

obesity (this is assessed by examining the semistandardized coefficients). Here, it is observed that with each one unit increase in fast food consumption per week, the risk of super morbid obesity versus the combined morbid and obese designations are 26% greater, given that the other variables are held constant. In addition, frequency of eating out and exercise were statistically significant. For exercise, the odds of being super morbidly obese versus morbidly obese and obese combined are decreased by 50.3% for those who reported exercising at least once per week, all else equal. For each one unit increase in eating out per week, the risk of super morbid obesity versus morbidly obese and obese combined are 40.1% greater, other variables held constant. Finally, it was observed that the variable for eating in general due to boredom was approaching significance ($z=−1.69$, $p=0.09$). Thus, the odds of being in the highest category of obesity versus the lower two categories combined are decreased by 35% for those who reported eating due to boredom, all else equal.

Model 3 adjusted for the effects of background characteristics in addition to behavioral ones. Here, we find

that the effects of our behavioral variables are not diminished with the inclusion of additional controls. The variables for social class, fast food consumption, and exercise were all significant at the 0.01 level. Additionally, the variables for Hispanic ethnicity, early onset obesity, eating out, and eating due to boredom were all approaching significance ($p≤0.1$). As mentioned above, it is important to note the effects of fast food consumption as this variable exerts the most influence on the outcome. Once the additional controls were added, fast food consumption remained significant and, with each one unit increase in fast food consumption, the odds of being in the highest category of obesity versus the lower two combined were increased by about 29%, all else equal. Table 3 reports the predicted probabilities for fast food consumption at 0–7 or more times per week.

For each value of fast food, the highest category of respondents is in the morbidly obese category, which makes sense based on the fact that the largest number of respondents falls into this category. However, it is important to note that, with each increase in value of

Table 3 Predicted probabilities of obesity status by fast food consumption

Fast food consumption per week	Obese ($y=1$)	Morbidly obese ($y=2$)	Super morbidly obese ($y=3$)
0	0.296	0.577	0.127
1	0.246	0.596	0.158
2	0.203	0.603	0.195
3	0.165	0.598	0.237
4	0.133	0.581	0.286
5	0.106	0.554	0.340
6	0.085	0.516	0.399
7+	0.067	0.472	0.461

fast food, the predicted probability for super morbidly obese ($y=3$) increases significantly. This indicates that the effect of fast food consumption on super morbidly obese status is strongly correlated. Alternately, as fast food consumption increases, the predicted probability of being in the lowest category ($y=1$) of obesity decreases. The overall sample mean for fast food consumption is 2.68, thus the predicted probabilities at a value of 3 should give an estimate close to the observed percentages in obesity categories.

Discussion

The foregoing results provide evidence of a strong association between behavioral factors, including fast food consumption and rates of exercise and severe forms of obesity. Even after controlling for the effects of background characteristics, the strength of these influences is not diminished. Fast food consumption emerged as a key determinant of higher levels of obesity and exerted the greatest influence relative to the other independent variables in the model for behavioral factors and the full model. Additionally, Table 3 displays the effects of this variable in the form of predicted probabilities, and it is observed that higher rates of fast food consumption directly correlate with increasing values in the highest obesity category, i.e., super morbid obesity (rates are decreased in the lower two categories). Lending further support to the notion that behavioral factors related to diet have a measureable impact on obesity outcomes are studies such as the one conducted by Mozaffarian and colleagues [14]. Their research used longitudinal data to track weight outcomes related to the consumption of specific categories of food and demonstrated that upward weight change was strongly associated with the

intake of potatoes, sugary beverages, red meats, and processed meats [14] (all of which are standard fare in a typical fast food restaurant). This is a particularly important study as it underscores the relationship between consumption of specific foods and obesity, thus reinforcing our findings that fast food correlates with the most severe forms of obesity.

Overall, some disagreement exists as to the formal definition of fast food. However, it is generally accepted to characterize fast food as that which is designed for ready availability, use, or consumption and is easily reached and/or in nearby locations [15]. This type of food is often offered in establishments that have drive-through windows, a limited menu, no formal wait staff, the food preparation process is highly mechanized, and offerings are prepared prior to ordering [16]. Additionally, some consideration should be given to the type and nutritional makeup of fast food. Given that fast food itself is correlated with obesity, it is important to note the characteristics of many of the offerings at fast food establishments which include oversized portions, high energy density, highly processed, high fat content, and large amounts of refined starch and added sugars [17]. The largest sales categories of fast food are hamburgers, pizza, and fried chicken [18]. According to the USDA, fast food consumption has steadily increased since the 1980s and accounted for 37.9% of away from home food expenditures in 2002 [19]. It is expected that spending on fast food will increase by 6% between 2000 and 2020 [19]. Given these trends, it is necessary to address ways in which the negative effects of consuming unhealthy options at fast food restaurants may be counteracted. Our recommendations include greater transparency and availability of nutrition content, efforts to control portion sizes and/or increase consumer awareness of portion sizes, and full reporting of ingredients.

Given that the largest gains in rates of obesity have been observed for those in the higher levels (morbid and super morbid) and it is expected that these rates will continue to increase, it is of the utmost importance that studies focus on the correlates to these severe forms of obesity. Studies such as this call to light the significance of fast food consumption in particular and demonstrate the need for continuing work focused on this relationship.

Limitations

Several limitations exist in the current research and are considered herein. This particular study is based on a sample

of presurgical bariatric patients in the San Antonio area and is thus limited by the data availability and coverage area. The sample consists largely of Hispanic respondents (approximately 49% Hispanic) and, in an effort to examine other disproportionately affected populations, i.e., African Americans, future research will include an expanded data pool that covers many of the major metropolitan areas in Texas. However, the current research is based in an area that ranks in the top 10 cities in the nation with respect to percentage of obese persons.

Thus, it is exceptionally important that current research focus on such areas in an effort to better understand the predictors of such high rates and provide information for other areas that will be affected in the future.

It should also be noted that the cross-sectional nature of the data does not allow for the investigation of causality with respect to the relationship between fast food consumption and severity of obesity. Though it is reasonable to suggest that higher rates of fast food consumption will lead to higher rates of severe obesity, we cannot make such assertions without the use of longitudinal data. However, we do find evidence of a strong and statistically significant association between these variables, and studies such as these represent an important step in the continued examination of the tremendous increases in severe forms of obesity.

In addition, it may be argued that bariatric patients are not representative of the general population of obese persons (this may be due in part to repeated failures at weight loss).

Nonetheless, the responses obtained from this group represent highly valuable information for a number of reasons. First, we are seeing exponential growth in the use of bariatric surgery as a form of treatment. Second, the most current research indicates that this is the only effective treatment for severe forms of obesity. Accordingly, as the rates of morbid and super morbid obesity are outpacing standard obesity, it can be expected that a great deal more obese persons will seek surgical intervention in coming decades. Finally, our data represents an array of individuals with respect to social class, level of education, and age, among others, and there is not a great degree of evidence to suggest that they are remarkably different from the general population of obese persons.

Conclusions

Recent studies have illustrated that extreme forms of obesity have become increasingly common and that the rates of both morbid and super morbid obesity are growing at a much faster pace than standard obesity [4]. In fact, the rate of growth for those in the super morbid obese category increased from roughly 1 in 2,000 to 1 in 400 (500% growth) between 1986 and 2000, while the rate of obesity increased from 1 in10 to 1 in 5 (200% growth) during the same period [4]. The potential ramifications for such growth are tremendous as these populations are much more likely to suffer from obesity-related illnesses and require a great deal more in the way of accommodations than the general population. Accordingly, the health care costs associated with these more extreme forms can be expected to rise as a result of increases in the more extreme categories of obesity. As such, it is of the utmost importance that studies related to obesity focus on the correlates associated with such patterns. Furthermore, it is particularly important to focus on bariatric patients as this is the only viable treatment option for those in the more severe categories of obesity.

Our findings are suggestive of an important connection between behavioral factors (specifically those related to fast food consumption) and extreme forms of obesity. We have effectively shown that fast food exhibits a significant association with the likelihood of more extreme forms of obesity. This indicates several things. First, in combating the obesity epidemic, it is important to recognize the effects of such behaviors and develop strategies that address the role of fast food consumption. Health care practitioners and members of the research community should understand this connection and focus their efforts on increasing awareness of behavioral factors as well as stress the associated outcomes. Though we cannot assert complete causation with respect to the relationship between fast food and extreme forms of obesity, we firmly support the argument that the availability and popularity of fast food must be diminished if there is to be any change in the growth of obesity rates. Additionally, as bariatric surgery becomes increasingly utilized as a form of treatment, it is necessary that the research community focuses on studies that investigate those who seek treatment. Future studies should continue to explore the relationship between such behaviors and extreme forms of obesity as well as assess postsurgical success rates (as measured by sustained weight loss) with respect to presurgical characteristics.

Appendix

Medical Information Questionnaire

1. At what point in your life (age in years) did you being to think of yourself as overweight/obese?
2. If you were able to provide an answer to the previous question, which of the following is most appropriate:
   a. Took immediate action (joined a weight loss group, started diet, joined a gym, etc.)
   b. Planned to take action (visited doctor, health professional, nutritionist, etc for purposes of gathering information)
   c. Chose not to take action (did not see problem with weight)
   d. Chose not to take action (lack of motivation to change)
   e. Unable to take action due to disability/health issue
   f. Unable to take action due to funds
   g. Unable to take action due to time constraints
   h. Unable to take action due to lack of information
   i. Other _____
3. Prior to attending this seminar, how knowledgeable would you consider yourself regarding proper nutrition and eatinghabits?
   a. Very knowledgeable
   b. Moderately knowledgeable
   c. Somewhat knowledgeable
   d. Not Very knowledgeable
   e. No Knowledge
4. How often do you eat fast food?
   a. Multiple times per day
   b. Daily
   c. Weekly
   d. Monthly
   e. Less than monthly
5. What is your primary reason for choosing to eat fast food?
   a. Price
   b. Taste
   c. Convenience
   d. Speed
   e. Too busy to cook
   f. Compelled/enticed by advertisement
   g. Other _____
6. Is your spouse currently considering bariatric surgery, or have they undergone a bariatric procedure in the past?
   a. Yes, they have undergone bariatric surgery
   b. Yes, they are currently considering bariatric surgery
   c. No
7. One a scale of-15 how supportive would you say your family has been of your decision to pursue bariatric intervention? (1=least supportive, 5=most supportive): _____
8. How often does your family help with your weight loss goals?
   a. Often
   b. Usually
   c. Seldom
   d. Rarely
   e. Never
9. How would you rank yourself on the following scale?
   a. Upper ($200K+)
   b. Upper Middle ($100-199K; white collar professional)
   c. Lower Middle ($50-99K; semi-professional)
   d. Working ($30-49K; blue collar/service)
   e. Lower (<$29K)
10. At/after the point you became obese, who would you have been most likely to positively respond to in reference to your weight and related concerns?
    a. Medical professional
    b. Friend
    c. Family member
    d. Educator
    e. Clergy member
    f. Other

11. Thinking about the previous question, how would you have liked them to broach the issue?
    a. Highly technical (i.e. your BMI is beyond normal range)
    b. Concerned (i.e. afraid to lose you)
    c. Empathetic (i.e. I've been in your position)
    d. Harsh (i.e. you could die if you don't change)
    e. Inspirational
    f. Other _____

12. What is your highest level of educational attainment?
    a. Less than high school
    b. High school graduate
    c. Come college
    d. Associate's degree
    e. Bachelor's degree
    f. Graduate or professional degree

13. If you decide to proceed with bariatric surgery, which of the following methods do you MOST LIKELY expect to use to cover the costs of the procedure?
    a. Insurance
    b. Surgical loans
    c. Out of pocket payment
    d. Other (please specify): _____
    e. Not sure

14. How many days a week do you exercise?

15. If you do not exercise, why? (circle all that apply)
    a. Pain
    b. Lack of motivation
    c. Lack of time
    d. Lack of access
    e. Other

16. How much TV do you watch daily?
    a. Never
    b. Rarely (1-2 hours)
    c. Sometimes (3-5 hours)
    d. Most of the time (5+ hours)

17. How often do you eat out?
    a. Multiple times per day
    b. Daily
    c. Weekly
    d. Monthly
    e. Less than monthly

18. What are your reasons for eating? (circle all that apply)
    a. Physical hunger
    b. Loneliness
    c. Happiness
    d. Boredom
    e. Anger
    f. Exhaustion
    g. Frustration

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