

THE RELATIONSHIP BETWEEN EMOTIONAL EATING, DEPRESSION, AND BODY MASS

INDEX

By

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# CHAPTER I

## INTRODUCTION

While it is commonly believed that there is a relationship between obesity and depression, the extant research has been inconclusive and inconsistent on this topic. Several studies have shown that obese individuals were at an elevated risk of depression (Hawkins & Stewart, 2012; Roberts, Deleger, Strawbridge, & Kaplan, 2003; Faith et al. 2011; Luppino, 2013). However, other research has indicated that overweight individuals were less depressed, while other research still has indicated that there was no association between obesity on the risk for depression (Hasler et al., 2004; John et al., 2005; Faith, Matz, & Jorge, 2002). It is possible, that the direction of the relationship between depression and obesity depends another variable or variables. This research focuses on measures of eating style such as emotional eating, overeating, and unplanned snacking. We will examine the hypothesis that the association between depression and obesity is moderated by these variables.

### Obesity and depression

Obesity is defined as having a very high amount of body fat in relation to lean body mass. It is often operationalized as a Body Mass Index ( $BMI = kg/m^2$ ) greater than or equal to 30 (CDC, 2011; Flegal et al., 2002; Flegal et al., 2007). The health effects of obesity and depression have been documented in detail and both are major public health concerns (Ogden et al., 2012; NIH, 2010; Mathers, 2006; Murray, 1997; Brownell & Wadden, 1992; Pi-Sunyer, 1993). Worldwide, obesity has doubled since 1980, and 11% of the world's population is considered

obese (WHO, 2011). In the United States alone, more than one-third of the adult population is obese (Ogden et al., 2012). Obesity is a risk factor for chronic medical illnesses, including diabetes mellitus, cardiovascular disease, chronic back pain, hypertension, and degenerative joint disease (WHO, 2011; Wassertheil-Smoller et al., 2004; Kopelman, 2007, Visscher & Seidell, 2001; Kop et al., 2011; Khaodhiar, McCowen, & Blackburn, 1999) as well as significantly increased mortality rates (Flegal et al., 2007; Pennix et al., 2001; Wassertheil-Smoller et al., 2004; Simon et al., 2008). While it is well known that obesity is associated with chronic health problems, there is less certainty regarding the psychological effects of obesity.

Similar to obesity, depression is a widespread problem. Major depression is one of the most prevalent psychiatric disorders in the United States (Simon et al., 2008; Hasin et al., 2005) and also increases risk of mortality (Flegal et al., 2007; Wassertheil-Smoller et al., 2004; Simon et al., 2006). Like obesity, depression is also associated with chronic medical conditions, as well as poor treatment compliance, higher utilization of health services, and worse health outcomes (Finkelstein, Ruhm, & Kosa, 2005; Katon & Sullivan, 1990; Katon & Ciechanowski, 2002).

Estimates place the total (direct and indirect) costs of obesity in the United States at as much as \$139 billion dollars per year (US Dep. of Hum. Serv., 2001; Finkelstein, Ruhm, & Kosa, 2005). Depression costs the United States \$31 billion per year due to lost work time (Stewart et al., 2013). Due to the associated physical, psychological, and economic problems, understanding the relationship between obesity and depression is becoming increasingly more important as both are prominent public health issues.

### *Psychosocial Theories of Obesity*

Examining the relationship between obesity and depression raises several important theoretical questions: is it distressing or psychologically harmful to be overweight? Is there a psychosocial impact of obesity? Several theories offer explanations as to why obesity may be psychologically harmful.

One causal model postulates that the stigmatizing nature of obesity prompts stereotyping and discrimination from others. According to this theory, being stigmatized, in turn, causes depression as well as other negative psychological and social outcomes (Brownell et al., 2005; Puhl & Brownell, 2006).

An alternative causal model argues that depression exerts causal effects on obesity. In this model, depression is hypothesized to cause obesity indirectly through behaviors such as emotional eating, eating high-calorie food, and a sedentary lifestyle (Dallman, Pecoraro, & la Fleur, 2005; Oliver & Wardle, 1999; Wise, Adams-Campbell, Palmer, & Rosenberg, 2006).

A final theory suggests that overeating reflects an inability to differentiate between physical hunger and feelings of internal emotional distress. This theory posits that food is used to decrease uncomfortable feelings of distress (Macht, 2008), and that use of food as a coping strategy contributes to weight gain.

### *Literature Review*

While it is commonly believed that obesity is related to negative mental health outcomes, the extant research on this topic has been inconclusive. Many studies have examined the association between depression and obesity; however, despite the large size of this literature, results have been inconclusive.

Some evidence suggests no relationship or an inverse relationship between depressive symptoms and obesity (Hasler et al., 2004; John et al., 2005; Faith, Matz, & Jorge, 2002). In general, most research reports at least some association between obesity and depression; however, the magnitude of this relationship is variable across studies.

Despite the large size of this literature, some reviews have reported relatively small bivariate correlations between measures of depression and obesity (Blaine, 2008; Faith & Allison, 1996; Friedman & Brownell, 1995). The National Health Interview Survey found that depression and BMI were correlated at .08 in a study of over 30,000 American adults (National Center for Health Statistics, 2006). The 1995 National Longitudinal Study of Adolescent Health surveyed over 20,000 youth and found comparably small correlations (.08 for girls and  $-.01$  for boys) between depression and BMI (Needham & Crosnoe, 2005).

Several studies of cross-sectional data have also produced weak associations. Wadden et al. (1989) found that obese adolescent females were not significantly more depressed than their non-obese peers. A review of cross-sectional data of depressive symptoms and obesity found only weak associations between obesity and increased risk of depression (Atlantis & Baker, 2008). Additionally, a meta-analysis of cross-sectional data from community-based samples found that depression is associated with a relatively modest 18% increased risk of obesity (de Wit et al., 2010). On the other hand, a 2012 review of cross-sectional and prospective studies found a more robust positive association with depression and obesity, with 64% of reviewed studies finding this relationship significant (Hawkins & Stewart, 2012)

Results from longitudinal studies have been slightly more consistent. Several studies report more robust results, finding that obese adults measured at baseline were approximately two times more likely to be depressed at follow-up than non-obese adults measured at baseline

(Roberts, Deleger, Strawbridge, & Kaplan, 2003; Roberts, Kaplan, Shema, & Strawbridge, 2000; Roberts, Strawbridge, Deleger, & Kaplan, 2002). A recent review of longitudinal studies found bidirectional associations between depression and obesity, with obese individuals having a 55% increased risk depression and depressed individuals having a 58% increased risk of obesity (Luppino, 2013). Another review of population-based studies found consistent positive associations between obesity and depressive symptoms (Faith et al. 2011). However, subsequent longitudinal research did not find a relationship between obesity and future depression (Hasler et al., 2005a).

Other studies have had slightly more robust results, finding moderate association between obesity and depression (Simon et al., 2006). A 2009 study (Ouwens, van Strien, & Leeuwe, 2009) examined the associations between symptoms of depression and emotional eating. Results indicated a positive relationship between depressive symptoms and emotional eating. Extreme obesity has also been shown to be associated with an increased risk for depression, even across races and genders (Dong, Sanchez, & Price, 2004).

### Emotional Eating and Depression

Emotional eating is defined as the propensity to eat in response to aversive or unpleasant affective states (Arnou, Kenardy, Agras, 1995) and is considered an inappropriate response to emotional distress (Heatherton, Herman, & Polivy, 1991). Emotional eaters tend to consume greater quantities of sweet, high-fat foods (Macht, 2008; van Strien, Herman, & Verheijden, 2009) in larger quantities (Herman & Polivy, 2005) and experience increased food cravings (Hawkins & Stewart, 2012; Hill, Weaver, & Blundell, 1991). Emotional eating is also related to childhood and adulthood overweight (Macht, 2008, van Strien, Herman, & Verheijden, 2009).

There is evidence for increased food intake in response to emotional arousal (Herman & Polivy, 2005) as well as increased food cravings during emotional states, such as anger, lonely, bored, upset, or irritable (Hill, Weaver, & Blundell, 1991).

Many studies have investigated the relationship between emotions and eating. Symptoms of depression have been found to correlate with emotional overeating (Ouwens et al., 2008; Masheb & Grilo, 2006), with individuals reporting overeating in response to negative emotions (Geliebter & Aversa, 2003; Patel & Schlundt, 2001; McKenna, 1972). Emotional eating is also associated with obesity (Geliebter & Aversa, 2003; Ozier et al., 2008). One study induced negative and neutral moods in college students and found that negative moods caused greater self-reported emotional eating compared with neutral moods (Bekker, van de Meerendonk, & Mollerus, 2004). The relationship between negative mood and eating has also been shown to be moderated by dieting status, with dieters eating more when depressed than when not depressed (Baucom & Aiken, 1981).

Not surprisingly, research also indicates that emotional eating acts as a hindrance to weight loss and maintaining weight loss (Geliebter & Aversa, 2003; Leon & Chamberlain, 1973). After significant weight loss, those who regained the weight did significantly more emotional eating than those who did not regain the weight (Leon & Chamberlain, 1973). Blair et al. (1990) found that emotional eaters were also less successful at approaching target weight than those who reduced their frequency of emotional eating. In addition, individuals who reduced the amount of emotional eating lost significantly more weight than individuals continuing to emotionally overeat (Blair et al., 1990).

Disturbances in eating behavior are common in both obesity (Gibson, 2012) and depression (DSM-IV-TR). Despite research indicating some link between obesity and

depression, there is little discussion of the possible mechanisms contributing to this co-occurrence. Emotional eating will be examined as a potential moderating factor in the relationship between depression and BMI. We hypothesize that the association between depressive symptoms and BMI will be stronger for individuals who report emotional eating.

### Current Study

Depression may be a risk factor for obesity, but it is unclear what mechanisms are involved in this relationship. Few previous studies have examined potential moderators between obesity and depression. The inconsistent findings in previous research indicate that obesity and depression do not always co-occur, which raises the question: when does an association between these conditions occur?

The DSM-IV-TR states one diagnostic criteria for depression as a marked appetite change, either an increase or decrease. This diagnostic criterion suggests that there may be two patterns of how people respond to emotions; for some, strong emotion may suppress appetite, while for others, it may disinhibit appetite. Disturbances in eating behavior are common in both obesity (Gibson, 2012) and depression (DSM-IV-TR) and eating to alleviate negative affect may contribute to obesity in depressed people. The research on emotional eating supports this, showing increased appetite in response to negative emotions in susceptible individuals (Geliebter & Aversa, 2003; Patel & Schlundt, 2001; McKenna, 1972). Food choices, in turn, have also been shown to affect mood (Gibson, 2006). This potentially suggests a bidirectional core relationship between depression and eating, in which mood affects food choices and food choices affect mood.

The aim of the present study was to examine emotional eating as a potential moderating factor in the relationship between depression and BMI. In particular, we are interested in whether individuals with elevated symptoms of both depression and problem eating will have the highest BMIs. We predict that problem eating will modify the association between depression and BMI, with the relationship between BMI and depression emerging only for those with problem eating.

## CHAPTER II

### METHOD

#### Participants

Participants took part in phase one of the 2010 Southern Community Cohort Study (SCCS). SCCS is a large epidemiological study conducted by Vanderbilt, Meharry, and the International Epidemiology Institute. SCCS is a prospective cohort study designed to understand health disparities between African Americans and Whites in the southern United States. Participants will be followed in upcoming years, and subsequent phases will include further interviews and surveys (Signorello et al., 2005).

A sample of 59,831 people (63% female) ages 45-79 was selected from patients and their families at community mental health centers in 12 southern states. Recruitment targeted low SES areas (60.8% of participants earning less than \$15,000/year) in rural and urban settings. An interviewer administered a computer assisted baseline questionnaire that included questions about demographics, health behavior, medical history, and nutrition. Lifestyle (e.g. physical activity and exercise) and psychosocial questionnaire (symptoms of depression) were also reported by all participants.

#### Measures

*Body Mass Index (BMI)* was calculated from a person's self-reported weight in kilograms divided by their squared height in meters ( $\text{kg}/\text{m}^2$ ). BMI is used to screen for weight categories that may lead to health problems and is an effective method for population assessment of

overweight and obesity (WHO, 2011). The current research follows the World Health Organization standards which classify BMIs between 18.5-24.9 as acceptable weight; 25-29.9 as overweight; and  $\geq 30$  as obese (WHO, 2011). Of participants, 25.60% ( $n=15,316$ ) were normal weight ( $BMI = 20-24.9 \text{ kg/m}^2$ ); 29.18% ( $n = 17,457$ ) were overweight ( $BMI = 25-29.9 \text{ kg/m}^2$ ); and 45.22% ( $n = 27,058$ ) were obese ( $BMI \geq 30 \text{ kg/m}^2$ ). A subsample of the interviews included recording of participants' measured weight and height. Self-reported and measured weights were strongly correlated,  $r = .95$ ,  $p < 0.05$ , and did not vary by race, education, or income (Cohen et al., 2009). Additionally, there was no evidence of overweight or obese people misrepresenting their weight any more than normal weight individuals (Cohen et al., 2009).

*Depressive symptoms* were measured using the Center for Epidemiologic Studies Short Depression Scale (CES-D 10) (Radloff, 1977). The CES-D 10 is a 10-item self-report questionnaire used to measure depressive symptomatology in the general population. For each item, participants responded on a four-point scale how frequently during the past week they had felt a certain way. Higher scores reflected increased symptoms of depression, with a response of 0 indicating a feeling that was experienced rarely or none of the time (less than one day in the past week) and a 3 indicating a feeling that was experienced almost all of the time (5-7 days in the past week).

*Problem eating* was measured using three self-report questions which assessed the frequency of specific problem eating behaviors. The following eating behaviors were measured: eating to cope with emotions, overeating, and unplanned snacking. Participants selected one of eight possible frequency categories, with frequencies ranging from never to two or more times per day. The problem eating items are as follows:

1. How often do you eat as a way to cope with negative feelings like anger, unhappiness, stress, or depression?
2. How often do you overeat, that is eating until you feel stuffed or too full?
3. How often do you eat unplanned snacks? That is, how often do you find yourself snacking on food then thinking ‘I wish I had not eaten that’?

Correlations between individual problem eating items and BMI and depression symptoms can be found in Table 3.

### Procedure

Total CES-D scores were broken up into quintiles, creating categories based upon the number of depressive symptoms endorsed. The distribution of total CES-D scores (0-30) was used to create five quintiles of depressive symptomatology: none (0-4.0), mild (4.1-7.0), moderate (7.1-10.0), high (10.1-14.0), and severe (14.1-30.0).

A composite variable was created to measure eating problems. The three eating behavior items (emotional eating, overeating, unplanned snacks) were summed, and the distribution of total scores was used to create four quartiles of eating problems: none, low, medium, and high.

## CHAPTER III

### RESULTS

The current sample consists of 59,831 people (63% female), the majority African Americans (71.86%), ranging in age from 45-79. The sample is primarily made up of low SES individuals, with more than half earning less than \$15,000/year (60.8%) and currently unemployed (62.37%). Nearly three-quarters (72.22%) reached no higher educational level than high school, with only 6% graduating from college (see Table 1).

Table 2 displays means and standard deviations of problem eating quartiles, depression quintiles, and BMI by sex and race as well as significance testing for sex and race. Tukey HSD post-hoc comparisons indicated that BMI values were significantly greater for women than men across all races. Mean depression scores for black men and women differed significantly from each other in every quintile. In contrast, white men and women's mean depression scores differed only in the top quintile.

Table 3 includes Pearson's correlation coefficients for problem eating, depressive symptoms, and BMI. Problem eating and BMI were strongly correlated,  $r = .24$ ,  $p < 0.01$ . CES-D depression scores and BMI were significantly correlated,  $r = .04$ ,  $p < 0.01$ ; however, this correlation was relatively weak. Correlations between BMI and CES-D depression scores were calculated separately for each problem eating quartile. Depression scores and BMI were significantly negatively correlated in the first quartile ( $r = -.048$ ,  $p < 0.01$ ) and second quartile ( $r = -.016$ ,  $p < 0.05$ ); significantly positively correlated in the top quartile ( $r = .038$ ,  $p < 0.01$ ); and not significantly correlated in the third quartile ( $r = -.004$ ,  $p = n.s$ ).

Main effects were calculated using a between subjects ANOVA, seen in Table 4. A three-way analysis of variance was conducted, with BMI as the dependent variable and sex, depression, and problem eating as between subject variables. Age and race were controlled for as covariates. Results yielded main effects for gender and problem eating. The main effect for gender,  $F(1, 59748) = 1817.542, p < 0.05$ , was such that the average BMI was significantly higher for women ( $M = 32.07, SD = 8.14$ ) than for men ( $M = 27.89, SD = 6.19$ ). The main effect of problem eating,  $F(1, 59748) = 726.099, p < 0.05$ , indicated that the more frequent the problem eating behavior, the greater the BMI value. Interestingly, no main effect was found for depression,  $F(4, 59748) = 3.272, p > 0.05$ , indicating that depression severity is not associated with BMI value (see Table 4).

As predicted, there was a significant eating problems by depression interaction,  $F(12, 59748) = 4.902, p < 0.05$ . As seen in Figure 1, the interaction showed that BMI was greatest in individuals with severe depression, but only for individuals with the highest level of eating problems. Individuals with a combination of the greatest depression level (severe depression) mixed with the most eating problems (top 25%) had the greatest BMI scores. This suggests that problem eating and depression are related to elevated BMI, with eating problems acting as a moderator.

This finding is further supported by the correlations between BMI and depression for each problem eating quartile. These results indicate that increased depression is associated with lower BMI for individuals with mild or no problem eating behaviors. This relationship is different for individuals with the highest eating problems, however, and for this group greater depression is related to greater BMI. In other words, the relationship between BMI and depression emerges only for those with severe problem eating.

Table 1  
*Characteristics of study participants*

Variable	Black				White				Other			
	Male (n=17,753)		Female (n=25,242)		Male (n=4,962)		Female (n=9,862)		Male (n=722)		Female (n=1,290)	
	N	%	N	%	N	%	N	%	N	%	N	%
<b>Age</b>												
40-49	9,588	54.01	12,361	48.97	2,251	45.36	3,976	40.32	368	50.97	561	43.49
50-59	5,773	32.52	8,238	32.64	1,564	31.52	3,362	34.09	240	33.24	467	36.20
60-69	1,869	10.53	3,421	13.55	849	17.11	1,907	19.34	88	12.19	199	15.43
70-79	523	2.95	1,222	4.84	298	6.01	617	6.26	26	3.60	63	4.88
<b>Income</b>												
< \$15,000	1,166	62.90	15,535	61.54	2,901	58.46	5,622	57.01	422	58.45	735	56.98
\$15-25,000	3,938	22.18	5,937	23.52	1,052	21.20	2,029	20.57	169	23.41	266	20.62
\$25-50,000	2,020	11.38	2,889	11.45	669	13.48	1,346	13.65	91	12.60	191	14.81
> \$50,000	629	3.54	881	3.49	340	6.85	865	8.77	40	5.54	98	7.60
<b>Education</b>												
Dropout	6,215	35.01	7,975	31.59	1,519	32.06	2,869	29.09	207	28.67	322	24.96
H.S./GED	7,465	42.05	9,939	39.37	1,936	39.02	4,020	40.76	263	36.43	410	31.78
Some college	2,899	16.33	5,044	19.98	912	18.38	1,923	19.50	161	22.30	375	29.07
College grad.	862	4.86	1,638	6.49	343	6.91	696	7.06	62	8.59	119	9.22
Grad/Prof schl	312	1.76	646	2.56	180	3.63	354	3.59	29	4.02	64	4.96
<b>Marital Status</b>												
Married/cohab	15,168	29.11	6,661	26.39	2,114	42.60	4,225	42.84	283	39.20	446	34.57
Divorced/sepd	6,096	34.34	8,705	34.49	1,760	35.47	3,481	35.30	263	36.43	506	39.22
Widowed	664	3.74	3,591	14.23	211	4.25	1,357	13.76	26	3.60	170	13.18
Single/never married	5,825	32.81	6,285	24.90	877	17.67	799	8.10	150	20.78	168	13.02
<b>Employment</b>												
Yes	6,646	37.44	9,764	38.68	1,542	31.08	3,286	33.32	262	36.29	460	35.66
No	11,044	62.21	15,125	59.92	3,405	68.62	6,468	65.59	458	63.43	815	63.18
Unknown	63	0.35	353	1.40	15	0.30	108	1.10	2	0.28	15	1.16

Table 2  
*Characteristics of study variables and significance testing*

Variable	Black		White		Other	
	Male (n=17,753)	Female (n=25,242)	Male (n=4,962)	Female (n=9,862)	Male (n=722)	Female (n=1,290)
BMI	Mean (SD) 27.59 <sup>A,1</sup> (6.00)	Mean (SD) 32.49 <sup>C,2</sup> (8.05)	Mean (SD) 29.91 <sup>B,3</sup> (6.69)	Mean (SD) 31.08 <sup>D,4</sup> (8.28)	Mean (SD) 28.36 <sup>A,5</sup> (6.29)	Mean (SD) 31.43 <sup>D,6</sup> (8.26)
<i>Problem Eating</i>						
1 <sup>st</sup> quartile	0.01 <sup>A,1</sup> (0.01)	0.01 <sup>B,2</sup> (0.01)	0.01 <sup>A,3</sup> (0.01)	0.01 <sup>B,3</sup> (0.01)	0.01 <sup>A,4</sup> (0.01)	0.01 <sup>B,4</sup> (0.01)
2 <sup>nd</sup> quartile	0.13 <sup>A,1</sup> (0.09)	0.14 <sup>B,2</sup> (0.09)	0.13 <sup>A,3</sup> (0.09)	0.14 <sup>B,4</sup> (0.09)	0.13 <sup>A,5</sup> (0.09)	0.13 <sup>B,5</sup> (0.08)
3 <sup>rd</sup> quartile	0.79 <sup>A,1</sup> (0.26)	0.81 <sup>B,2</sup> (0.26)	0.79 <sup>A,3</sup> (0.26)	0.82 <sup>B,4</sup> (0.25)	0.82 <sup>A,5</sup> (0.24)	0.82 <sup>B,5</sup> (0.26)
4 <sup>th</sup> quartile	2.19 <sup>A,1</sup> (0.96)	2.29 <sup>B,2</sup> (1.05)	2.23 <sup>A,3</sup> (1.00)	2.40 <sup>C,4</sup> (1.12)	2.31 <sup>A,5</sup> (1.12)	2.45 <sup>C,5</sup> (1.13)
<i>Depressive Symptoms</i>						
1 <sup>st</sup> quintile	2.46 <sup>A,1</sup> (1.35)	2.36 <sup>B,2</sup> (1.39)	2.39 <sup>A,3</sup> (1.34)	2.44 <sup>C,3</sup> (1.33)	2.36 <sup>A,4</sup> (1.36)	2.35 <sup>B,C,4</sup> (1.36)
2 <sup>nd</sup> quintile	5.99 <sup>A,1</sup> (0.80)	6.00 <sup>B,1</sup> (0.80)	6.02 <sup>A,2</sup> (0.82)	5.99 <sup>B,2</sup> (0.82)	5.92 <sup>A,3</sup> (0.81)	6.07 <sup>B,3</sup> (0.82)
3 <sup>rd</sup> quintile	8.99 <sup>A,1</sup> (0.80)	8.96 <sup>B,2</sup> (0.82)	8.93 <sup>A,3</sup> (0.81)	8.98 <sup>B,3</sup> (0.80)	8.97 <sup>A,4</sup> (0.83)	9.07 <sup>B,4</sup> (0.82)
4 <sup>th</sup> quintile	12.27 <sup>A,1</sup> (1.07)	12.32 <sup>B,2</sup> (1.09)	12.30 <sup>A,3</sup> (1.08)	12.37 <sup>B,3</sup> (1.13)	12.27 <sup>A,4</sup> (1.07)	12.31 <sup>B,4</sup> (1.12)
5 <sup>th</sup> quintile	18.17 <sup>A,1</sup> (3.01)	18.83 <sup>C,2</sup> (3.28)	19.06 <sup>B,3</sup> (3.52)	19.77 <sup>D,4</sup> (3.78)	19.21 <sup>B,5</sup> (3.78)	19.87 <sup>D,5</sup> (3.77)

Note: Within a row, means with different superscripts significantly differ from each other. Numerical superscripts denote comparisons of sex within race (i.e. comparison of white men and white women within variable level). Letter superscripts denote comparisons of race within sex (i.e. comparison of black men, white men, and other men within variable level).

Table 3

*Pearson's correlation coefficients between emotional eating, depressive symptoms, BMI*

	BMI	CES-D	Cope	Snack	Overeat	PE	Mean (SD)
BMI (kg/m <sup>2</sup> )	1.00						30.43 (7.71)
Depressive symptoms (CES-D)	0.04**	1.00**					1.68 (0.94)
Eat to cope	0.20**	0.27**	1.00				0.12 (0.35)
Snacking	0.19**	0.11**	0.41**	1.00			0.26 (0.47)
Overeating	0.16**	0.10**	0.36**	0.44**	1.00		0.15 (0.35)
Problem Eating (PE)	0.24**	0.17**	0.58**	0.67**	0.58**	1.00	1.66 (0.98)

\*\*  $p < 0.01$ .

Note: Problem Eating composite variable made up of sum of scores from variables Eat to cope, Snacking, and Overeating.

Table 4  
*Tests of between-subject effects*

Dependent Variable: BMI				
Source	df	Mean square	F	Sig
Corrected model	82	8083.1	166.72	.000
Intercept	1	22566053.7	465443.09	.000
Gender	1	88119.8	1817.54	.000
Eating Problems	3	35203.4	726.09	.000
Depression Symptoms	4	79.8	1.65	.160
Gender * Eating Problems	3	694.7	14.33	.000
Gender * Depression Symptoms	4	230.6	4.76	.001
Eating Problems * Depression Symptoms	12	237.6	4.90	.000
Gender* Eating Problems * Depression Symptom	12	84.1	1.73	.053
Error	59748	48.5		
Total	59831			
Corrected Total	59830			

Note: R-squared = .186 (R-squared adjusted for age = .185)

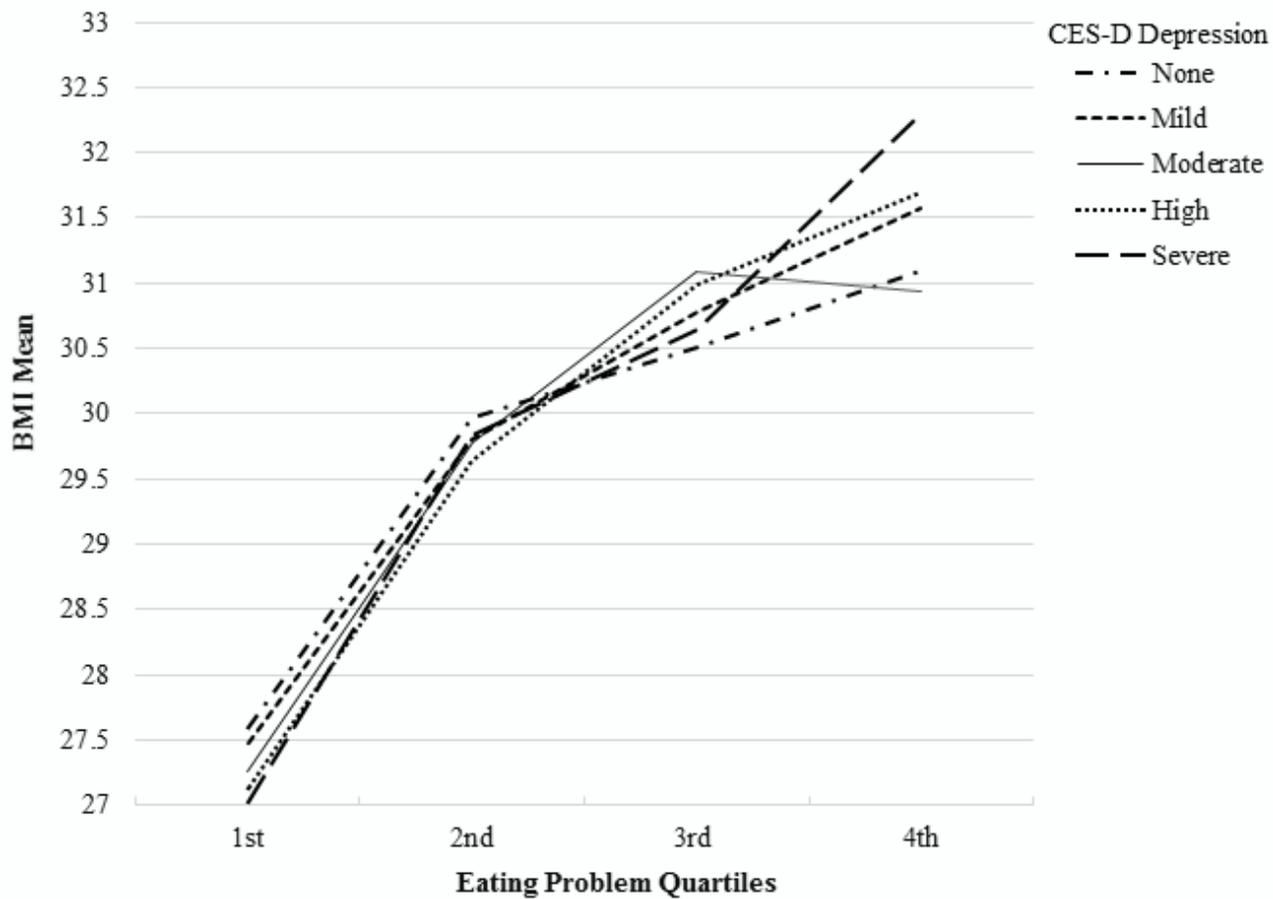


Figure 1. Interaction of eating problems, depressive symptoms, and BMI

## CHAPTER IV

### DISCUSSION

The present study examined problem eating and depressive symptoms in relation to BMI. As predicted, higher depressive symptoms were related to increased levels of problem eating. Consistent with much previous research (Hasler et al., 2004; John et al., 2005; Faith, Matz, & Jorge, 2002), no relationship was found between depression and BMI. In the current sample, the only significant interaction effect with depression is eating problems in predicting BMI. This suggests that problem eating is acting as a moderator in the relationship between depression and BMI, and that the combination of depressive symptoms and high levels of problem eating behavior is a risk factor for increased BMI. In other words, the relationship between BMI and depression emerges only for those with problem eating.

When comparing the estimated marginal means of BMIs, we see that people with the combination of the greatest depression level (severe depression) mixed with the most eating problems (top 25%) have the highest BMI scores. The combination of depressive symptoms appears to be a risk factor for increased BMI. These findings suggest that there is something unique about the combination of depression and problem eating in terms of risk of being overweight.

There is a clear relationship between problem eating and BMI. In the current sample, problem eating and BMI are strongly correlated, while depression and BMI are only weakly correlated. This indicates that depression does not account for much of the variance in BMI.

Therefore, even though there is a statistically significant moderation effect, the effect size is small and not accounting for much of the variance of BMI.

Correlations between BMI and depression scores for problem eating quartiles support this conclusion, with greater depression associated with greater BMI, but only in the highest category of problem eating. In fact, increased depressive symptoms are associated with lower BMI in the bottom two quartiles. This supports our original hypothesis that the relationship between BMI and depression (in terms of risk for obesity) emerges only for those with severe eating problems. This pattern suggests a behavioral contribution to obesity in the form of problem eating which is stronger than the contribution of depression, even when modified.

There are several limitations of the current study. The current study only includes data from the first phase of the SCCS prospective cohort study, making these results cross-sectional in nature. The cross-sectional nature of the present data precludes making conclusions about causal processes. The hypothesis that eating problems moderate the association between depressive symptoms and BMI needs to be tested in longitudinal data sets.

As SCCS was designed to study the racial disparities in risk factors for cancer and other medical disease, only brief assessments of mental health and behavior are included. With only three questions assessing problem eating, our assessment of eating behavior is limited. Future research should include a more detailed assessment of eating behavior and depression.

One advantage of the current study is the large population-based sample. However, despite its large size, this sample is limited in some respects, particularly age. With no participants under the age of 49, this limits the generalizability of the current findings. Further research should examine these questions in a more representative age sample. In addition, the sample has high levels of depression, low incomes which is also limiting.

In conclusion, current findings suggest an association between problem eating, depressive symptoms, and BMI. Problem eating may be one factor explaining the relationship between depressive symptoms and BMI.

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