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Is a dramatic increase in obesity associated with mental and physical health of the US working population?

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Abstract

Using the Behavioral Risk Factor Surveillance System (BRFSS) data, this study comprehensively examines the association between obesity and mental/ physical health of the US working population (aged 20 to 55) from 1993 to 2010. Rather than specific and objective clinical instrument, this study uses the self-reported general health measures such as the number of bad mental health days and the number of bad physical health days to assess the individual's health related quality of life. We find that mental and physical health has deteriorated between 1993 and 2010. This is more prominent for low income and less educated adults. Also, white and black adults have more days of bad mental and physical health over recent decades. Controlling for macro socio-economic factors, micro demographic characteristics, and which state they live, the negative association between obesity and mental health has become stronger between 1993 and 2010. The association is much stronger for low income as well as white and Hispanic female adults. On the other hand, surprisingly, obesity is weakly related to general physical health. Our findings suggest that the social cost of obesity may not only occur through diabetes, heath disease and other extreme illnesses but it may also occur through emotional and mental distress in general. Thus, we need to develop public policies focusing on obesity and general mental health at the same time.

Introduction

Healthy life, an ultimate goal of life, is a harmonious state of complete mental, physical, and social well-being (WHO, 1946) and is a major component of quality of life. Despite strenuous effort to be well and dramatic advancement in medical and material wellbeing, contemporary people seem not to be better off than before in health. One of the main risk factors for health discussed in recent decades is obesity. The obesity rate among U.S. adults has risen to more than 35% (or over 78 million) in 2010 (Ogden et al., 2012) and cast a tremendous burden on socio-economic cost in the US, around $ 215 billion annually (Hammond & Levine, 2010). Though an array of policy interventions to prevent and control obesity has been established, questions on the effectiveness of these programs have been frequently raised (Browne et al., 2004; National Alliance on Mental Illness report, 2006; Thomas, 2006). The reason is partly due to a lack of clear understanding on the association between general mental/physical health and obesity. If one would be associated with the other, policy intervention or treatment targets to control only either mental/physical health or obesity may not work well, nor enjoy synergy. In this regard, this study investigates the association between obesity and mental/physical health from 1993 to 2010 in U.S. working population using the Behavioral Risk Factor Surveillance System (BRFSS) data.

Previous Studies

Obesity and Depression

The National Health and Nutrition Examination Survey (NHANES) data show that more than one out of 20 Americans felt depression in any 2-week period in 2005-2006 (Pratt & Brody, 2008) and approximately one third of adults and one sixth of children and adolescents in the U.S

were obese (BMI ≥ 30), as of 2010[1]. These two fast growing epidemics are expected to be one of the leading contributors to the burden of disease in 2020 (Murray & Lopez, 1997).

As the depression[2] and obesity epidemic spreads, concern about the significant health and economic consequences has grown. Several studies have reported that depression provokes unhealthy behaviors such as sedentary lifestyle, smoking, excessive alcohol consumption, over-eating, and low levels of physical exercise, which lead to a higher incidence of chronic disease (Goodman & Whitaker, 2003; Katon, 2003; Van Gool et al., 2006). Depressives were reported to be the group most at risk for attempting or committing suicide (Vandivort & Locke, 1979). Obesity is also associated with a far-ranging negative effect on health, including high blood pressure (Chobanian et al., 2003), heart disease (Hubert et al., 1983; Freedman et al., 1999), diabetes (Mokdad et al., 2001; Aronne, 2002), osteoarthritis (Davis et al., 1990), and cancer of breast, endometrium, colon, and prostate (Abu-Abid et al., 2002) and as a result, leads to increased risk of morbidity and mortality (Van Italie, 1979; Must et al., 1992). Obviously, being depressed and being obese degrades 'Health-Related Quality of Life (HRQOL)' since they usually see their well-being worse than they appear (Dixon et al., 2003; Groessl et al., 2004; Jia & Lubekin, 2005; Moore et al, 2005).

Epidemic depression and obesity will cost the depressed and obese and the society an arm and a leg. Greenberg et al. (2003) reported that the total economic cost of depression was $83.1 billion in 2000, including $26.1 billion for direct treatment cost, $5.4 billion for suicide-related costs, and $51.5 billion for workplace costs from missing days and reduced productivity. Further,

[1] "U.S. Obesity Trends," Centers for Disease Control and Prevention, accessed March 28, 2012, http://www.cdc.gov/obesity/data/trends.html

[2] Mental health is widely categorized into anxiety disorder, mood disorder, impulse-control disorder, and substance use disorder, according to National Institute of Mental Health (NIMH)[2] and Kessler et al. (2005). Among them, mood disorder, especially depression, has been widely discussed and conjectured to be associated with obesity. In this review, we limit previous studies to depression related studies.

from 4.32% (Allison et al. 1999) to 5.7% (Wolf & Colditz, 1998) of national health care expenditures in the United States are attributable to obesity. Taking into account invisible productivity loss, physical inactivity, and the cost of weight loss program and intervention, this amount exceeds $215 billion annually (Hammond & Levine, 2010; Stein & Colditz, 2004).

As growing depression and obesity problem has been widely discussed and debated, a plethora of research studies have explored their causes. Certainly, many interrelated factors likely play a role to cause different types of depression: 'biological factors' such as heredity and chemical imbalance in the brain; 'social and psychological factors' such as stressful life events, loneliness, early childhood trauma and loss, low self-esteem, pessimism, and dependence, etc.; 'medical factors' such as chronic pains and disability and side effect of medication; 'lifestyle factors' such as sedentary lifestyle, unhealthy diet, and substance abuse (Judd, 2008; Von Gool et al., 2006). Similarly, numerous risk factors affecting excess weight gain have been explored: the environmental factors which promote increased energy intake and decrease energy expenditure such as the prevalence of fast food and habitual trend shift away from the consumption of meals at home (Chou et al., 2002; Currie et al., 2009; Jeffery & French, 1998; Papas et al., 2007); individual behavioral factors such as sedentary lifestyle and physical inactivity (Barlow & Dietz, 1998; Ebbeling et al., 2002; Gordon-Larsen et al., 2006; Gortmaker et al., 1999; Ludwig et al. 2001; Morril & Chinn, 2004; Papas et al., 2007); the interaction of social and psychological factors in a densely interconnected social network (Bahr et al., 2008; Christakis & Fowler, 2007; Hammond & Epstein, 2007).

In contrast to the concerted effort to document the risk factor of depression and obesity, psychopathological pathway between depression and obesity has been less broadly examined. Earlier, depression has been conjectured to be associated with obesity but, reported with

inconsistent causal direction and strength. Earlier research studies showed that there is no difference between the obese persons and persons of the normal weight with regard to psychopathological disturbance (Stunkard & Wadden, 1992). Recent research, however, has proposed various mechanisms to explain the unidirectional or reciprocal causal relationship between depression and obesity.

One the one hand, obesity might cause depression directly or indirectly. Biologically, obesity could induce alterations in the brain and risk of depression through increased risk of diabetes and insulin resistance (Luppino et al., 2010). Losing more weight is predicted to decrease depression symptoms (Dixon et al., 2003). Recent studies, however, have focused more on psychological pathways. Some scholars have paid attention to the direct relationship between the disparagement of the body image and depression. For example, in the U.S. where slimness is a socially accepted beauty ideal, obesity is a social stigma that prompts negative stereotyping, which, in turn, causes depression (Friedman & Brownell, 1995; Luppino et al., 2010; Puhl & Brownell, 2006). Other scholars have concentrated on indirect relationship between the two, mediated by disturbed eating patterns and eating disorders, but the findings are mixed. Smith et al. (1998) and Sherwood et al. (1999) find that persons with binge eating disorder have significantly higher BMIs and report more depressive symptoms. However, Linde et al. (2004) demonstrate that while weight, binge eating disorder, and current depression and depression history are highly correlated for women, they are not for men. Puhl & Brownell (2006) maintain that the obese are more likely to be exposed to weight stigmatization and depression but, frequent coping strategy to weight stigmatization is not binge eating disorder, though they experienced eating more or refusing to diet more than once. Furthermore, activity limitations due

to obesity or obesity-related chronic disease lead to risk of depression by reducing involvement in the pleasurable physical activity (Simon et al., 2006; Simon et al., 2008).

On the other hand, depression may increase the risk of obesity through such behaviors as binge eating, consumption of calorie-dense food, and reduced physical activity (Blaine, 2008). Recent findings show that easily prepared, highly palatable, and highly energy dense snacks and meals are more likely to be consumed among those who reported more eating under stress (Oliver & Wardle, 1999); those who are physically active are less likely to be depressed and to be obese (Cassidy et al., 2004). In terms of causal direction, Goodman & Whitaker (2003) and Blaine (2008) argue that baseline depressed mood worsens follow-up BMI for both those already obese at baseline and those not yet obese at baseline, while baseline obesity did not predict follow-up depression. The use of anti-depressants is also known to possibly induce weight gain due to improved appetite and more delightful eating resulting from diminished depression, though the exact underlying mechanism is ambiguous (Schwartz et al., 2004; Vanina et al., 2002). Further, depressed individuals are more likely to drop out from obesity control programs, partly because they eat more in an attempt to manage their negative feeling or partly because symptoms like lethargy and lack of motivation cause attrition (Clark et al., 1996).

These inconsistent evidences may be, in part, due to lack of longitudinal population-based samples (Oliver & Wardle, 1999; Luppino et al., 2010), heterogeneity of samples (Heo et al. 2006), restricted sample range (Linde et al., 2004; Simon et al., 2006), difference between clinical and epidemiological samples (Goodman & Whitaker, 2003; Sherwood et al.,1999; Smith et al., 1998), inconsistent control of moderators (Blaine, 2008; Clark et al., 1996; Dong et al., 2004; Friedman & Brownell, 1995; Heo et al., 2006; Puhl & Brownell, 2006), and possible

reciprocal, not unidirectional, association (Blaine, 2008; Luppino et al., 2010; Roberts et al., 2003; Simon et al., 2006).

We propose that prior studies have serious limitations to reveal the linkage between depression and obesity especially because of the following two reasons. First, findings based on community-based cross-sectional data may have limited explanatory power since antecedent factors and changes in depression and obesity themselves over time are not considered. Second, much of these studies have examined the linkage among diagnosed depressives who meet psychiatric diagnostic criteria. In this regard, we investigate the association between mental health and obesity in a nationally represented population, not patients only, using a question about recent perceived mental health status in BRFSS, not using symptom based assessment.

Obesity and Health-Related Quality of Life (HRQOL)

While it is well acknowledged that obesity is associated with disease specific morbidity and mortality among patients seeking treatment, recent researches have begun to document that obesity is associated with general poor Health-Related Quality of Life (HRQOL) in the general population (Fabricatore et al., 2005; Hassan et al., 2003; Katz et al., 2000; Swallen et al., 2005). Rather than a conventional medical outcome determined by the objective clinical assessment from the clinician's perspective, self-assessment on perceived current health status from the patient's perspective becomes more critical since it offers the overall condition on functioning and well-being and it can be used to evaluate the effects of treatment (CDC, 2000; Fontaine & Barofsky, 2001). In addition, HRQOL measures have been proven to be not only a reliable and valid indicator of general health needs with administrative efficiency but also a powerful predictor of mortality and morbidity (CDC, 2000; Hassan et al., 2003).

Not surprisingly, most studies confirmed the negative association between obesity and

physical HRQOL. The obese scored significantly lower on physical functioning and role limitations caused by physical problems since obesity reduces energy levels (Fontaine & Barofsky, 2001). The likelihood of experiencing bad physical days is 87% higher in extremely obese and 21% higher in obese than non-obese from cross-sectional analysis of 2000 BRFSS since various comorbidities and functional limitations associated with obesity may deteriorate physical quality of life (Hassan et al., 2003). Increased weights lead patients to be more likely to be limited in daily living activities (Katz et al., 2000). Obese adolescents are more likely to report poor general health and more functional limitation (Swallen et al., 2005)

However, the association between obesity and mental HRQOL has been quite controversial. Katz et al. (2000) and Swallen et al. (2005) demonstrate no significant difference in mental health between obese and non-obese. Fabricatore et al., (2005) also find the same evidence that increasing BMI is not related with depression. But, Hassan et al. (2003) shows that the likelihood of feeling bad mental days is 41% higher in extremely obese and 17% higher in obese compared to non-obese after controlling for diet and exercise from 2000 BRFSS.

This discrepancy may partly be due to sample selection and the nature of cross-sectional data. Clinical samples were subject to bias due to nonrandom sample selection and small sample size without controlling confounding factors (Fontaine & Barofsky, 2001; Hassan et al., 2003; Katz et al., 2000; Swallen et al., 2005). With agreement with the validated measure of HRQOL and the plausible bias embedded in small clinical samples, this study addresses commonly stated limitations in previous cross-sectional analysis, using the BRFSS data from 1993 to 2010 that is nationally representative.

Obesity and Socio-Economic Status (SES)

Previous studies have introduced numerous covariates, but with unclear findings. The association between depression and obesity is more likely to be observed among those who are experiencing more severe depression level and longer depression mood (Heo et al., 2006; Pine et al., 2001; Stunkard et al., 2003) and among the most obese individuals (De Wit et al., 2009; Dixon et al., 2003; Heo et al., 2006; Onylke et al., 2003; Stunkard et al., 2003). However, looking for the correlation depends upon how to define the depression and obesity. Further, it is greatly dependent on demographic, socioeconomic, genetic and familial factors, and their interaction. This complex interrelationship with even other compounding factors, such as smoking behavior or chronic illness, presents a challenge to disentangle. For instance, some researchers reported much stronger relationship between obesity and depression for women partly due to biological difference, perceptional disparity in dealing with stigmatization, and different preference and accessibility on treatment (Blaine, 2008; Carpenter et al., 2000; Heo et al., 2006; Istvan et al., 1992; Sherwood et al., 1999), while others reported no differences between female and male (Dong et al., 2004; Haukkala & Uutela, 2000; Linde et al. 2004; Simon et al., 2006). Some researchers find that the association between obesity and depression appears stronger among younger, well-educated, and non-Hispanic whites (Franko et al., 2005; Goodman & Whitaker, 2002; Simon et al., 2006), while other studies find that it is independent of age (Heo et al., 2006), education (Haukkala & Uutela, 2000; Pine et., 2001), race/ethnicity (Dong et al., 2000). Similarly, some researchers find that lower socioeconomic status leads to increased depression and obesity due to social isolation and lower self-esteem (Goodman & Whitaker, 2002; Goodman et al., 2003), whereas other studies find no significant relationship between socioeconomic status and being depressed and being obese (Dong et al., 2000; Pine et al., 2001).

Later, Stunkard et al. (2003) argued that obesity is positively related with depression for high SES women but is negatively related with depression for low SES women.

With respect to the association between HRQOL and obesity, only a few studies adopted socio-demographic status as covariates but, with inconsistent evidence. Katz et al. (2000) find that weight gain is negatively associated with HRQOL only for women and African Americans possibly because of different accessibility to treatment. Swallen et al. (2005) find that girls are more likely to than boys to report poor general health, functional limitation, and depression. They find that Hispanics and Asians are more likely than whites to report poor health related quality of life, while blacks are much less likely than whites to report it.

Few studies, however, have explicitly examined whether the association between mental/physical health and obesity varies by gender and race, income, and education over time. Our analysis shed more light on both macro socio-economic status (SES) and micro demographic characteristics in determining the association between mental/physical health and obesity over time. The association between mental/physical and obesity may depend on different SES and micro demographic characteristics since different groups with different SES may not only have different perception on desirable body size and shape, attitudes on body image, and weight concerns, but also have different dietary habits and physical activities and different accessibility on treatment, as shown in previous researches.

Data

In this paper we use the Behavioral Risk Factor Surveillance System (BRFSS) data – which was designed to measure behavioral risk factors for the adult population (18 years of age or older) living in households. BRFSS, initiated by the Centers for Disease Control and

Prevention (CDC) in 1984, is a cross-sectional telephone survey conducted by state health departments with guidelines and technical assistance provided by the CDC. It is the largest, continuously conducted telephone health survey in the world. BRFSS includes information on health risk behaviors, preventive health practices, and health care access primarily related to chronic disease and injury. The data also includes key individual demographic characteristics such as age, gender, race, marital status, employment status, and which state they live. Thus, BRFSS is ideal to study the relationship between obesity and mental/physical health over time.[3]

We define the population of analysis as men and women aged 20 to 55 years old surveyed from 1993 and 2010. This is the nationally representative sample of US working adults for past two decades. The yearly sample size of the study has gradually increased from 67,000 in 1993 to 186,000 in 2010. We do not include pregnant women (around 1.5% of the sample) in our defined sample because their BMI and physical/mental health measures are not reliable. We use individual body mass index (BMI) as an obesity measure recorded in BRFSS. BMI is measured by weight (kg)/ [height (m)]^2 and adult obesity is conventionally defined as a BMI of 30 or higher. We exclude individuals with BMI>=60 (around 0.1% of the sample) because their BMIs are too extreme to be reliable in this analysis. We create an obesity dummy variable that indicates 1 if 30<=BMI <60 and 0 if BMI<30. Also, note that the data in 50 states and District of Columbia (DC) are generally available through all years except in 2002 when 28 states and DC did not have the BRFSS survey.

In order to assess the individual's mental/ physical health, we use two self-reported health measures that are part of CDC's Health-Related Quality of Life (HRQOL) measures. CDC has defined Health-Related Quality of Life (HRQOL) as "an individual's or group's perceived physical and mental health overtime." In order to measure HRQOL, CDC uses a set of questions

[3] http://www.cdc.gov/brfss/about.htm

called the "Healthy Days Measures" since 1993 (CDC, 2000). The core 4 questions include the following:

1. Would you say that in general your health is excellent, very good, good, fair or poor?
2. Now thinking about your physical health, which includes physical illness and injury, how many days during the past 30 days was your physical health not good?
3. Now thinking about your mental health, which includes stress, depression, and problems with emotions, how many days during the past 30 days was your mental health not good?
4. During the past 30 days, approximately how many days did poor physical or mental health keep you from doing your usual activities, such as self-care, work, or recreation?

These four measures pertain to general self-rated health and recent days of physical health, mental health, and activity limitation. Especially, question 2 is a global measure of recent physical symptoms and question 3 is a global measure of recent mental and emotional distress. They are our main measures of an individuals' physical and mental health and are measured on a scale from 0 to 30. The validation of these measures is well supported in terms of various validity categories. CDC (2000) shows that these measures are correlated with other more objective or established health outcomes and measurements; it is well correlated with other categorical health-related responses; it also predicts well short-term mortality; it is acceptable for use with people with disabilities in both surveillance and research; it is reliable and responsive across general population.

Descriptive Statistics

Figure 1 clearly shows the upward trend of all three measures. Obesity rate was doubled from little less than 15% in 1993 for adults aged 20 to 55 and increased to just less than 30%.

Days of bad physical health also increased from less than 2.5 days to 3 days, around 20% increase. Days of bad mental health increased from little more than 3 days to little less than 4 days, around 30% increase. In Figures 2 and 3, we see the days of bad mental health and physical health by obese and non-obese adults. Figure 2 indicates that days of bad mental health increase over the period but the trend is steeper for obese adults. Thus, it seems that the association between obesity and bad mental health is stronger over years. Figure 3 suggests a different story for the association between obesity and bad physical health. Even though obese adults experience more days of bad physical health in 1993, the difference between obese and non-obese adults did not widen over years. It seems that the association between obesity and physical health has not changed over time.

Table 1 shows the obesity rate by the socio-economic status of the sample. It is clear that there has been a large increase in the obesity rate from 1993 to 2010 across different income, education, gender and race groups. Low income and less educated adults are more likely to be obese both in 1993 and 2010. Also, black and Hispanic men and women are more likely to be obese both in 1993 and 2010.

Tables 2 and 3 shows the descriptive statistics of variables we use in the analysis by obese and non-obese adults in 1993 and 2010. Obese adults are older than non-obese adults. Obese adults concentrate in low income and less educated groups consistent with Table 1. Obese adults are more likely to get married and live with children in 1993 while they are equally likely to get married and live with children in 2010. Sample weight in BRFSS is used for reported figures and tables.

Statistical Strategy and Main Results

In Figure 4, we frame a causal relationship between obesity and mental/ physical health. We understand that macro socio-economic factors affects obesity and physical/ mental health while obesity and physical/ mental health affects each other. For example, economic cycle and social norm change are macro socio-economic factors that can affect obesity and physical/ mental health. Also, as mentioned in the previous section, there have been many studies to show the causal and inverse-causal relationship between obesity and physical/ mental health depends on socio-economic characteristics such as income, education, gender and race. In this study, we focus on estimating the magnitude of the association between obesity and mental/ physical health over time controlling for macro socio-economic factors and other micro-demographic characteristics. In subsample analyses, we investigate how much obesity is associated with mental/ physical health in different socio-economic groups.

We use the OLS regression model with robust standard errors. The number of bad physical health days and the number of bad mental health days are used as outcome variables. In order to estimate the association between obesity and mental/ physical health conditions, year dummies with 1993 as a reference year are included to control for the macro-socio economic factors over time. The coefficient of obesity dummy variable indicates the association between obesity and health in 1993 and the coefficients of interaction terms between obesity and year dummies indicate the association between obesity and health in other years compared to 1993. We also control for micro-demographic characteristics using age dummies, the interaction terms between obesity dummy and age dummies, race dummies, education dummies, marital status dummy, dummy for whether living with children, dummy for whether living with other adults, gender dummy, and employment status dummy. Regional characteristics such as weather and local cultural and political differences are controlled for using state dummies. We control for all

covariates in the form of dummy variables because it allows us to control for macro- and micro-factors in a nonparametric fashion.

In Table 4, we report the estimated coefficients for all men and women aged 20 to 55 and those subgroups by income levels.[4] The estimated coefficients of year dummies indicate that working age men and women are increasingly more stressed and depressed. Compared to 1993, they experience around one more day of bad mental health in 2010. When we look at the estimates in different income groups, low income groups experience steeper increase in bad mental health days than high income groups. The lowest income group, less than $10,000, in 2010 have 2 more days of bad mental health than in 1993. On the other hand, the highest income group, more than $50,000, experience no increase in bad mental health days. It is possible that material hardship gets worse for low-income groups over time.

In order to know how obesity becomes an important factor in mental health, we look at the interaction terms between obesity and year dummies. In 1993, we find no association between obesity and mental health across all demographic groups. It seems that the difference of the number of bad mental health days in 1993 shown in Figure 2 disappear when we control for micro-social economic characteristics of individuals. However, the association between them has become stronger over years. Obese working age men and women feel more days of bad mental health, around 0.6 days in 2010, than in 1993. This association is much stronger for lower income individuals, around one more day for individuals who earn less than $20,000 in 2010 than in 1993. For high earners such as more than $50,000, the association between obesity and mental health is not there. It seems that the association between obesity and mental health is diluted by material wellbeing. But readers need to be cautious about this outcome because the

[4] In BRFSS, individual incomes are recorded in the shown intervals in Table 1. Thus, the real term of income of each income category must be lower in recent years than early years. In other words, people in the lowest income category, less than $10,000, may earn much less in 2010 than in 1993.

income category in this analysis is not adjusted for inflation because BRFSS have kept using the same unadjusted income category over time. Thus, individuals belonging to the low income category have become poorer over years and the stronger association may be driven by this data limitation.

In Table 5, we investigate the association between obesity and mental health for working men and women in different education levels. As we expect, individuals with higher education experience minor increase in bad mental health days over years compared to those with lower education. Individuals who obtain less than high school experience around 2 more days of bad mental health days in 2010 than in 1993. For obese individuals, education seems to not matter much in terms of mental health. Only individuals with some college education experience an increase in bad mental health days associated with obesity. This is an interesting outcome compared to Table 4 since less educated individuals feel more days of bad mental health but there is no difference in mental health between obese and non-obese adults that belongs in less educated individuals.

Table 6 shows the association between obesity and mental health for working men and women in race and gender. White and black men and women experience an increase in bad mental health days over years compared to other race and gender. They have around one more day of bad mental health in 2010 than in 1993. On the other hand, white and Hispanic women experience an increase in bad mental health days associated with obesity. This outcome is consistent with what previous research suggests. However, it is not clear what explains this stronger association in these female groups. More study is needed.

Tables 7 to 9 present the regression results to examine the relationship between obesity and physical health. Except for the outcome variable, the regression model and covariates are all

the same as before. We find that individuals experience more days of bad physical days in recent years, such as 2010 than earlier years such as 1993, and low income and less educated adults experience more days of bad mental health by around one to two days in 2010 compared to 1993. However, different from mental health, physical health is not correlated with obesity after controlling for macro socio-economic factors, micro-demographic characteristics, and which state they live. Except for the Asian men, obese adults do not have more days of bad physical health between 1993 and 2010. It seems that the wide difference of bad physical days between obese and non-obese adults shown in Figure 3 disappears when we control for covariates in the regression model. This is a surprising outcome since the negative relationship between obesity and physical health is widely acknowledged. We may have this finding since our sample does not have adults aged more than 55 and our physical outcome is the self-reported general health.

Discussion and Conclusion

There have been various studies to investigate the relationship between obesity and health due to the sharp increase in obesity rates in the recent decades raises a serious concern in terms of individual's wellbeing, health care cost, and labor productivity. However, findings are inconsistent and rarely based on the general population. Using the BRFSS data, this study comprehensively examines the association between obesity and mental/ physical health of the US working population over the recent two decades from 1993 to 2010. Rather than specific and objective clinical instrument, this study uses the self-reported general health measures such as the number of bad mental health days and the number of bad physical health days to assess the individual's health related quality of life. Self-assessed perceptions on unhealthy days are generally considered not only a simple and valid indicator of general health needs but also a

powerful predictor of mortality and morbidity (CDC, 2000). This study focuses on US adults aged 20 to 55 because they are the main work force in the US and main care givers of children. This sample definition also eliminates the complication of the analysis driven by aging population in the US.

We find that mental and physical health has deteriorated between 1993 and 2010. This is more prominent for low income and less educated adults. Also, white and black adults have more days of bad mental and physical health over recent decades. Controlling for macro socio-economic factors, micro demographic characteristics, and which state they live, the negative association between obesity and mental health has become stronger between 1993 and 2010. The association is much stronger for low income as well as white and Hispanic female adults. On the other hand, surprisingly, obesity is weakly related to general physical health.

Our findings suggest that the social cost of obesity may not only occur through diabetes, heath disease and other extreme illnesses but it may also occur through emotional and mental distress in general. Thus, we need to develop public policies focusing on obesity and general mental health at the same time.

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Figure 1. Obesity, Mental/ Physical Health

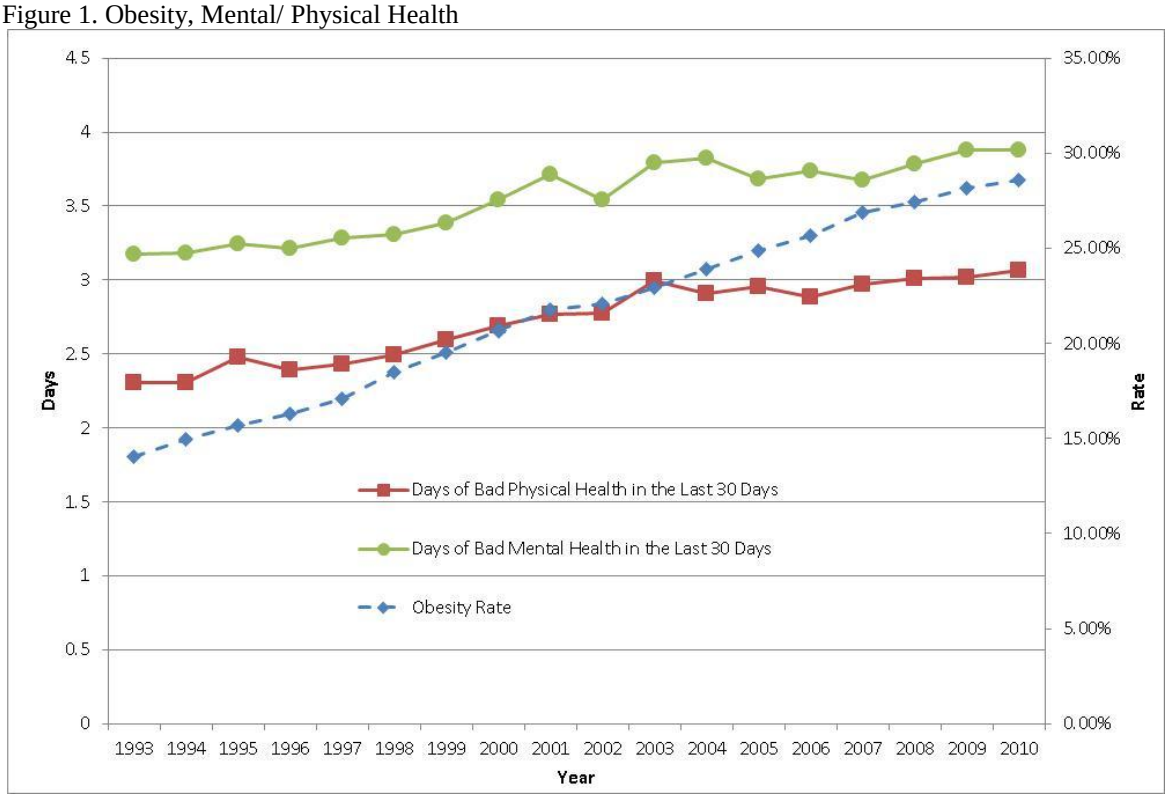

Figure 2. Days of Bad Mental Health in the Last 30 days

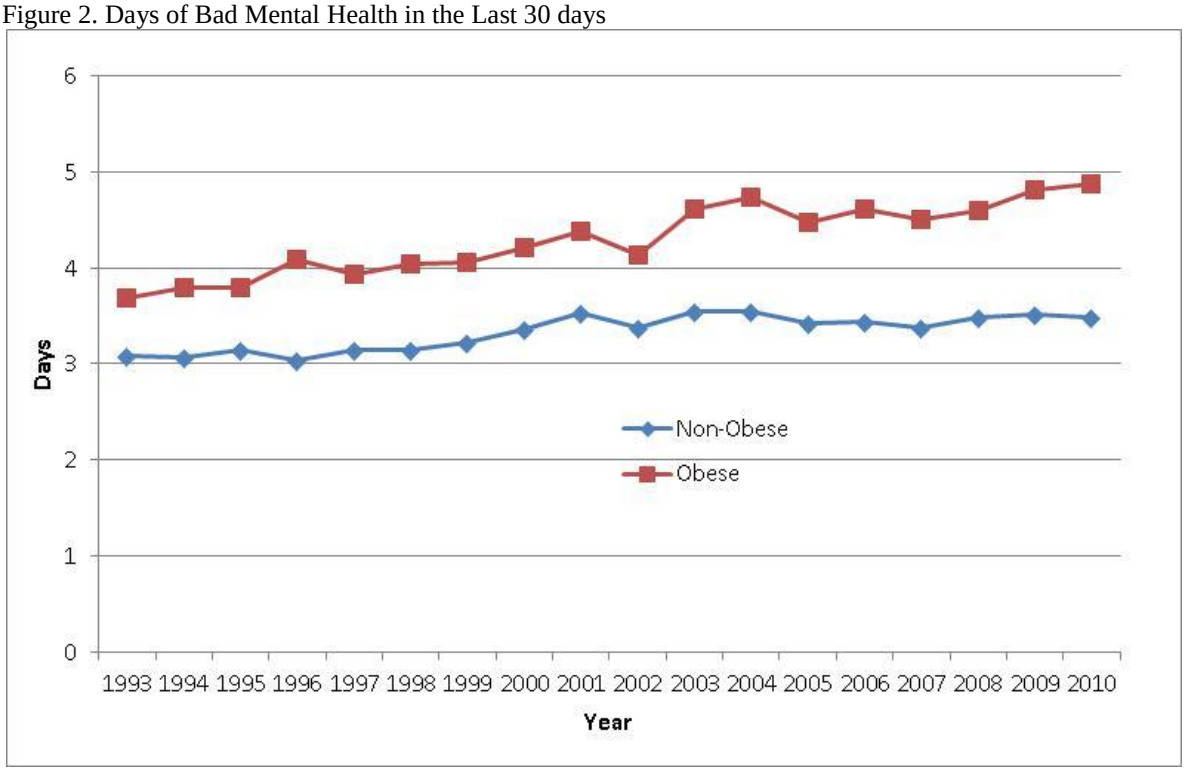

Figure 3. Days of Bad Physical Health in the Last 30 days

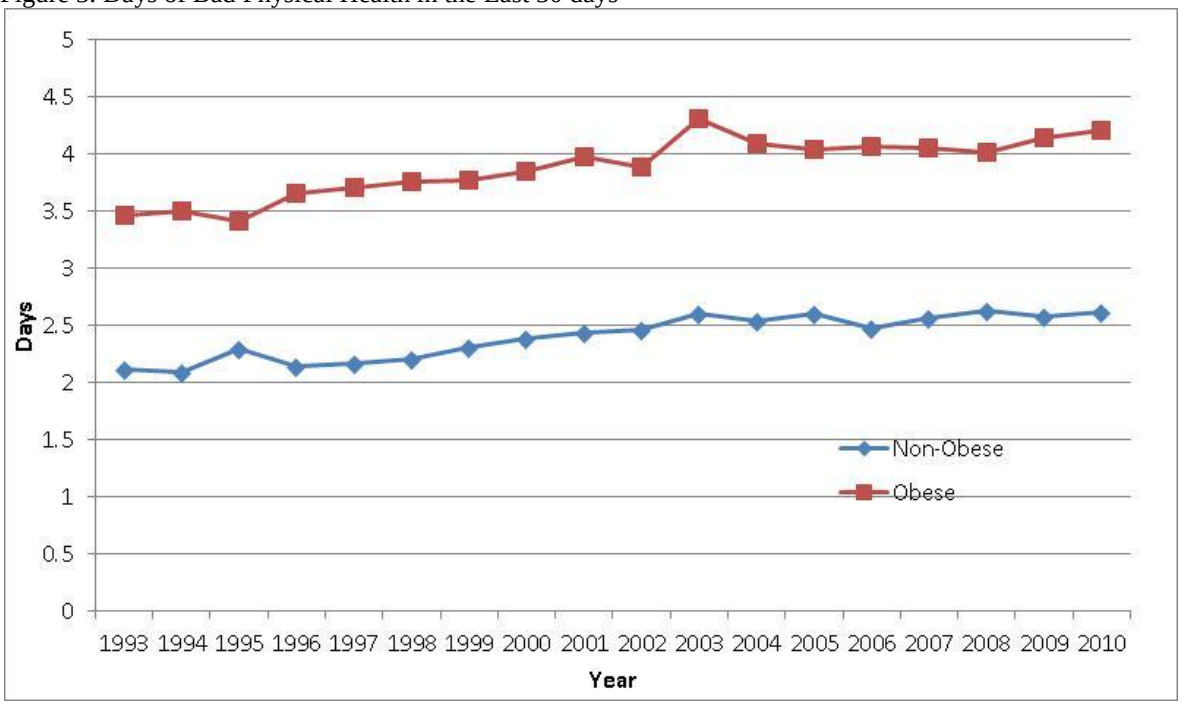

Figure 4. Causal Diagram between Obesity and Mental/ Physical Health

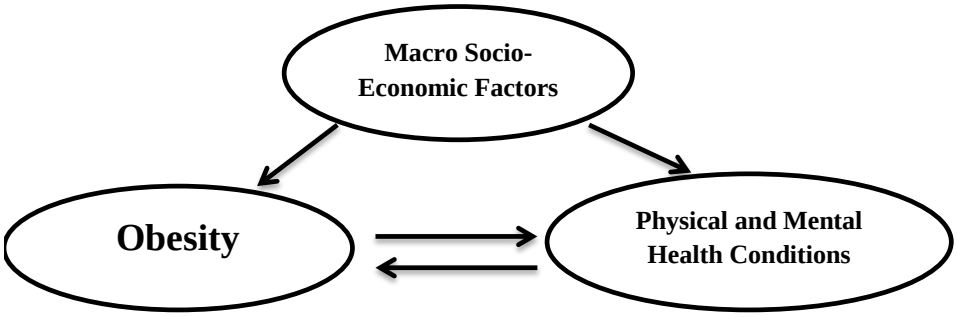

Table 1. Obesity Rate of Men and Women Aged 20 to 55

	1993	2010
All	14.02%	28.58%
Less than $10,000	17.99%	36.77%
$10,000 to $15,000	17.11%	37.91%
$15,000 to $20,000	17.66%	35.30%
$20,000 to $25,000	14.74%	34.26%
$25,000 to $35,000	14.06%	32.32%
$35,000 to $50,000	14.03%	31.02%
Over $50,000	11.21%	25.05%
9th grade or less	22.41%	36.84%
Some high school	19.91%	35.73%
High school graduate	16.12%	34.03%
Some college	13.59%	31.27%
College graduate or more	10.08%	21.55%
White Female	11.94%	24.26%
White Male	14.23%	29.34%
Black Female	25.60%	44.84%
Black Male	18.32%	36.56%
Hispanic Female	16.48%	31.77%
Hispanic Male	15.30%	32.52%
Asian Female	2.71%	8.03%
Asian Male	6.09%	9.74%

Sample Weight in BRFSS is used.

Table 2. Descriptive Statistics of Main Variables in 1993

	Non-Obese Adults		Obese Adults		All	
	Mean	St.D	Mean	St.D	Mean	St.D
Days of Bad Mental Health	3.09	6.78	3.68	7.44	3.17	6.88
Days of Bad Physical Health	2.12	5.59	3.46	7.42	2.30	5.90
Age	35.64	9.68	38.61	9.47	36.05	9.70
Less than $10,000	0.09	0.28	0.11	0.32	0.09	0.29
$10,000 to 15,000	0.08	0.27	0.10	0.30	0.08	0.27
$15,000 to 20,000	0.08	0.27	0.11	0.31	0.09	0.28
$20,000 to 25,000	0.10	0.30	0.10	0.30	0.10	0.30
$25,000 to 35,000	0.18	0.38	0.17	0.38	0.18	0.38
$35,000 to 50,000	0.21	0.41	0.20	0.40	0.21	0.40
Over $50,000	0.27	0.44	0.21	0.40	0.26	0.44
White	0.79	0.41	0.73	0.44	0.78	0.41
Black	0.08	0.28	0.14	0.35	0.09	0.29
Hispanic	0.09	0.28	0.10	0.30	0.09	0.28
Asian	0.03	0.17	0.01	0.09	0.03	0.16
Other Races	0.02	0.12	0.02	0.13	0.02	0.12
Less than 9th Grade	0.02	0.15	0.04	0.19	0.02	0.16
Some High School	0.06	0.24	0.09	0.29	0.07	0.25
High School Graduate	0.32	0.47	0.37	0.48	0.32	0.47
Some Collge	0.29	0.45	0.28	0.45	0.29	0.45
Collge Graduate or More	0.31	0.46	0.21	0.41	0.29	0.46
Currently Married	0.62	0.49	0.66	0.47	0.62	0.48
Whether Living with Children	0.52	0.50	0.56	0.50	0.53	0.50
Whether Living with Other Adults	0.86	0.35	0.85	0.35	0.86	0.35
Female	0.49	0.50	0.47	0.50	0.48	0.50
Employment	0.79	0.41	0.76	0.43	0.79	0.41

Sample Weight in BRFSS is used.

Table 3. Descriptive Statistics of Main Variables in 2010

	Non-Obese Adults		Obese Adults		All	
	Mean	St.D	Mean	St.D	Mean	St.D
Days of Bad Mental Health	3.48	7.43	4.88	8.94	3.88	7.92
Days of Bad Physical Health	2.61	6.60	4.21	8.43	3.07	7.21
Age	38.55	10.00	40.05	9.47	38.98	9.88
Less than $10,000	0.05	0.21	0.07	0.25	0.05	0.22
$10,000 to 15,000	0.04	0.19	0.06	0.23	0.04	0.20
$15,000 to 20,000	0.06	0.23	0.08	0.26	0.06	0.24
$20,000 to 25,000	0.07	0.26	0.09	0.29	0.08	0.27
$25,000 to 35,000	0.09	0.28	0.10	0.30	0.09	0.29
$35,000 to 50,000	0.13	0.33	0.14	0.35	0.13	0.34
Over $50,000	0.58	0.49	0.47	0.50	0.55	0.50
White	0.68	0.47	0.63	0.48	0.67	0.47
Black	0.09	0.28	0.15	0.36	0.11	0.31
Hispanic	0.14	0.35	0.17	0.37	0.15	0.36
Asian	0.05	0.23	0.01	0.11	0.04	0.20
Other Races	0.04	0.19	0.04	0.20	0.04	0.19
Less than 9th Grade	0.02	0.16	0.04	0.19	0.03	0.16
Some High School	0.05	0.22	0.07	0.26	0.06	0.23
High School Graduate	0.24	0.43	0.31	0.46	0.26	0.44
Some College	0.26	0.44	0.29	0.45	0.27	0.44
College Graduate or More	0.43	0.50	0.29	0.46	0.39	0.49
Currently Married	0.64	0.48	0.63	0.48	0.64	0.48
Whether Living with Children	0.59	0.49	0.59	0.49	0.59	0.49
Whether Living with Other Adults	0.89	0.31	0.88	0.32	0.89	0.31
Female	0.49	0.50	0.46	0.50	0.48	0.50
Employment	0.72	0.45	0.69	0.46	0.71	0.45

Sample Weight in BRFSS is used.

Table 4. Obesity and Days of Bad Mental Health by Income Levels

	All	Less than $10,000	$10,000 to $15,000	$15,000 to $20,000	$20,000 to $25,000	$25,000 to $35,000	$35,000 to $50,000	Over $50,000
yr1994	-0.12***	-0.25	0.3	-0.2	-0.05	0.21**	-0.16*	-0.12*
yr1995	0.32***	0.38	0.84***	0.02	0.03	0.20**	0.11	-0.01
yr1996	0.41***	1.05***	0.78***	-0.02	0.29**	0.19**	0.12	0.05
yr1997	0.42***	0.71***	0.89***	0.50***	0.22*	0.26***	0.01	0
yr1998	0.53***	0.61***	1.05***	0.56***	0.49***	0.28***	0.16**	0.07
yr1999	0.60***	1.32***	0.91***	0.65***	0.55***	0.41***	0.20**	0.05
yr2000	0.77***	1.42***	1.47***	0.80***	0.78***	0.58***	0.37***	0.09
yr2001	0.92***	1.83***	1.65***	1.26***	0.92***	0.73***	0.45***	0.19***
yr2002	0.75***	2.08***	1.74***	0.95***	0.72***	0.53***	0.40***	-0.07
yr2003	0.82***	1.96***	1.88***	1.15***	0.95***	0.70***	0.34***	0.02
yr2004	0.90***	2.17***	1.92***	1.47***	0.91***	0.66***	0.51***	0.07
yr2005	0.86***	2.32***	1.80***	1.20***	1.05***	0.64***	0.44***	0
yr2006	0.90***	2.41***	2.40***	1.36***	1.20***	0.74***	0.48***	-0.03
yr2007	0.91***	2.36***	2.45***	1.82***	1.11***	0.84***	0.37***	-0.03
yr2008	1.00***	2.57***	2.15***	1.78***	1.31***	0.92***	0.58***	0.04
yr2009	0.95***	2.21***	2.65***	1.79***	1.36***	0.82***	0.46***	-0.01
yr2010	0.99***	2.41***	2.49***	1.68***	1.47***	0.97***	0.49***	-0.01
obese	0.14	0.48	-0.46	-0.42	-0.13	0.64	0.07	0.59
obese*yr1994	0.07	0.41	-0.17	0.29	0.49	-0.60**	0.23	-0.09
obese*yr1995	0.30**	1.15**	1.24**	0.08	0.48	-0.06	-0.1	0.02
obese*yr1996	0.30**	-0.12	0.54	1.36***	0.34	-0.43	0.36	0.07
obese*yr1997	0.33***	0.85	0.77	0.68*	0.37	-0.19	0.01	0.11
obese*yr1998	0.39***	1.70***	0.77	0.56	0.70**	-0.42	0.15	0.09
obese*yr1999	0.35***	1.20**	0.6	0.3	0.61*	-0.25	0.13	0.06
obese*yr2000	0.40***	0.85*	1.66***	0.71*	0.51	-0.24	0.12	0
obese*yr2001	0.44***	1.73***	1.50***	0.41	0.71**	-0.23	0.09	0
obese*yr2002	0.21*	0.26	0.51	0.23	0.5	-0.24	-0.16	-0.12
obese*yr2003	0.52***	1.59***	1.05**	1.01***	0.67**	-0.35	0.27	0.04
obese*yr2004	0.57***	1.22***	1.23***	0.84**	1.09***	0.03	0.21	0
obese*yr2005	0.55***	1.00**	1.36***	0.93***	0.87***	-0.03	0.19	0.03
obese*yr2006	0.60***	1.08**	1.47***	0.74**	0.78**	-0.22	0.38*	0.12
obese*yr2007	0.64***	1.07**	1.15***	0.60*	1.14***	-0.01	0.45**	0.09
obese*yr2008	0.60***	0.91**	1.55***	0.75**	1.06***	-0.11	0.24	0.11
obese*yr2009	0.60***	0.92**	1.17***	0.71**	0.57*	0.02	0.39*	0.14
obese*yr2010	0.63***	0.74*	1.11***	1.08***	0.91***	-0.11	0.25	0.16
R Squared	0.0830	0.0989	0.0900	0.0606	0.0513	0.0339	0.0282	0.0236
N	2081219	104266	93144	135568	179765	279263	376928	912285

Note: * p<.1; ** p<.05; *** p<.01; Age dummies, interaction terms between obesity dummy and age dummies, race dummies, dummies for which state they live, education dummies, marital status dummy, dummy for whether living with children, dummy for whether living with other adults, gender dummy, and employment dummy are controlled for.

Table 5. Obesity and Days of Bad Mental Health by Education Levels

	All	9th grade or less	Some high school	High school graduate	Some college	College graduate or more
yr1994	-0.12***	-0.59	0.15	-0.06	-0.15*	-0.16**
yr1995	0.32***	0.72*	0.54**	0.33***	0.35***	0.15**
yr1996	0.41***	0.77*	0.51**	0.55***	0.35***	0.25***
yr1997	0.42***	1.28***	0.68***	0.55***	0.51***	0.09
yr1998	0.53***	1.51***	1.10***	0.61***	0.59***	0.23***
yr1999	0.60***	1.18***	1.48***	0.82***	0.60***	0.21***
yr2000	0.77***	1.77***	1.78***	1.02***	0.79***	0.31***
yr2001	0.92***	2.32***	1.87***	1.22***	0.94***	0.42***
yr2002	0.75***	2.47***	1.95***	1.04***	0.71***	0.25***
yr2003	0.82***	2.30***	2.11***	1.19***	0.75***	0.33***
yr2004	0.90***	2.31***	2.11***	1.25***	0.97***	0.32***
yr2005	0.86***	2.20***	2.34***	1.12***	0.88***	0.33***
yr2006	0.90***	2.12***	2.22***	1.26***	0.97***	0.31***
yr2007	0.91***	2.00***	2.14***	1.25***	0.97***	0.34***
yr2008	1.00***	2.27***	2.35***	1.36***	1.05***	0.41***
yr2009	0.95***	2.41***	2.22***	1.22***	1.09***	0.36***
yr2010	0.99***	2.48***	2.41***	1.32***	1.05***	0.38***
obese	0.14	2.68	-0.78	-0.08	0.39	-2.47***
obese*yr1994	0.07	-0.01	-0.02	0.01	0.27	-0.11
obese*yr1995	0.30**	-0.92	0.53	0.05	0.67***	0.14
obese*yr1996	0.30**	1.19	0.98*	-0.1	0.54**	0.18
obese*yr1997	0.33***	0.29	0.3	0.12	0.45**	0.25
obese*yr1998	0.39***	-0.06	0.49	0.28	0.36*	0.33*
obese*yr1999	0.35***	0.47	0.45	0.08	0.52***	0.12
obese*yr2000	0.40***	-0.53	0.93**	0.24	0.42**	0.12
obese*yr2001	0.44***	-0.13	0.69	0.08	0.57***	0.31*
obese*yr2002	0.21*	-1.15	-0.17	0.02	0.26	0.16
obese*yr2003	0.52***	-0.14	0.61	0.14	0.69***	0.31*
obese*yr2004	0.57***	0.25	1.18***	0.2	0.69***	0.24
obese*yr2005	0.55***	-0.38	0.35	0.37**	0.68***	0.25
obese*yr2006	0.60***	-0.13	1.05**	0.35**	0.63***	0.30*
obese*yr2007	0.64***	0.04	0.84**	0.34**	0.75***	0.33*
obese*yr2008	0.60***	0.23	1.21***	0.19	0.74***	0.28
obese*yr2009	0.60***	-0.14	1.41***	0.36**	0.58***	0.24
obese*yr2010	0.63***	0.01	0.7	0.40**	0.74***	0.26
R Squared	0.0830	0.1434	0.0934	0.0787	0.0739	0.0474
N	2081219	36018	107067	586178	604406	747550

Note: * p<.1; ** p<.05; *** p<.01; Age dummies, interaction terms between obesity dummy and age dummies, race dummies, dummies for which state they live, education dummies, marital status dummy, dummy for whether living with children, dummy for whether living with other adults, gender dummy, and employment dummy are controlled for.

Table 6. Obesity and Days of Bad Mental Health by Race and Gender

	All	White Female	White Male	Black Female	Black Male	Hispanic Female	Hispanic Male	Asian Female	Asian Male
yr1994	-0.12***	-0.16**	-0.17***	-0.01	0.14	-0.1	-0.11	0.05	0.05
yr1995	0.32***	0.39***	0.26***	0.47**	0.35*	0.03	0.09	-0.07	-0.11
yr1996	0.41***	0.54***	0.26***	0.81***	0.59***	0.03	0.33	0.75**	-0.19
yr1997	0.42***	0.61***	0.22***	0.50**	1.10***	0.24	0.23	0.09	0.11
yr1998	0.53***	0.70***	0.35***	0.93***	0.87***	0.23	0.42*	-0.13	-0.05
yr1999	0.60***	0.75***	0.47***	0.88***	1.15***	0.17	0.46*	-0.27	0.11
yr2000	0.77***	1.02***	0.57***	1.11***	1.13***	0.27	0.40*	0.17	-0.11
yr2001	0.92***	1.26***	0.68***	1.00***	1.24***	0.46*	0.47**	-0.34	0.07
yr2002	0.75***	1.10***	0.48***	1.65***	1.28***	-0.07	-0.14	-0.08	-0.17
yr2003	0.82***	1.10***	0.60***	0.96***	1.17***	0.44*	0.74***	0.19	0.15
yr2004	0.90***	1.19***	0.70***	1.11***	1.35***	0.36	0.39*	-0.01	0.41
yr2005	0.86***	1.19***	0.69***	1.06***	1.07***	-0.1	0.33	0.24	0.09
yr2006	0.90***	1.24***	0.69***	1.07***	1.06***	0.13	0.44**	0.25	0.07
yr2007	0.91***	1.26***	0.74***	1.04***	1.35***	-0.27	0.35	0.15	0.45*
yr2008	1.00***	1.31***	0.85***	1.26***	1.37***	0.29	0.41*	0.23	-0.04
yr2009	0.95***	1.30***	0.67***	1.39***	1.20***	0.28	0.54**	0.12	-0.01
yr2010	0.99***	1.34***	0.74***	1.24***	1.08***	0.27	0.60***	-0.06	-0.24
obese	0.14	0.76*	-0.07	-0.72	1.66*	-0.12	0.68	0.4	3.39
obese*yr1994	0.07	0.01	0.16	-0.11	-1.04*	0.3	0.86	0.37	0.05
obese*yr1995	0.30**	0.60***	0.03	0.26	-1.06*	0.47	0.69	0.19	0.67
obese*yr1996	0.30**	0.44**	0.21	0.07	-0.55	0.87	1.25*	-2.31*	0.81
obese*yr1997	0.33***	0.57***	0.12	0.62	-1.87***	1	0.71	-0.35	0.87
obese*yr1998	0.39***	0.67***	0.09	0.43	-1.01*	0.82	0.23	1.4	0.02
obese*yr1999	0.35***	0.53***	0.25	0.2	-1.19**	1.52**	0.44	1.19	-0.52
obese*yr2000	0.40***	0.72***	0.21	0.44	-1.52***	1.33**	0.85	0.39	-1.03
obese*yr2001	0.44***	0.64***	0.26*	0.73*	-1.13**	1.02*	0.35	1.35	-0.77
obese*yr2002	0.21*	0.42*	0	0.34	-1.44**	1.51**	0.26	-0.02	-0.54
obese*yr2003	0.52***	0.73***	0.22	0.58	-0.67	1.33**	0.87	-0.37	0.14
obese*yr2004	0.57***	0.90***	0.23	0.69*	-1.04**	1.27**	0.54	-0.29	-0.97
obese*yr2005	0.55***	0.81***	0.23	0.74**	-0.79	1.26**	0.35	0.16	-0.24
obese*yr2006	0.60***	0.87***	0.32**	0.81**	-0.92*	1.29**	0.25	1.01	0.12
obese*yr2007	0.64***	0.94***	0.28**	0.69*	-0.72	1.26**	0.63	0.75	-0.16
obese*yr2008	0.60***	0.89***	0.22	0.94***	-0.91*	0.93	0.77	1.04	-0.16
obese*yr2009	0.60***	0.89***	0.24*	0.48	-0.75	1.46**	0.54	0.39	0.77
obese*yr2010	0.63***	1.01***	0.32**	0.70*	-0.88*	1.27**	0.17	0.49	1.35
R Squared	0.0830	0.0853	0.0830	0.0600	0.0736	0.0442	0.0606	0.0408	0.0361
N	2081219	921929	701791	120337	60999	89487	63628	23585	20530

Note: * p<.1; ** p<.05; *** p<.01; Age dummies, interaction terms between obesity dummy and age dummies, race dummies, dummies for which state they live, education dummies, marital status dummy, dummy for whether living with children, dummy for whether living with other adults, gender dummy, and employment dummy are controlled for.

Table 7. Obesity and Days of Bad Physical Health by Income Levels

	All	Less than $10,000	$10,000 to $15,000	$15,000 to $20,000	$20,000 to $25,000	$25,000 to $35,000	$35,000 to $50,000	Over $50,000
yr1994	-0.08**	-0.44***	0.32**	0.21	-0.04	0	0.06	0
yr1995	0.33***	0.08	0.3	0.26*	0.15	0.11	0.18***	0.01
yr1996	0.36***	0.56***	0.43**	0.35**	0.14	0.09	0.11*	-0.01
yr1997	0.43***	0.41*	0.75***	0.37***	0.17	0.09	0.18***	0.08
yr1998	0.48***	0.53**	0.49***	0.55***	0.28***	0.17**	0.19***	0.06
yr1999	0.62***	1.07***	0.85***	0.59***	0.61***	0.33***	0.32***	0.03
yr2000	0.75***	1.20***	1.27***	0.86***	0.50***	0.44***	0.31***	0.18***
yr2001	0.81***	1.38***	1.13***	1.06***	0.63***	0.46***	0.38***	0.21***
yr2002	0.72***	1.27***	1.26***	0.63***	0.45***	0.39***	0.32***	0.11**
yr2003	0.77***	1.12***	1.49***	0.88***	0.71***	0.46***	0.36***	0.12***
yr2004	0.77***	1.35***	1.28***	1.04***	0.66***	0.31***	0.39***	0.13***
yr2005	0.90***	1.49***	1.60***	1.38***	0.88***	0.55***	0.47***	0.17***
yr2006	0.89***	1.86***	2.17***	1.39***	0.94***	0.47***	0.41***	0.10**
yr2007	0.93***	1.90***	1.81***	1.61***	1.04***	0.61***	0.47***	0.13***
yr2008	1.01***	2.04***	1.97***	1.69***	1.07***	0.65***	0.59***	0.17***
yr2009	0.82***	1.06***	1.69***	1.11***	0.63***	0.51***	0.35***	0.12***
yr2010	0.80***	1.25***	1.99***	1.14***	0.77***	0.45***	0.32***	0.03
obese	0.17	0.54	0.08	-0.26	-0.28	0.07	-0.24	0.64*
obese*yr1994	-0.09	-0.34	-0.25	-0.15	-0.04	-0.09	0	0.02
obese*yr1995	0.12	0.39	0.77	0.6	0.29	-0.03	-0.13	0
obese*yr1996	0.02	0.12	-0.53	1.09***	0.04	-0.26	0.03	-0.03
obese*yr1997	0.09	1.40***	0.74	0.32	0.18	-0.14	-0.06	-0.12
obese*yr1998	0.14	1.01**	0.58	0.45	0.15	-0.11	0.11	-0.06
obese*yr1999	0.11	0.38	0.5	0.53	0.01	-0.1	0.07	0.08
obese*yr2000	0.17*	0.28	0.72	0.25	0.59*	-0.15	0.2	0.09
obese*yr2001	0.28***	0.78	1.07**	0.87**	0.56*	0.15	0.32*	-0.04
obese*yr2002	0.11	0.39	0.2	0.51	-0.01	-0.16	0.42*	-0.01
obese*yr2003	0.32***	1.38***	0.48	1.08***	0.3	0	0.35*	0.1
obese*yr2004	0.34***	1.00**	0.67*	0.92***	0.62**	0.39*	0.15	0.06
obese*yr2005	0.32***	0.77*	0.91**	0.5	0.42	0.11	0.27	0.18
obese*yr2006	0.30***	0.87**	0.4	0.25	0.61**	0.26	0.32*	0.11
obese*yr2007	0.32***	0.71*	0.90**	0.51	0.41	0.16	0.44**	0.12
obese*yr2008	0.19**	0.13	0.28	0.45	0.46	0.11	0.1	0.15
obese*yr2009	0.20**	0.5	0.54	0.76**	0.48*	0.12	0.24	0.06
obese*yr2010	0.22**	0.14	0.23	0.71**	0.52*	0.1	0.31*	0.09
R Squared	0.1232	0.1871	0.1848	0.1292	0.1062	0.0692	0.0482	0.0264
N	2085189	104342	93274	135715	180041	279969	377790	914058

Note: * p<.1; ** p<.05; *** p<.01; Age dummies, interaction terms between obesity dummy and age dummies, race dummies, dummies for which state they live, education dummies, marital status dummy, dummy for whether living with children, dummy for whether living with other adults, gender dummy, and employment dummy are controlled for.

Table 8. Obesity and Days of Bad Physical Health by Education Levels

	All	9th grade or less	Some high school	High school graduate	Some college	College graduate or more
yr1994	-0.08**	-1.48***	-0.01	0.08	-0.03	-0.16***
yr1995	0.33***	-0.09	0.34	0.41***	0.43***	0.14***
yr1996	0.36***	0.22	0.50**	0.51***	0.40***	0.08
yr1997	0.43***	0.56	0.61***	0.56***	0.50***	0.16***
yr1998	0.48***	0.74*	1.05***	0.55***	0.61***	0.14***
yr1999	0.62***	0.89**	1.16***	0.81***	0.65***	0.26***
yr2000	0.75***	1.33***	1.25***	0.92***	0.83***	0.36***
yr2001	0.81***	1.31***	1.51***	1.02***	0.95***	0.33***
yr2002	0.72***	1.63***	1.45***	0.86***	0.84***	0.27***
yr2003	0.77***	1.66***	1.45***	1.09***	0.77***	0.31***
yr2004	0.77***	1.30***	1.59***	0.99***	0.86***	0.30***
yr2005	0.90***	1.42***	1.74***	1.16***	0.96***	0.41***
yr2006	0.89***	1.57***	1.52***	1.19***	0.99***	0.36***
yr2007	0.93***	1.52***	1.71***	1.24***	1.04***	0.39***
yr2008	1.01***	1.60***	1.81***	1.28***	1.17***	0.42***
yr2009	0.82***	1.42***	1.36***	0.98***	0.93***	0.36***
yr2010	0.80***	1.51***	1.53***	1.06***	0.89***	0.26***
obese	0.17	-1.07	-0.78	-0.25	0.77***	0.33
obese*yr1994	-0.09	0.64	-0.1	-0.09	-0.3	0.11
obese*yr1995	0.12	1.44	0.82	-0.09	-0.03	0.14
obese*yr1996	0.02	1.70*	-0.19	-0.17	-0.01	0.13
obese*yr1997	0.09	0.6	0.18	0.07	0.04	0.02
obese*yr1998	0.14	0.1	0.47	0.16	-0.25	0.32*
obese*yr1999	0.11	0.56	0.08	0.11	-0.01	0.1
obese*yr2000	0.17*	-0.03	0.62	0.2	0.06	0.08
obese*yr2001	0.28***	0.92	0.47	0.29*	0	0.36**
obese*yr2002	0.11	-1.02	0.67	0.15	-0.15	0.21
obese*yr2003	0.32***	0.33	0.89**	0.17	0.27	0.25
obese*yr2004	0.34***	1.01	0.36	0.44***	0.16	0.2
obese*yr2005	0.32***	-0.11	0.61	0.32**	0.09	0.39***
obese*yr2006	0.30***	0.22	0.85**	0.32**	0.04	0.29*
obese*yr2007	0.32***	0.36	0.32	0.29*	0.19	0.31**
obese*yr2008	0.19**	0.15	0.81*	0.06	-0.01	0.26*
obese*yr2009	0.20**	0.54	0.62	0.21	-0.08	0.25*
obese*yr2010	0.22**	0.26	0.45	0.1	0.08	0.27*
R Squared	0.1232	0.2089	0.1624	0.1285	0.1117	0.0577
N	2085189	36056	106985	587017	605838	749293

Note: * p<.1; ** p<.05; *** p<.01; Age dummies, interaction terms between obesity dummy and age dummies, race dummies, dummies for which state they live, education dummies, marital status dummy, dummy for whether living with children, dummy for whether living with other adults, gender dummy, and employment dummy are controlled for.

Table 9. Obesity and Days of Bad Physical Health by Race and Gender

	All	White Female	White Male	Black Female	Black Male	Hispanic Female	Hispanic Male	Asian Female	Asian Male
yr1994	-0.08**	-0.19***	-0.02	0.09	-0.13	0.11	0.28	-0.05	0.07
yr1995	0.33***	0.34***	0.31***	0.48***	0.1	0.13	0.55**	0.15	-0.36
yr1996	0.36***	0.43***	0.29***	0.56***	0.55***	0.28	0.1	0.26	-0.25
yr1997	0.43***	0.53***	0.36***	0.42***	0.60***	0.3	0.26	0.21	0.15
yr1998	0.48***	0.52***	0.50***	0.68***	0.58***	0.13	0.37*	-0.1	-0.43*
yr1999	0.62***	0.73***	0.52***	0.94***	0.76***	0.24	0.50**	0.14	-0.01
yr2000	0.75***	0.86***	0.65***	0.99***	0.87***	0.45**	0.54***	0.04	0.13
yr2001	0.81***	0.96***	0.68***	0.91***	0.66***	0.69***	0.68***	0.04	0.14
yr2002	0.72***	0.91***	0.53***	1.09***	0.82***	0.58***	0.1	0.06	-0.35
yr2003	0.77***	0.95***	0.64***	0.91***	0.71***	0.62***	0.69***	0.1	-0.14
yr2004	0.77***	0.94***	0.67***	0.85***	0.64***	0.40**	0.50**	0.19	-0.12
yr2005	0.90***	1.08***	0.84***	1.05***	0.65***	0.51***	0.35*	0.44*	0.12
yr2006	0.89***	1.08***	0.83***	0.95***	0.54***	0.40**	0.53***	0.40*	0.1
yr2007	0.93***	1.15***	0.87***	0.80***	0.82***	0.41**	0.68***	0.14	-0.08
yr2008	1.01***	1.24***	0.86***	0.81***	0.87***	0.63***	0.82***	0.19	-0.04
yr2009	0.82***	1.09***	0.60***	0.65***	0.32*	0.46**	0.25	0.29	0.11
yr2010	0.80***	1.06***	0.60***	0.73***	0.24	0.46**	0.41*	0.08	-0.1
obese	0.17	0.32	0.26	0.5	1.46**	0.13	-0.77	0.39	1.03
obese*yr1994	-0.09	-0.04	0.11	-0.78**	-0.78	0.01	-0.25	-0.48	2.04**
obese*yr1995	0.12	0.35*	-0.05	-0.24	-0.27	-0.27	0.52	-1.39	3.27***
obese*yr1996	0.02	0.12	0.02	-0.26	-0.72	-0.03	0.33	-0.79	1.70**
obese*yr1997	0.09	0.15	-0.05	0.13	-0.69	0.64	1.20**	-0.29	2.17**
obese*yr1998	0.14	0.35*	-0.13	0.13	-1.21**	0.29	0.71	-0.17	1.22*
obese*yr1999	0.11	0.19	0.09	-0.28	-0.75	0.66	0.71	1.12	1.53**
obese*yr2000	0.17*	0.45***	0.04	-0.25	-0.86*	0.16	0.82	-1.32	1.83***
obese*yr2001	0.28***	0.53***	0.11	-0.14	-0.54	0.3	0.92*	-0.04	0.89
obese*yr2002	0.11	0.43**	0	-0.78*	-0.66	0.13	1.18**	-0.16	1.11**
obese*yr2003	0.32***	0.52***	0.14	-0.17	-0.58	0.3	1.02**	0.76	2.70***
obese*yr2004	0.34***	0.55***	0.09	0.01	-0.07	0.67	0.83*	0	2.90***
obese*yr2005	0.32***	0.52***	0.12	0.07	-0.21	0.27	1.00**	-0.27	1.83***
obese*yr2006	0.30***	0.48***	0.08	0.02	-0.09	0.27	0.84*	-0.69	1.33**
obese*yr2007	0.32***	0.51***	0.11	0.14	-0.6	0.08	0.85*	0.6	2.01***
obese*yr2008	0.19**	0.37**	0.18	0.01	-1.09**	0.08	0.53	-0.46	2.06***
obese*yr2009	0.20**	0.39**	0.06	0	-0.48	0.47	1.15**	0.29	1.61***
obese*yr2010	0.22**	0.41***	0.09	0.1	-0.59	0.36	1.01**	-0.78	2.48***
R Squared	0.1232	0.1195	0.1466	0.1275	0.1421	0.0833	0.1085	0.0354	0.0374
N	2085189	924153	703682	120036	60961	89512	63673	23596	20531

Note: * p<.1; ** p<.05; *** p<.01; Age dummies, interaction terms between obesity dummy and age dummies, race dummies, dummies for which state they live, education dummies, marital status dummy, dummy for whether living with children, dummy for whether living with other adults, gender dummy, and employment dummy are controlled for.