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Personality disorders and body weight

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ABSTRACT

We examine the impact of Axis II personality disorders (PDs) on body weight. PDs are psychiatric conditions that develop early in life from a mixture of genetics and environment, are persistent, and lead to substantial dysfunction for the affected individual. The defining characteristics of PDs conceptually link them with body weight, but the direction of the relationship likely varies across PD type. To investigate these links, we analyze data from Wave II of the National Epidemiological Survey of Alcohol and Related Conditions. We measure body weight with the body mass index (BMI) and a dichotomous indicator for obesity (BMI $\geq$ 30). We find that women with PDs have significantly higher BMI and are more likely to be obese than otherwise similar women. We find few statistically significant or economically meaningful effects for men. Paranoid, schizotypal, and avoidant PDs demonstrate the strongest adverse impacts on women's body weight while dependent PD may be protective against elevated body weight among men. Findings from unconditional quantile regressions demonstrate a positive gradient between PDs and BMI in that the effects are greater for higher BMI respondents.

1. Introduction

This study examines the impact of Axis II personality disorders (PDs) on body weight. PDs are a class of psychiatric conditions that lead to diminished social functioning and impose substantial costs on both the disordered person and individuals with whom they interact. As defined by the American Psychiatric Association's *Diagnostic and Statistical Manual of Mental Disorders* (American Psychiatric Association, 2000), PDs are "pervasive, inflexible and enduring patterns of inner experiences and behavior that can lead to clinically significant distress or impairment in social, occupational, or other areas of functioning." The psychiatric literature attributes the development of PDs to a confluence of genetics and early childhood (ages 0–3) environment (American Psychiatric Association, 2000; Yudofsky, 2005). Given that PDs manifest themselves early in life and are exceedingly difficult if not impossible to treat (American Psychiatric Association, 2000; Yudofsky, 2005), they are considered lifetime conditions. Unlike better-known Axis I conditions (e.g., depression, generalized anxiety, schizophrenia, bipolar disorder), being diagnosed with a particular PD implies a lifetime with the disorder. Some of the most common PDs

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among the general public include antisocial, borderline, narcissistic, and obsessive-compulsive.

Although defining features of PDs (described in detail in Section 2) conceptually link these disorders with body weight, empirical evidence is scant. To the best of our knowledge, only two studies examine PDs and body weight using nationally representative data (Mather et al., 2008; Petry et al., 2008). Findings from both studies indicate a positive correlation between body weight and having a PD with the magnitude and statistical significance of the relationships varying across specific PD types. Although these studies are important and interesting, several key questions remain unanswered. Specifically, both Mather et al. (2008) and Petry et al. (2008) regress PD outcomes on measures of body weight. Because PDs develop early in life and are persistent, however, the implied direction of causality in these studies is counter to the psychiatric understanding of PDs. Nothing in the psychiatric literature supports the hypothesis that body weight in adulthood leads to the development of PDs. Instead, PDs manifest early in life and thus predate adult body weight by many years. In addition, neither Mather et al. (2008) nor Petry et al. (2008) examine the full set of PDs recognized by the APA (schizotypal, narcissistic, and borderline PDs are not available in their data sets) nor do they consider heterogeneity across PD type. Moreover, these studies rely on self-reported weight and height without correcting for the potential measurement error contained in self-reports, particularly for overweight and obese individuals (Cawley and Burkhauser, 2006; Rowland, 1990).

The paucity of rigorous empirical research is surprising given that PDs are prevalent in society and obesity is a major public health concern. Statistics based on nationally representative community-based samples from the early 2000s suggest that 9–15% of American adults meet clinical PD criteria (Grant et al., 2004; Lenzenweger et al., 2007). Moreover, PDs are documented risk factors for poor health and health behaviors (Brent et al., 1994; Chen et al., 2008; Compton et al., 2005, 2007; Eaton et al., 2008; Grant et al., 2004; McWilliams et al., 2008; Pietrzak et al., 2007; Samuels, 2011; Skodol et al., 2002), and increased utilization of health care and social services (Feenstra et al., 2012; Gustavsson et al., 2011; Maclean et al., 2013; Samuels, 2011; Soeteman et al., 2008; Vaughn et al., 2010).

In 2010, 35.7% of adult men and 35.8% of adult women in the U.S. were obese (Flegal et al., 2012). Obesity is the second leading cause of preventable death and contributes to a host of morbidities including Type II diabetes, asthma, cancer, and heart disease (Dixon, 2010). As a result of these health problems, obesity raises annual health care costs by an estimated $2741 per obese adult ($190.2 billion per year overall) representing 20.6% of U.S. national health care expenditures (Cawley and Meyerhoefer, 2012). Moreover, obesity leads to lower productivity in the labor market (Baum and Ford, 2004; Cawley, 2004; Han et al., 2009) and the intergenerational transfer of obesity may result in spillover effects for future generations (Agras and Mascola, 2005). Thus, identifying important risk factors for obesity and leveraging this information to design effective health policies and health care interventions can improve population health, reduce health care costs, and enhance labor market productivity.

2. Background on Axis II personality disorders

This section describes the etiology and common features of PDs, and discusses how these disorders are conceptually related to body weight.

2.1. Background on Axis II personality disorders

To be diagnosed with a PD, an individual must exhibit "an enduring pattern of inner experience and behavior that deviates markedly from the expectations of the individual's culture" (American Psychiatric Association, 2000). This pattern must manifest itself in at least two of the following ways: (1) cognition, (2) affectivity, (3) interpersonal functioning, and (4) impulse control. Furthermore, the pattern must be inflexible and pervasive across a broad range of personal and social situations; must lead to clinically significant distress or impairment in social, occupational, or other important areas of functioning; must be stable and of long duration, with onset traceable back to adolescence or at least early adulthood; and cannot be attributable to a manifestation or consequence of substance use, a medical condition, or another mental disorder.

The DSM divides PDs into three clusters. Cluster A, which incorporates a cognitive dimension (Paris, 2003), includes paranoid, schizoid, and schizotypal PDs. People with Cluster A disorders are often viewed as odd or eccentric, have abnormal cognitions or ideas, speak and act in strange ways, and have difficulty relating to others. Cluster B, which corresponds to externalizing dimensions (Paris, 2003), includes antisocial, borderline, histrionic, and narcissistic PDs. People with Cluster B disorders tend to act in dramatic, hostile, emotional, and erratic fashions; have difficulty with impulsive behavior; act out; and often violate social norms. Cluster C, which corresponds to internalizing dimensions (Paris, 2003), includes avoidant, dependent, and obsessive-compulsive PDs. People with Cluster C disorders are regularly anxious, fearful, and excessively afraid of social interactions and of feeling out of control. Appendix A offers a summary of the traits associated with each specific PD.

Based on their defining characteristics PDs could be related to body weight, and the relationships might differ across PDs. For example, borderline PD is associated with impulsivity. Persons affected by this condition may have problems with binge eating, which may increase body weight. Those who suffer from avoidant, schizoid, and schizotypal PDs shun activities that require personal interactions while those who suffer from paranoid PD are deeply distrustful of others. Persons affected by these conditions may avoid personal interactions and this may extend to exercise. Moreover, increased time in solitary activities may promote excess food consumption and corresponding weight gain.

Alternatively, specific PDs may protect against elevated body weight. Persons affected by dependent PD are easily hurt by criticism or disapproval and may maintain a healthy weight to prevent unwanted criticism. A defining

feature of narcissistic PD is a pre-occupation with beauty and attention. This feature may pre-dispose those affected by narcissistic PD to engage in diet and physical activities that promote beauty and garner positive attention, and thus protect against increased body weight.

The direction of the relationship with body weight for a final set of PDs is less clear. Features of antisocial PD include a predisposition toward substance use and a disregard for personal wellbeing. These characteristics may result in poor nutrition and physical activity patterns (e.g., under or over consumption of food), and thus increased or decreased body weight. Histrionic disorder is associated with an extreme focus on physical appearance and problems with impulsivity. Focus on physical appearance may yield healthy body weights (e.g., through regular exercise and proper nutrition). Alternatively a fixation on body weight may lead to eating disorders such as anorexia or bulimia and low body weight while problems with impulse control may lead to overeating and increased body weight. Those who suffer from obsessive-compulsive PD are preoccupied with rules, orderliness, and control. Their attention to detail might lead to improved health (e.g., unrelentingly adhering to recommended nutrition and physical activity guidelines), and thus lower the risk of elevated body weight. However, because persons with obsessive-compulsive PD may become overly focused on body weight, this may lead to problems with excessive food restriction and physical activity. Thus, the psychiatric literature suggests a strong, yet complex, conceptual link between PDs and body weight.

3. Conceptual framework

Almond and Currie (2011) develop a two-period health production function that permits health investments (health harming or health promoting) during childhood to have a sustained impact on adult health outcomes. In combination with the psychiatric literature detailed above, this model provides a useful framework within which to understand the impact of PDs on health broadly and we apply insight gained from this framework to empirically study the impact of PDs on body weight.

In the AC model, an individual's lifespan is divided into two periods: (1) childhood and (2) post childhood. This structure is formalized through a linear health production function:

$$h = A[\gamma I_1 + (1-\gamma) I_2] \quad (1)$$

where h is health in adulthood (i.e., post childhood), I_1 is health investments made in childhood, I_2 is health investments made post childhood, A is a shift parameter, and γ is a share parameter, which ranges from zero to one and captures the relative weights of I_1 and I_2.[1] If $\gamma \neq 0.5$, both the level and the timing of health investments are important for adult health. For example, if $\gamma > 0.5$, then health investments that occur in childhood yield higher returns than health investments occurring later in life. If $A\gamma > 1$, then adult health (h) is affected more than proportionally with childhood health investments (I_1). Thus, this framework allows health investments received in childhood to have a relatively large and sustained impact on adult health (e.g., to offset a negative health shock in childhood, the individual must compensate with a correspondingly larger health investment during the post childhood period). Because PDs develop early in life as a result of genetics and early childhood environment, they can be viewed as a form of negative health investment and are predicted to persistently impact health into adulthood in the AC framework. That PDs are notoriously difficult to treat is consistent with the model prediction that a relatively large investment in the post childhood period is necessary to offset a negative health investment received in the childhood period.

[1] Assuming a more complex health production function yields additional predictions, but a linear function conveys the basic model features.

4. Data, measures, and empirical model

4.1. Data

The National Epidemiological Survey of Alcohol and Related Conditions (NESARC) is a nationally representative survey conducted by the U.S. Bureau of the Census for the National Institute on Alcohol Abuse and Alcoholism (NIAAA). We utilize Wave II of the NESARC, which was fielded in 2004 and 2005, supplemented by Wave I data for selected PDs that were not re-measured in Wave II. Of the 43,093 Wave I respondents surveyed in 2001 and 2002, 34,653 (corresponding to an 86.7% retention rate) completed Wave II (National Institute on Alcohol Abuse and Alcoholism, 2010). Respondents were age 20 years and older in Wave II, and interviewed face-to-face through computer-assisted personal interviewing. The NESARC is particularly well-suited to our research as it is large and nationally representative, is specifically designed to measure psychiatric disorders including PDs, contains a rich set of personal characteristics, and contains classification of all ten PDs recognized by the APA. After excluding respondents with missing data, our final sample includes 14,368 men and 19,633 women ages 20 to 90, representing over 98% of the Wave II eligible sample.

4.2. Outcome variables

We examine two measures of body weight using Wave II data: a continuous measure for BMI (i.e., weight in pounds $\times$ 703/height in inches squared) and a dichotomous indicator for obesity (BMI $\geq$ 30). We report findings using the raw BMI variable, but results are similar in direction and statistical significance if we transform the measure into the natural logarithm of BMI. Weight and height are self-reported in the NESARC. Because self-reported weight and height are known to contain substantial reporting error (Rowland, 1990), we employ an algorithm to correct for potential reporting bias in these variables (Cawley and Burkhauser, 2006). This algorithm is based on comparisons of reported weight and height, and weight and height measured by trained medical

professionals in the Continuous National Health and Nutrition Examination Surveys (NHANES) 1999–2008.[2] Cawley and Burkhauser (2006) show that use of this algorithm can substantially reduce reporting error in body weight variables based on self-reports, thereby improving the accuracy of obesity status classification. Moreover, work by Rowland (1990) suggests that self-reports of weight and height can be unreliable for statistical analysis in specific sub-groups of the population. In a sensitivity analysis we re-estimate all models using BMI measures based on uncorrected weight and height, and results are consistent.

4.3. Axis II personality disorders

The independent variables of primary interest are PDs. NESARC administrators at the NIAAA utilized the Alcohol Use Disorder and Associated Disabilities Schedule DSM IV (AUDADIS) to classify respondents as meeting criteria for ten PDs disorders classified by the APA. The validity of the AUDADIS is well documented (Grant et al., 2003, 1995; Ruan et al., 2008) and this instrument is commonly utilized to diagnose psychiatric conditions, including PDs, in survey data (Blanco et al., 2008, 2013; Compton et al., 2005; Grant et al., 2008, 2005; Hasin et al., 2011; Sareen et al., 2011). NESARC respondents answered a series of questions on lifetime behaviors using a laptop computer. NIAAA epidemiologists later applied the AUDADIS algorithm to the completed surveys and determined whether a respondent met criteria for each specific PD. To receive a classification for a PD, NESARC respondents must have endorsed a requisite number of symptoms pertaining to the given PD (e.g., at least four of the seven criteria for avoidant PD), with a least one symptom causing social and/or occupational dysfunction. The AUDADIS is an objective instrument and leaves little discretion to the administrator: responses to yes/no questions are entered into the algorithm, which produces a binary indicator for meeting the PD.

In the NESARC, seven PDs are measured in Wave I (antisocial, avoidant, dependent, obsessive-compulsive, paranoid, schizoid, and histrionic) and four are measured in Wave II (antisocial, schizotypal, narcissistic, and borderline). To examine all ten PDs individually and collectively, we utilize information from both Waves I and II to construct our PD measures. In other words, our measures of avoidant, dependent, obsessive-compulsive, paranoid, schizoid, and histrionic PD are generated using data from Wave I while our measures of schizotypal, narcissistic, and borderline PD are generated using data from Wave II. We assume that if a PD was present in Wave I, it was also present in Wave II. This assumption is consistent with the persistent nature of PDs and underlies the decision of the NESARC administrators not to re-evaluate participants for all PDs at both waves. Antisocial is the only PD assessed in both Waves (for purposes of checking validity of this assumption) and we code respondents as meeting the antisocial PD criteria if NESARC administrators classify them with this PD in either Wave. The correlation between antisocial PD in Waves I and II is 97%,[3] which lends credence to the claim that PDs are persistent throughout the life-course.

We construct three distinct measures of PDs for the empirical models. First, we define a dichotomous measure for any PD, coded one if the respondent meets the criteria for any of the ten PDs measured in the NESARC, and zero otherwise. Second, we construct indicators for one PD and two or more PDs, with no PD as the omitted category. These variables allow us to explore dose-response relationships between PDs and body weight. Third, we include unique indicators for the ten specific PDs (these indicators are not mutually exclusive). Analysis of individual PDs can shed light on how the relationships between PDs and body weight vary across specific PD types.

4.4. Other control variables

In our core models we adjust for age, race/ethnicity, birth outside the U.S., region of residence, and rural status. To explore potential mechanisms through which PDs may impact body weight and minimize potential bias from omitted variables, we estimate models that sequentially include two blocks of variables: (1) household characteristics (household income, marital status, number of children in the household, presence of an infant in the household, education, health insurance, and employment) and (2) comorbidities (Axis I mental health disorders including manic episode, schizophrenia, major depression, and general anxiety; substance use including illicit drug abuse, alcohol abuse, smoking; and chronic health conditions including hypertension, Type II diabetes, heart attack, arthritis, and stroke).

4.5. Empirical model

To estimate the impact of PDs on body weight, we estimate the following reduced-form health production function separately by sex utilizing insight gained from the AC model:

$$B_i = \delta_0 + PD_i\delta_1 + X_i\delta_2 + \varepsilon_i \quad (2)$$

where B_i is a measure of body weight (BMI or an indicator for obesity), PD_i represents a single or multiple measures of PDs (i.e., any PD, one PD and two or more PDs, or unique indicators for each of the ten PDs classified by NESARC administrators), X_i is a vector of personal characteristics, the δ's are parameters to estimate, and ε_i is a random error term. We employ ordinary least squares (OLS) regression when the outcome variable is BMI and a logit model when the outcome variable is the obesity indicator. For the logit models, we report average risk differences, or marginal

[2] Cawley and Burkhauser (2006) utilized the NHANES III which was fielded between 1988 and 1994. Based on personnel communications with Professor Cawley, we updated this algorithm with the Continuous NHANES 1999–2008 to better match our study period (2004–2005).

[3] Of the respondents who participated in the Wave II survey ($N = 34{,}653$), 33,427 respondents did not have antisocial PD in either Wave; 1154 respondents had antisocial PD in both Waves; 0 respondents had antisocial PD in Wave I and not in Wave II; and 72 respondents had antisocial PD in Wave II and not in Wave I.

effects, for obesity between respondents with and without PDs. Risk differences are calculated by first setting the pertinent PD variable equal to one and estimating the probability or risk of the dependent variable ($p1$), then re-setting the PD variable equal to zero and re-estimating the risk of the dependent variable ($p0$). The estimated mean risk difference is the average of the individual risk differences ($p1 - p0$).

As we described earlier, we sequentially include household characteristics, chronic conditions, substance use, and Axis I mental health conditions into the health production function and compare parameter estimates across specifications. This approach allows us to explore potential mechanisms through which PDs may impact body weight. Specifically, if estimates decline in magnitude as we include additional covariates, this pattern of results suggests that these covariates are mechanisms for the relationship estimated in Eq. (2). While it is beyond the scope of this study to undertake a full analysis of mechanisms, we view this exploratory analysis as an important first step in understanding the role of PDs in body weight and leave a formal analysis for future work.

We contend that after including household characteristics, chronic conditions and substance use, and Axis I mental health conditions, the estimates generated in Eq. (2) should have a causal interpretation as we are able to address two crucial threats to identification: bias from reverse causality and omitted variables. First, given the etiology of PDs (i.e., PDs develop early in life as a result of genetics and environment and are persistent, thus predating adult body weight by many years) we can rule out reverse causality. Second, we are able to control for a detailed set of covariates that are not typically available in social science data sets (e.g., Behavioral Risk Factor Surveillance Survey, National Longitudinal Surveys of Youth) and thus are able to include important variables that are often omitted (e.g., socioeconomic status, physical health, Axis I mental health disorders).

In all analyses, we use survey commands in Stata MP Version 12 that account for survey design characteristics (StataCorp, 2011). In particular, we employ survey weights and cluster standard errors around the primary sampling unit. Thus, our findings are generalizable from the NESARC sample to the broader U.S. population ages 20–90 years.

5. Results

5.1. Summary statistics

Table 1 (males) and Table 2 (females) report summary statistics for each gender-specific sample, stratified by PD status. 23% ($N = 3459$) of men and 20% ($N = 4213$) of women meet the criteria for at least one PD. 10% of men and 9% of women have 2 or more PDs. The most prevalent PD for both men and women is obsessive-compulsive disorder: 35% of men with any PD and 40% of women with any PD. Dependent disorder is the least common PD: 1% of men and 3% of women with any PD.

Mean BMI among men and women in our sample is 28.46 (standard deviation [SD] = 5.42) and 27.93 (SD = 6.59), respectively. Obesity rates are 31% for men and 32% for women. BMI and the prevalence of obesity are higher among men with any PD (28.68 [SD = 5.80], 34%) than no PD (28.40 [SD = 5.29], 31%). This pattern is observed among women as well. Mean BMI is 28.91 (SD = 7.19) among women with a PD and 27.69 (SD = 6.41) among women without a PD. The percent obese among women with and without a PD is 38% and 30%, respectively. All of the sex-specific differences are statistically significant at $p < 0.05$ or lower (t-tests for BMI and χ^2 tests for obesity).

The demographics of our analysis sample are broadly consistent with the general U.S. population in terms of age, race/ethnicity, region, urbanicity, income, marital status, education, etc. For example, roughly 71%, 11%, 4%, 11%, and 2% of the sample is White, African American, Asian, Hispanic, and other non-white race, and 13% is foreign born. Moreover, approximately 14%, 27%, 31%, and 27% of the analysis sample have less than high school, high school, some college, and college education. We observe economically and statistically significance differences between respondents with and without a PD. On average, respondents not classified with a PD are more advantaged in terms of income, education, and access to private health insurance; have fewer chronic conditions and Axis I mental health disorders; are less likely to smoke; and are more likely to be married and less likely to be divorced or never married than respondents who are classified with a PD. Interestingly, respondents classified with a PD are more likely to work full time *and* to be unemployed than respondents who are not classified with a PD.

5.2. Body mass index results

Table 3 reports selected results from the BMI regressions. The top panel presents selected estimates for men and the bottom panel applies to women. In each panel, the results are presented sequentially for Models 1 (parsimonious controls), 2 (household characteristics), and 3 (comorbidities). The full set of estimated coefficients from the any PD specification (Model 3) is reported in Appendix Table B and additional results are available on request.

Among men, PDs are not significantly related to BMI. However, PDs are strongly related to BMI among women. The mean BMI among women is 27.93 (SD = 6.59). In Model 1, having any PD leads to a 1.02 unit increase in BMI ($p < 0.001$). Adjusting for household characteristics and comorbidities (Model 3) reduces the parameter estimate by nearly half to 0.50, but the estimated effect remains statistically significant ($p < 0.01$). Relative to the mean BMI for females, these coefficient estimates represent a 1.8–3.7% increase in BMI or 2.9–5.9 pounds for a 5′4″ woman. Results are consistent if we model PDs with indicators for one PD and two or more PDs. The coefficient on the indicator for two or more PDs is larger than the coefficient on the indicator for one PD in all specifications, although the coefficient on one PD is indistinguishable from zero in Model 3. This pattern is broadly consistent with a dose-response relationship between PDs and BMI in that higher levels of disorder have larger impacts on BMI. Avoidant PD has the largest impact on BMI among women. In the fully-adjusted model (Model 3), women with avoidant PD have a

Table 1
Weighted means and prevalence for body mass index, obesity, Axis II personality disorders, and socio-demographic characteristics among men.

	Full sample	No PD	PD	p-Value*
BMI (standard deviation)	28.46 (5.42)	28.40 (5.29)	28.68 (5.80)	0.037
Obesity (BMI $\geq$ 30)	0.31	0.31	0.34	0.006
Any PD	0.23	0.00	1.00	<0.001
One PD	0.13	0.00	0.57	<0.001
Two or more PDs	0.10	0.00	0.43	<0.001
Paranoid PD	0.04	0.00	0.16	<0.001
Schizoid PD	0.03	0.00	0.13	<0.001
Schizotypal PD	0.04	0.00	0.18	<0.001
Antisocial PD	0.06	0.00	0.26	<0.001
Borderline PD	0.06	0.00	0.24	<0.001
Histrionic PD	0.02	0.00	0.08	<0.001
Narcissistic PD	0.08	0.00	0.33	<0.001
Avoidant PD	0.02	0.00	0.08	<0.001
Dependent PD	0.00	0.00	0.01	<0.001
Obsessive-compulsive PD	0.08	0.00	0.35	<0.001
Age 20–25	0.10	0.09	0.13	<0.001
Age 26–30	0.09	0.08	0.13	<0.001
Age 31–35	0.10	0.09	0.11	0.004
Age 36–40	0.10	0.10	0.10	0.434
Age 41–45	0.11	0.11	0.11	0.560
Age 46–50	0.11	0.11	0.11	0.607
Age 51–55	0.09	0.10	0.08	0.087
Age 56–60	0.09	0.09	0.08	0.028
Age 61–65	0.05	0.05	0.04	0.066
Age 66–70	0.05	0.05	0.03	<0.001
Age 71–75	0.04	0.05	0.03	<0.001
Age 76–80	0.03	0.04	0.02	<0.001
Age 81–85	0.02	0.03	0.01	<0.001
Age 86+	0.01	0.01	0.01	0.023
White	0.71	0.72	0.69	0.008
African American	0.10	0.09	0.12	<0.001
Asian	0.04	0.05	0.03	0.005
Hispanic	0.12	0.12	0.13	0.580
Other non-white race	0.02	0.02	0.03	<0.001
Born outside the U.S.	0.14	0.15	0.11	<0.001
Resides in the South	0.39	0.39	0.38	0.573
Resides in the Northeast	0.18	0.18	0.18	0.966
Resides in the Midwest	0.18	0.18	0.19	0.792
Resides in the West	0.25	0.25	0.26	0.605
Lives outside an MSA	0.16	0.16	0.16	0.985
Household income <5k	0.01	0.01	0.02	0.048
Household income 5–20k	0.13	0.12	0.17	<0.001
Household income 20-40k	0.23	0.23	0.25	0.027
Household income 40–60k	0.20	0.20	0.20	0.828
Household income 60–80k	0.16	0.16	0.15	0.404
Household income 80–100k	0.09	0.10	0.08	0.010
Household income $\geq$100k	0.18	0.19	0.14	<0.001
Married or living as married	0.67	0.70	0.60	<0.001
Divorced/separated	0.10	0.09	0.13	<0.001
Widowed	0.03	0.03	0.02	<0.001
Never married	0.20	0.18	0.25	<0.001
Number of children in the household	0.58	0.58	0.58	0.995
Infant in the household	0.12	0.12	0.13	0.050
Less than high school	0.14	0.14	0.15	0.036
High school diploma	0.27	0.27	0.27	0.610
Some college	0.30	0.29	0.34	<0.001
College degree	0.29	0.30	0.23	<0.001
Private insurance	0.73	0.75	0.67	<0.001
Medicare	0.19	0.20	0.15	<0.001
Medicaid	0.04	0.04	0.07	<0.001
Other public insurance	0.12	0.12	0.13	0.268
Work full time	0.65	0.65	0.63	0.106
Work part time	0.08	0.08	0.10	0.005
Unemployed	0.03	0.03	0.06	<0.001
Not in the labor force	0.24	0.24	0.21	0.001
Manic episode	0.02	0.00	0.06	<0.001
Schizophrenia	0.01	0.00	0.02	<0.001
Major depression	0.05	0.03	0.15	<0.001
General anxiety	0.02	0.01	0.07	<0.001
Alcohol abuse	0.14	0.12	0.24	<0.001

Table 1 (*Continued*)

	Full sample	No PD	PD	*p*-Value*
Illicit Drug abuse	0.03	0.02	0.08	<0.001
Smoking	0.23	0.21	0.33	<0.001
High blood pressure	0.23	0.23	0.24	0.719
Diabetes	0.08	0.08	0.08	0.602
Heart attack	0.01	0.01	0.01	0.777
Arthritis	0.17	0.17	0.19	0.049
Stroke	0.01	0.01	0.01	0.526
N	14,368	10,909	3459	

* *p*-Values for differences in variable means (*t*-test) or proportions (χ^2-squared test) between the PD and no PD samples.

Table 2
Weighted prevalence of body mass index, obesity, Axis II personality disorders, and socio demographic characteristics among women.

	Full sample	No PD	PD	*p*-Value*
BMI (standard deviation)	27.93 (6.59)	27.69 (6.41)	28.91 (7.19)	<0.001
Obesity (BMI ≥ 30)	0.32	0.30	0.38	<0.001
Any PD	0.20	0.00	1.00	<0.001
One PD	0.11	0.00	0.55	<0.001
Two or more PDs	0.09	0.00	0.45	<0.001
Paranoid PD	0.05	0.00	0.25	<0.001
Schizoid PD	0.03	0.00	0.15	<0.001
Schizotypal PD	0.04	0.00	0.18	<0.001
Antisocial PD	0.02	0.00	0.10	<0.001
Borderline PD	0.06	0.00	0.31	<0.001
Histrionic PD	0.02	0.00	0.09	<0.001
Narcissistic PD	0.05	0.00	0.24	<0.001
Avoidant PD	0.03	0.00	0.14	<0.001
Dependent PD	0.01	0.00	0.03	<0.001
Obsessive-compulsive PD	0.08	0.00	0.40	<0.001
Age 20–25	0.09	0.08	0.12	<0.001
Age 26–30	0.09	0.08	0.11	<0.001
Age 31–35	0.09	0.09	0.12	<0.001
Age 36–40	0.09	0.09	0.11	0.002
Age 41–45	0.11	0.10	0.13	0.003
Age 46–50	0.10	0.10	0.10	0.796
Age 51–55	0.09	0.09	0.10	0.069
Age 56–60	0.09	0.09	0.07	<0.001
Age 61–65	0.05	0.05	0.04	0.001
Age 66–70	0.05	0.06	0.03	<0.001
Age 71–75	0.05	0.06	0.03	<0.001
Age 76–80	0.05	0.05	0.02	<0.001
Age 81–85	0.03	0.03	0.01	<0.001
Age 86+	0.02	0.03	0.01	<0.001
White	0.71	0.72	0.65	<0.001
African American	0.12	0.11	0.17	<0.001
Asian	0.04	0.04	0.03	0.010
Hispanic	0.11	0.11	0.12	0.260
Other non-white race	0.02	0.02	0.03	0.005
Born outside the U.S.	0.13	0.14	0.11	0.001
Resides in the South	0.38	0.38	0.38	0.910
Resides in the Northeast	0.18	0.18	0.19	0.329
Resides in the Midwest	0.19	0.19	0.18	0.630
Resides in the West	0.25	0.25	0.25	0.787
Lives outside an MSA	0.17	0.17	0.16	0.335
Household income <5k	0.02	0.02	0.02	0.006
Household income 5–20k	0.20	0.20	0.23	<0.001
Household income 20–40k	0.25	0.25	0.27	0.034
Household income 40–60k	0.19	0.19	0.18	0.401
Household income 60–80k	0.13	0.13	0.12	0.084
Household income 80–100k	0.07	0.07	0.07	0.448
Household income ≥100k	0.13	0.14	0.10	<0.001
Married or living as married	0.61	0.62	0.54	<0.001
Divorced/separated	0.13	0.12	0.18	<0.001
Widowed	0.11	0.12	0.07	<0.001
Never married	0.15	0.14	0.20	<0.001
Number of children in the household	0.64	0.62	0.74	<0.001
Infant in the household	0.13	0.12	0.15	<0.001
Less than high school	0.14	0.14	0.14	0.371
High school diploma	0.28	0.28	0.27	0.295

Table 2 (*Continued*)

	Full sample	No PD	PD	*p*-Value*
Some college	0.33	0.31	0.38	<0.001
College degree	0.26	0.27	0.21	<0.001
Private insurance	0.72	0.74	0.66	<0.001
Medicare	0.23	0.24	0.16	<0.001
Medicaid	0.08	0.07	0.14	<0.001
Other public insurance	0.11	0.11	0.11	0.583
Work full time	0.43	0.42	0.46	<0.001
Work part time	0.16	0.16	0.15	0.912
Unemployed	0.03	0.03	0.05	<0.001
Not in the labor force	0.39	0.40	0.34	<0.001
Manic episode	0.02	0.01	0.08	<0.001
Schizophrenia	0.01	0.00	0.02	<0.001
Major depression	0.11	0.07	0.26	<0.001
General anxiety	0.05	0.03	0.14	<0.001
Alcohol abuse	0.05	0.04	0.10	<0.001
Illicit Drug abuse	0.02	0.01	0.05	<0.001
Smoking	0.19	0.16	0.30	<0.001
High blood pressure	0.26	0.27	0.24	0.002
Diabetes	0.08	0.08	0.09	0.079
Heart attack	0.01	0.01	0.01	0.003
Arthritis	0.26	0.26	0.27	0.102
Stroke	0.01	0.01	0.01	0.347
N	19,633	15,420	4213	

* *p*-Value for differences in variable means (*t*-test) or proportions (χ^2-squared test) between the PD and no PD samples.

1.34 unit higher BMI than women without this disorder. Schizotypal PD leads to higher BMI among women, but the coefficient is attenuated and statistically indistinguishable from zero after adjusting for comorbidities in Model 3.

5.3. Obesity results

Table 4 presents the obesity results and the organization is similar to that in Table 3. The full set of estimated coefficients from the any PD specification (Model 3) is reported in Appendix Table C and additional results are available on request.

Among men, results suggest that those who meet criteria for PDs have a higher risk of being obese ($p < 0.05$). Quantitatively, men with a PD are 2.0 percentage points (6.5% at the sample mean) more likely to be obese than men without a PD based on estimates generated in Model 1. However, the coefficient estimates are attenuated after controlling for household characteristics (Model 2). In specifications that include indicators for one PD and two or more PDs, we observe some evidence of a dose-response relationship. The risk of obesity is higher among men with two PDs compared to those with one PD in Model 1, but coefficient estimates are attenuated and no longer statistically different from zero once we control for household characteristics. One interpretation of this finding is that household characteristics and comorbidities are important mechanisms through which PDs influence obesity risk. Interestingly, in models that include indicators for unique PDs, dependent PD *lowers* the risk of obesity. Men with dependent PD are 14–16 percentage points less likely to be obese than men without this PD. However, only 41 men in our analysis sample are classified with dependent PD, so this estimated effect may capture a data anomaly rather than a true relationship.

Women with PDs also have an increased risk of being obese. Women with any PD are 7 percentage points ($p < 0.001$) more likely to be obese than women without a PD (Model 1). The marginal effect is reduced to 4 percentage points ($p < 0.001$) in the fully-adjusted model (Model 3). Relative to the sample mean (32%), these coefficient estimates suggest that women with PDs are 12.5–21.9% more likely to be obese than women without PDs. The larger estimated effect sizes for obesity relative to BMI may indicate a threshold effect. For example, the weight increase attributable to a PD may push an already overweight woman into the obese category and this phenomenon is masked in OLS regression which estimates effects at the mean. Results are consistent in the models that include indicators for one PD and two or more PDs, as the risk of obesity is higher for women with two or more PDs than women with one PD. In specifications that include the full set of PD indicators, paranoid, schizotypal, and avoidant PDs have the largest impact on obesity risk. In the fully-adjusted model (Model 3), women with paranoid, schizotypal, and avoidant PDs are 5, 4, and 6 percentage points more likely to be obese than women without these PDs.

5.4. Unconditional quantile regressions

To explore heterogeneity in the relationships between PDs and BMI across the BMI distribution, we apply unconditional quantile regression or UQR (Firpo et al., 2009). UQR allows consistent estimates of treatment effects at virtually any quantile of the unconditional distribution (quantiles are points taken at regular intervals from the cumulative distribution function of a random variable) and may capture heterogeneity in relationships between PDs and BMI that are masked by OLS. As

Table 3
Selected estimation results for Axis II personality disorders and BMI.

	Model 1		Model 2		Model 3	
	Beta	95% CI	Beta	95% CI	Beta	95% CI
Men (sample mean BMI = 28.46; unweighted N = 14,368)						
Panel 1: Any PD						
Any PD	0.18	[−0.09,0.44]	0.19	[−0.07,0.45]	0.19	[−0.08,0.45]
Panel 2: Number of PDs						
1 PD	0.11	[−0.19,0.41]	0.11	[−0.18,0.41]	0.19	[−0.10,0.49]
2+ PD	0.27	[−0.14,0.68]	0.30	[−0.12,0.72]	0.18	[−0.23,0.59]
Panel 3: Type of PD						
Paranoid	−0.30	[−1.04,0.45]	−0.29	[−1.03,0.45]	−0.25	[−0.97,0.47]
Schizoid	0.27	[−0.46,1.00]	0.25	[−0.47,0.98]	0.11	[−0.57,0.79]
Schizotypal	0.30	[−0.35,0.95]	0.35	[−0.30,1.00]	0.08	[−0.54,0.71]
Antisocial	−0.13	[−0.69,0.43]	−0.17	[−0.72,0.37]	−0.01	[−0.52,0.51]
Borderline	0.28	[−0.29,0.85]	0.27	[−0.30,0.84]	0.18	[−0.39,0.75]
Histrionic	−0.08	[−1.03,0.87]	−0.06	[−1.00,0.87]	−0.08	[−0.98,0.82]
Narcissistic	−0.03	[−0.43,0.37]	0.02	[−0.38,0.41]	0.10	[−0.28,0.49]
Avoidant	−0.17	[−0.96,0.63]	−0.15	[−0.95,0.64]	−0.24	[−0.99,0.51]
Dependent	−2.25	[−4.70,0.20]	−2.29	[−4.72,0.14]	−1.61	[−4.04,0.83]
Obsessive-compulsive	0.26	[−0.19,0.72]	0.25	[−0.19,0.70]	0.16	[−0.28,0.60]
Women (sample mean BMI = 27.93; unweighted N = 19,633)						
Panel 1: Any PD						
Any PD	1.02***	[0.71,1.33]	0.77***	[0.46,1.07]	0.50**	[0.17,0.83]
Panel 2: Number of PDs						
1 PD	0.61**	[0.22,0.99]	0.49*	[0.11,0.86]	0.32	[−0.06,0.69]
2+ PD	1.53***	[1.09,1.97]	1.11***	[0.67,1.56]	0.77**	[0.29,1.25]
Panel 3: Type of PD						
Paranoid	0.74*	[0.15,1.34]	0.40	[−0.19,1.00]	0.30	[−0.29,0.88]
Schizoid	0.08	[−0.57,0.73]	0.01	[−0.66,0.67]	−0.13	[−0.77,0.51]
Schizotypal	1.03*	[0.18,1.88]	0.98*	[0.13,1.83]	0.62	[−0.16,1.40]
Antisocial	0.63	[−0.27,1.53]	0.27	[−0.65,1.18]	0.69	[−0.21,1.59]
Borderline	0.45	[−0.14,1.04]	0.10	[−0.49,0.69]	−0.15	[−0.74,0.45]
Histrionic	−0.22	[−1.18,0.74]	−0.25	[−1.19,0.69]	−0.00	[−0.89,0.88]
Narcissistic	0.36	[−0.20,0.93]	0.43	[−0.12,0.98]	0.36	[−0.18,0.90]
Avoidant	1.76***	[0.89,2.63]	1.59***	[0.71,2.47]	1.34**	[0.47,2.22]
Dependent	0.38	[−1.80,2.57]	0.07	[−2.10,2.24]	0.30	[−1.62,2.21]
Obsessive-compulsive	−0.16	[−0.62,0.30]	−0.02	[−0.48,0.44]	−0.17	[−0.61,0.28]

Notes: All models estimated with ordinary least squares and account for survey design with the Stata MP Version 12 survey commands. Coefficients are adjusted betas. Panel 1 reports estimates from specifications that model PDs with an indicator for any PD, Panel 2 reports estimates from specifications that model PDs with indicators for one PD and two or more PDs, and Panel 3 reports estimates from specifications that model PDs with indicators for type of PD. Model 1 adjusts for age, race, ethnicity, birth outside the U.S., region of residence, and rural status. Model 2 adjusts for Model 1 variables, household income, marital status, number of children, an indicator for an infant in the household, education, health insurance, and employment. Model 3 adjusts for Model 2 variables, past year Axis I disorders (manic episode, schizophrenia, major depression, general anxiety), substance use indicators (illicit drug abuse, alcohol abuse, smoking), and doctor-diagnosed chronic conditions (hypertension, Type II diabetes, heart attack, arthritis, stroke).

*** $p < 0.001$.

** $p < 0.01$.

* $p < 0.05$.

articulated by Manning et al. (1995), focusing on mean effects may miss important and policy relevant information. At present, there is no statistically valid method to cluster standard errors in UQR. Instead, we rely on parametric bootstrapped standard errors with 400 repetitions.

We first report UQR coefficient for the 5th through 95th quantiles in Fig. 1 (men) and Fig. 2 (women) in models that control for any PD and parsimonious controls, household characteristics, and comorbidities (Model 3). For comparison, we also report the OLS estimates from Model 3. The UQR results suggest that the relationships between PDs and BMI vary across the BMI distribution for women, but not for men. Effects are largest for women with BMIs beyond the 65th quantile. Interestingly, the relationship between PDs and BMI among women may be negative at lower BMI levels (≤30th quantile), although the coefficients are imprecisely estimated in this range. Previous work has linked PDs (specifically avoidant, borderline, and obsessive-compulsive) with anorexia and bulimia (Rosenvinge et al., 2000; van Hanswijck de Jonge et al., 2003; Yates et al., 1989). Taken together, this information suggests that PDs can either increase or decrease body weight, and focusing solely on the mean effects or particular points in the distribution masks this heterogeneity.

Based on our OLS and logit findings, dependent PD has the strongest impact on BMI among men and avoidant, paranoid, and schizotypal PDs have the strongest effects on BMI among women. To better understand how, and for which respondents, these PDs impact body weight, we apply UQR to the BMI specification that includes the ten unique PD indicators in Model (3). The findings are reported in Appendix Fig. A (dependent PD among men),

Table 4
Selected estimation results for Axis II personality disorders and obesity (BMI ≥ 30).

	Model 1		Model 2		Model 3	
	Risk Dif.	95% CI	Risk Dif.	95% CI	Risk Dif.	95% CI
Men (sample proportion obese = 0.31; unweighted N = 14,368)						
Panel 1: Any PD						
Any PD	0.02*	[0.00,0.04]	0.02	[−0.00,0.04]	0.01	[−0.01,0.04]
Panel 2: Number of PDs						
1 PD	0.02	[−0.01,0.04]	0.01	[−0.01,0.04]	0.02	[−0.01,0.04]
2+ PD	0.03*	[0.00,0.06]	0.03	[−0.00,0.06]	0.01	[−0.02,0.04]
Panel 3: Type of PD						
Paranoid	0.01	[−0.04,0.06]	0.01	[−0.05,0.06]	0.01	[−0.04,0.06]
Schizoid	0.02	[−0.04,0.08]	0.02	[−0.04,0.07]	0.01	[−0.05,0.06]
Schizotypal	0.04	[−0.01,0.09]	0.04	[−0.01,0.09]	0.02	[−0.03,0.07]
Antisocial	0.01	[−0.04,0.05]	−0.00	[−0.04,0.04]	0.01	[−0.03,0.05]
Borderline	0.01	[−0.03,0.06]	0.01	[−0.04,0.06]	−0.01	[−0.05,0.04]
Histrionic	−0.04	[−0.10,0.03]	−0.04	[−0.10,0.03]	−0.04	[−0.10,0.02]
Narcissistic	−0.00	[−0.04,0.03]	0.00	[−0.03,0.03]	0.00	[−0.03,0.04]
Avoidant	0.02	[−0.06,0.10]	0.02	[−0.06,0.10]	0.01	[−0.06,0.09]
Dependent	−0.16**	[−0.28,−0.04]	−0.16**	[−0.28,−0.04]	−0.14*	[−0.27,−0.01]
Obsessive-compulsive	0.01	[−0.02,0.05]	0.01	[−0.02,0.05]	0.01	[−0.03,0.04]
Women (sample proportion obese = 0.32; unweighted N = 19,633)						
Panel 1: Any PD						
Any PD	0.07***	[0.05,0.09]	0.05***	[0.03,0.07]	0.04**	[0.02,0.06]
Panel 2: Number of PDs						
1 PD	0.03**	[0.01,0.06]	0.03*	[0.00,0.05]	0.02	[−0.01,0.04]
2+ PD	0.11***	[0.08,0.13]	0.08***	[0.05,0.11]	0.06***	[0.03,0.09]
Panel 3: Type of PD						
Paranoid	0.08***	[0.03,0.12]	0.05**	[0.01,0.09]	0.05*	[0.01,0.09]
Schizoid	0.01	[−0.03,0.05]	0.00	[−0.04,0.04]	−0.00	[−0.04,0.04]
Schizotypal	0.06**	[0.02,0.11]	0.06*	[0.01,0.11]	0.04*	[0.00,0.09]
Antisocial	0.03	[−0.03,0.10]	0.01	[−0.05,0.07]	0.04	[−0.03,0.10]
Borderline	0.03	[−0.01,0.06]	0.01	[−0.03,0.04]	−0.01	[−0.04,0.03]
Histrionic	−0.04	[−0.10,0.01]	−0.04	[−0.10,0.01]	−0.03	[−0.08,0.03]
Narcissistic	0.02	[−0.01,0.06]	0.03	[−0.01,0.06]	0.03	[−0.01,0.06]
Avoidant	0.09**	[0.03,0.14]	0.08**	[0.02,0.13]	0.06*	[0.01,0.12]
Dependent	−0.00	[−0.11,0.11]	−0.02	[−0.13,0.09]	−0.00	[−0.10,0.10]
Obsessive-compulsive	−0.01	[−0.04,0.02]	−0.00	[−0.03,0.03]	−0.01	[−0.04,0.02]

Notes: All models estimated with logit and account for survey design with the Stata MP Version 12 survey commands. Coefficients are adjusted risk differences. Panel 1 reports estimates from specifications that model PDs with an indicator for any PD, Panel 2 reports estimates from specifications that model PDs with indicators for one PD and two or more PDs, and Panel 3 reports estimates from specifications that model PDs with indicators for type of PD. Model 1 adjusts for age, race, ethnicity, birth outside the U.S., region of residence, and rural status. Model 2 adjusts for Model 1 variables, household income, marital status, number of children, an indicator for an infant in the household, education, health insurance, and employment. Model 3 adjusts for Model 2 variables, past year Axis I disorders (manic episode, schizophrenia, major depression, general anxiety), substance use indicators (illicit drug abuse, alcohol abuse, smoking), and doctor-diagnosed chronic conditions (hypertension, Type II diabetes, heart attack, arthritis, stroke).

*** $p < 0.001$.

** $p < 0.01$.

* $p < 0.05$.

Fig. B (avoidant PD among women), Fig. C (paranoid PD among women), and Fig. D (schizotypal PD among women) and follow the same format as Figs. 1 and 2. Although the estimated coefficients for only one PD are reported in the figures, these regressions control for all ten unique PD indicators. Consistent with any PD indicator, the effect sizes may be larger for higher BMI persons. An exception is dependent PD: the influence of this particular PD on BMI may be strongest among lower BMI men. However, given the small number of men who are classified with this PD ($n = 41$), we encourage readers to interpret this finding with some caution.

6. Robustness checks

Trull and colleagues developed alternative, more restrictive, diagnostic rules to classify PDs using the NESARC data (Trull et al., 2010). Both the NESARC and Trull algorithms require the respondent to endorse the requisite number of DSM-IV symptoms for the specific disorder (e.g., at least four of the seven criteria for avoidant PD). The difference is that in the Trull algorithm all symptoms (not just one as in the NESARC algorithm) must cause social or occupational dysfunction in order to "count." As a sensitivity check, we implement the Trull algorithm to classify PDs and re-estimate all models. The prevalence of any PD using the Trull algorithm is 8.5% among men and 7.4% among women, which is substantially smaller than the PD prevalence estimates using NESARC criteria (23% and 20%, respectively). Nevertheless, the estimated effects are consistent with the findings based on the more inclusive PD definitions reported earlier and are available on request.

A common concern with longitudinal data such as the NESARC is non-random attrition. Although we almost exclusively utilize Wave II data in our analyses, this

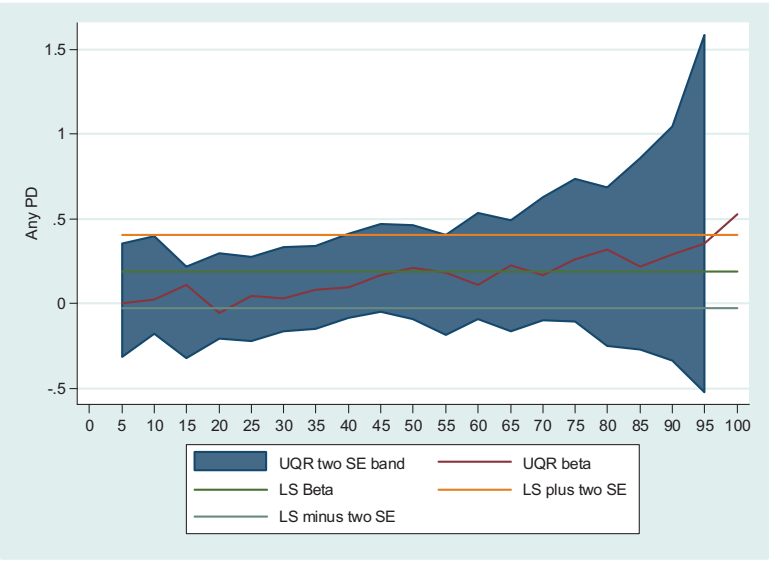

Fig. 1. Unconditional quantile regression results for Axis II personality disorders and BMI at the 5th through 95th quantiles among men. *Notes*: All models estimated with ordinary least squares and unconditional quantile regression, and account for survey design with the Stata MP Version 12 survey commands. Coefficients are adjusted betas. All models control for age, race, ethnicity, birth outside the U.S., region of residence, rural status, household income, marital status, number of children, an indicator for an infant in the household, education, health insurance, employment, past year Axis I disorders (manic episode, schizophrenia, major depression, general anxiety), substance use indicators (illicit drug abuse, alcohol abuse, smoking), and doctor-diagnosed chronic conditions (hypertension, Type II diabetes, heart attack, arthritis, stroke).

concern is relevant to our study as well. Respondents who attrite between Waves I and II may be inherently different from respondents who complete both waves. Such non-random attrition can lead to biased estimates (Wooldridge, 2010). To assess this potential data issue, we compare the PD status of Wave II non-responders (those who respond at Wave I and do not respond at Wave II) and responders (those who respond at both Wave I and II). These analyses are based on the seven PDs measured in Wave I and indicate no substantial differences in PD diagnoses between Wave II non-responders and responders. As an additional check, we re-estimate our models (again focusing on the seven PDs available in Wave I) using the sample of respondents who (1) completed Wave I only and

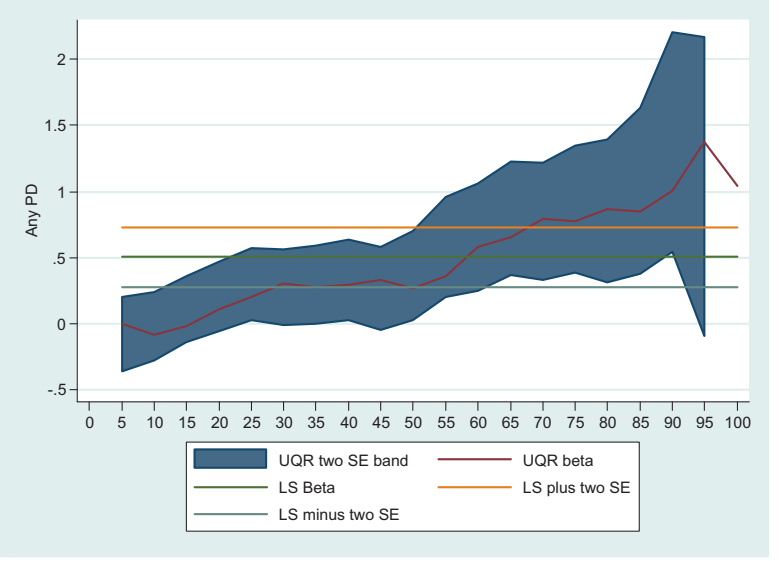

Fig. 2. Unconditional quantile regression results for Axis II personality disorders and BMI at the 5th through 95th quantiles among women. *Notes*: All models estimated with ordinary least squares and unconditional quantile regression, and account for survey design with the Stata MP Version 12 survey commands. Coefficients are adjusted betas. All models control for age, race, ethnicity, birth outside the U.S., region of residence, rural status, household income, marital status, number of children, an indicator for an infant in the household, education, health insurance, employment, past year Axis I disorders (manic episode, schizophrenia, major depression, general anxiety), substance use indicators (illicit drug abuse, alcohol abuse, smoking), and doctor-diagnosed chronic conditions (hypertension, Type II diabetes, heart attack, arthritis, stroke).

(2) completed both waves. The findings are consistent across these samples and further support our assumption that non-random attrition does not lead to significant bias in our data.

A related concern is whether persons affected by PDs are more or less likely to participate in the NESARC survey in Wave I. Although addressing this concern is beyond the scope of our study, it is important to consider how such behavior may impact the interpretation of our parameter estimates. If persons affected by PDs (and perhaps those persons who suffer from the most dysfunctional disorders) are less likely to participate in the NESARC survey altogether, then our estimates likely underestimate the true impact of PDs on body weight as we capture only a subset of relatively high-functioning disordered persons. On the other hand, if persons with PDs are more likely to participate in the NESARC survey then we will have an over-representation of disordered persons in our sample and the direction of bias is difficult to sign *ex ante*. We speculate based on defining features of PDs that the former scenario is more likely (e.g., individuals who suffer from paranoid PD are deeply distrustful of others and we suspect less likely to participate in surveys than non-disordered persons) and that our estimated impacts are lower bounds to the true effects. However, understanding how survey participation bias may impact the study of PDs specifically, and mental health conditions more broadly, is an important question for future work.

7. Discussion

The present study investigates the impact of PDs on body weight using the NESARC dataset. Our findings imply that women with PDs have significantly higher BMI and greater risk for obesity than women with no PDs. Specifically, our fully-adjusted models show that women with any PD have 1.8% higher BMI and are 12.5% more likely to be obese than women without PDs. Moreover, paranoid, schizotypal, and avoidant PDs demonstrate the strongest adverse impacts on body weight among women. We find few economically or statistically significant relationships between PDs and body weight among men. Considering heterogeneity in the relationships, our unconditional quantile regression results reveal particularly large effects at higher points in the BMI distribution.

Our findings for women are broadly consistent with the existing studies of PDs and body weight (Mather et al., 2008; Petry et al., 2008). However, unlike Mather et al. (2008) and Petry et al. (2008), we find little evidence that PDs are significantly related to body weight among men. We attribute differences between our findings and those of Mather et al. (2008) and Petry et al. (2008) to differences in modeling approach (e.g., we regress body weight on PDs while the Mather et al. (2008) and Petry et al. (2008) regress PDs on body weight) and use of control variables. We extend these previous two studies in several important ways. Namely, we (i) establish a causal relationship from PDs to body weight that is consistent with the psychiatric understanding of PDs, (ii) explore heterogeneity in the relationship across PD types, (iii) study the full set of PDs recognized by the APA, (iv) apply a correction algorithm to address errors in self-reported weight and height, and (v) allow relationships to vary across the BMI distribution.

Despite these advantages and enhancements, our study has several limitations that must be considered when interpreting the results. Because our PD measures are based on self-reported survey data rather than clinical diagnoses, we cannot rule out the possibility that our PD variables are measured with error. Although BMI is a standard measure of body weight, this variable has well-known limitations (Bohus, 2008; Burkhauser and Cawley, 2008). Unfortunately, the NESARC does not objectively measure height and weight nor does it include alternative measures such as percent body fat or waist circumference. Although we control for a rich set of covariates in our fully adjusted models (Model 3), some of these covariates may themselves be influenced by PDs. For example, previous work suggests that PDs impede labor market success (Ettner et al., 2011). Thus, while our specifications are better able to address bias from omitted variables, they may suffer from over-controlling or "bad control" bias (Angrist and Pischke, 2008). Moreover, even in a survey as rich as the NESARC, we are unable to control for all important variables, so some degree of residual omitted variable bias is probably present.

In conclusion, our results are compelling and timely, as obesity imposes substantial personal and social costs through increased medical care utilization, lowered productivity in the labor market, and other consequences. Under the Patient Protection and Affordable Care Act (ACA), doctors must identify obese patients and either provide counseling themselves or refer patients to a weight-loss program approved by the U.S. Preventive Services Task Force. Recommended programs involve intensive behavioral interventions, counseling, and pharmacotherapy, and entail 12–26 counseling sessions per year with a physician or community-based practitioner (McTigue et al., 2003). These ACA guidelines and recommendations have direct implications pertaining to our findings as the disorders that are most strongly associated with increased BMI and obesity risk include paranoid, schizotypal, and avoidant PDs. Features of these disorders may pose distinct challenges in weight-loss programs. Persons with paranoid PD are highly suspicious of others, have great concern that others have hidden motives, and often feel as though they are in danger, while persons affected by schizotypal PD are disinterested in social interactions of any type (A.D.A.M. Medical Encyclopedia, 2010). Persons affected with avoidant PD are easily hurt when criticized and avoid situations that involve contact with others. Understanding how PDs may affect weight-loss program participation and success is an important consideration for implementation of the ACA. Substance abuse treatment research suggests that patients with PDs respond better to conventional treatments that are sensitive to PD traits (Ekleberry, 2009). In this regard, developing weight-loss programs via the ACA that are tailored to the unique characteristics of the PD from which the patient suffers may be warranted.

Appendix A

See Figs. A, B, C and D and Tables A, B and C.

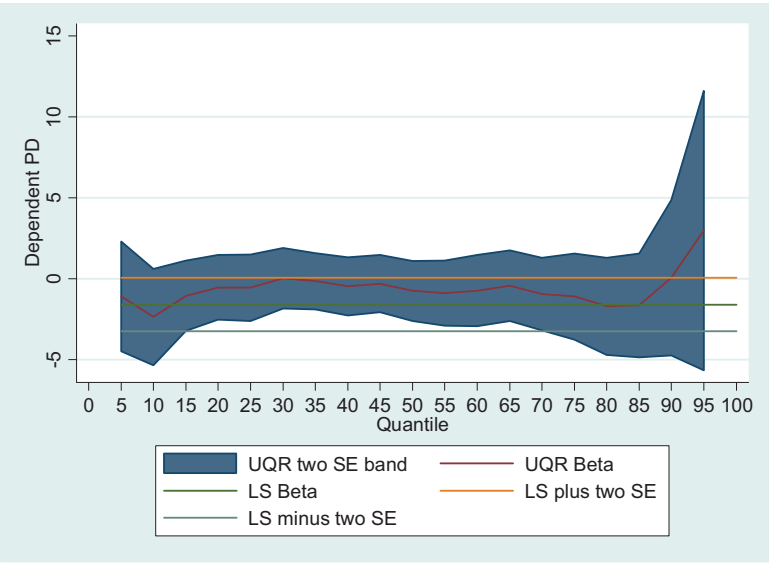

Fig. A. Unconditional quantile regression results for Axis II dependent personality disorder and BMI at the 5th through 95th quantiles among men. *Notes*: All models estimated with ordinary least squares and unconditional quantile regression, and account for survey design with the Stata MP Version 12 survey commands. Coefficients are adjusted betas. All models control for all ten unique PD indicators, age, race, ethnicity, birth outside the U.S., region of residence, rural status, household income, marital status, number of children, an indicator for an infant in the household, education, health insurance, employment, past year Axis I disorders (manic episode, schizophrenia, major depression, general anxiety), substance use indicators (illicit drug abuse, alcohol abuse, smoking), and doctor-diagnosed chronic conditions (hypertension, Type II diabetes, heart attack, arthritis, stroke).

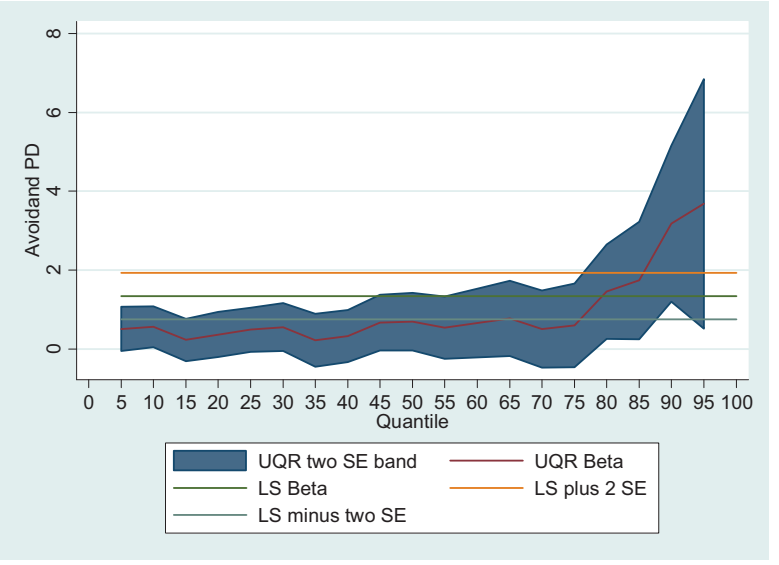

Fig. B. Unconditional quantile regression results for Axis II avoidant personality disorder and BMI at the 5th through 95th quantiles among women. *Notes*: All models estimated with ordinary least squares and unconditional quantile regression, and account for survey design with the Stata MP Version 12 survey commands. Coefficients are adjusted betas. All models control for all ten unique PD indicators, age, race, ethnicity, birth outside the U.S., region of residence, rural status, household income, marital status, number of children, an indicator for an infant in the household, education, health insurance, employment, past year Axis I disorders (manic episode, schizophrenia, major depression, general anxiety), substance use indicators (illicit drug abuse, alcohol abuse, smoking), and doctor-diagnosed chronic conditions (hypertension, Type II diabetes, heart attack, arthritis, stroke).

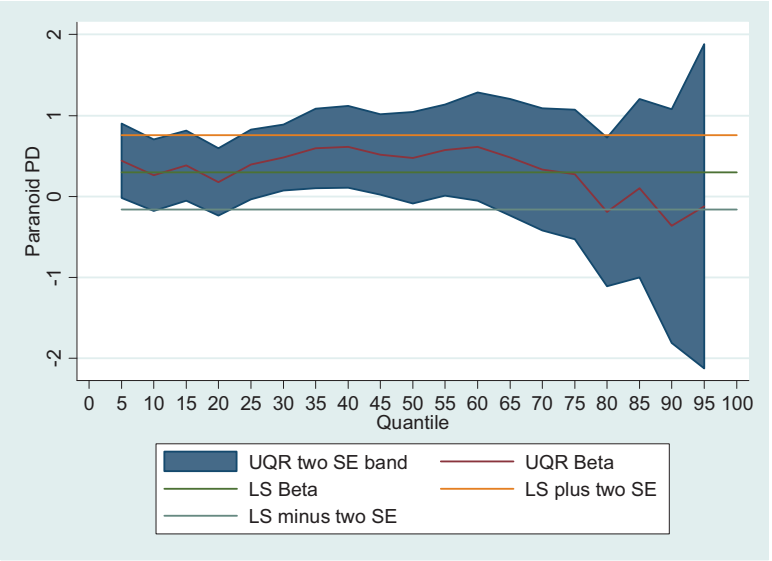

Fig. C. Unconditional quantile regression results for Axis II paranoid personality disorder and BMI at the 5th through 95th quantiles among women. *Notes*: All models estimated with ordinary least squares and unconditional quantile regression, and account for survey design with the Stata MP Version 12 survey commands. Coefficients are adjusted betas. All models control for all ten unique PD indicators, age, race, ethnicity, birth outside the U.S., region of residence, rural status, household income, marital status, number of children, an indicator for an infant in the household, education, health insurance, employment, past year Axis I disorders (manic episode, schizophrenia, major depression, general anxiety), substance use indicators (illicit drug abuse, alcohol abuse, smoking), and doctor-diagnosed chronic conditions (hypertension, Type II diabetes, heart attack, arthritis, stroke).

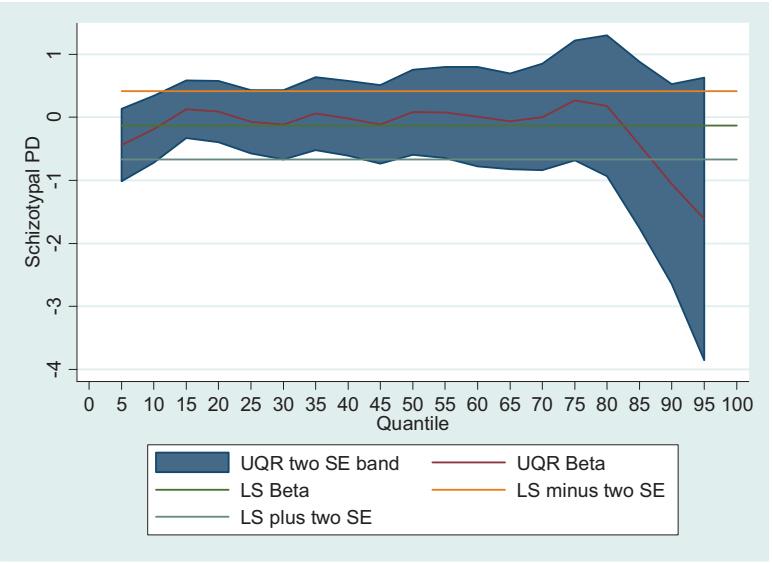

Fig. D. Unconditional quantile regression results for Axis II schizotypal personality disorder and BMI at the 5th through 95th quantiles among women. *Notes*: All models estimated with ordinary least squares and unconditional quantile regression, and account for survey design with the Stata MP Version 12 survey commands. Coefficients are adjusted betas. All models control for all ten unique PD indicators, age, race, ethnicity, birth outside the U.S., region of residence, rural status, household income, marital status, number of children, an indicator for an infant in the household, education, health insurance, employment, past year Axis I disorders (manic episode, schizophrenia, major depression, general anxiety), substance use indicators (illicit drug abuse, alcohol abuse, smoking), and doctor-diagnosed chronic conditions (hypertension, Type II diabetes, heart attack, arthritis, stroke).

Table A
Brief description of Axis II disorders.

Disorder	Individuals with this disorder:	Source
Cluster A		
Paranoid	"are highly suspicious of other people. As a result, people with this condition severely limit their social lives. They often feel that they are in danger, and look for evidence to support their suspicions. People with this disorder have trouble seeing that their distrustfulness is out of proportion to their environment."	A.D.A.M. Medical Encyclopedia (2010)
Schizoid	"are primarily characterized by a very limited range of emotion, both in expression of and experiencing. Persons with this disorder are indifferent to social relationships and display flattened affect."	PsyWeb.com (2012)
Schizotypal	"may be very disturbed. Their odd behavior may look like that of people with schizophrenia. For example, they may also have unusual preoccupations and fears, such as fears of being monitored by government agencies. More commonly, however, people with schizotypal personality disorder behave oddly and have unusual beliefs (such as aliens). They cling to these beliefs so strongly that it prevents them from having relationships. People with schizotypal personality disorder feel upset by their difficulty in forming and keeping close relationships."	A.D.A.M. Medical Encyclopedia (2011)
Cluster B		
Antisocial	"are characterized by a lack of regard for the moral or legal standards in the local culture. There is a marked inability to get along with others or abide by societal rules. Individuals with this disorder are sometimes called psychopaths or sociopaths."	PsyWeb.com (2012)
Narcissistic	"are characterized by behavior or a fantasy of grandiosity, a lack of empathy and a need to be admired by others. Narcissistic personality has a pathological unrealistic or inflated sense of self-importance, has an inability to see the viewpoints of others, and is hypersensitive to the opinions of others."	PsyWeb.com (2012)
Borderline	"are often uncertain about their identity. As a result, their interests and values may change rapidly. People with BPD also tend to see things in terms of extremes. Their views of other people may change quickly. These suddenly shifting feelings often lead to intense and unstable relationships. Other symptoms of BPD include: fear of being abandoned; feelings of emptiness and boredom; frequent displays of inappropriate anger; impulsivity with money, substance abuse, sexual relationships, binge eating, or shoplifting; intolerance of being alone; and repeated crises and acts of self-injury".	A.D.A.M. Medical Encyclopedia (2010b)
Histrionic	"is primarily characterized by exaggerated displays of emotion in everyday behavior. Emotions are expressed with extreme and often inappropriate exaggeration. Persons with this disorder are prone to sudden and rapidly shifting emotional expression."	PsyWeb.com (2012)
Cluster C		
Obsessive-compulsive	"is characterized by perfectionism and inflexibility. A person with obsessive-compulsive disorder becomes preoccupied with uncontrollable patterns of thought and action. Obsessive-compulsive symptoms may cause extreme distress and interfere with a person's occupational and social functioning."	PsyWeb.com (2012)
Avoidant	"can't stop thinking about their own shortcomings. They form relationships with other people only if they believe they will not be rejected. Loss and rejection are so painful that these people will choose to be lonely rather than risk trying to connect with others."	A.D.A.M. Medical Encyclopedia (2010a)
Dependent	"is primarily characterized by an extreme need for other people, to a point where the person is unable to make any decisions or take an independent stand on their own. There is a fear of separation, clinging, and submissive behavior. People with dependent personality disorder have a marked lack of decisiveness, self-confidence, and are self-denigrating."	PsyWeb.com (2012)

Table B
Estimation results for Axis II personality disorders and BMI in fully-adjusted model (Model 3).

	Men		Women	
Sample mean BMI	28.46		27.93	
Unweighted *N*	14,368		19,633	
	Beta	95% CI	Beta	95% CI
Any PD	0.19	[−0.08,0.45]	0.50**	[0.17,0.83]
Age 26–30	0.71*	[0.17,1.24]	1.16***	[0.64,1.68]
Age 31–35	1.00***	[0.47,1.54]	1.43***	[0.90,1.95]
Age 36–40	1.26***	[0.69,1.82]	1.49***	[0.96,2.02]
Age 41–45	0.66*	[0.13,1.20]	1.39***	[0.86,1.92]
Age 46–50	0.77**	[0.24,1.31]	1.52***	[1.00,2.05]
Age 51–55	0.51	[−0.04,1.07]	1.72***	[1.15,2.28]
Age 56–60	0.54	[−0.03,1.12]	1.01***	[0.46,1.57]

Table B (*Continued*)

	Beta	95% CI	Beta	95% CI
Age 61–65	−0.01	[−0.68,0.66]	0.70*	[0.11,1.30]
Age 66–70	−0.19	[−0.84,0.46]	−0.30	[−0.97,0.37]
Age 71–75	−1.11**	[−1.85,−0.38]	−1.12**	[−1.82,−0.41]
Age 76–80	−1.30***	[−2.03,−0.58]	−2.23***	[−3.04,−1.41]
Age 81–85	−2.03***	[−2.80,−1.26]	−3.46***	[−4.32,−2.61]
Age 86+	−3.01***	[−3.87,−2.16]	−4.90***	[−5.75,−4.04]
African American	0.10	[−0.23,0.44]	1.92***	[1.64,2.21]
Asian	−1.71***	[−2.30,−1.11]	−2.54***	[−3.05,−2.03]
Hispanic	0.54**	[0.17,0.91]	0.98***	[0.58,1.38]
Other non-White race	0.80	[−0.04,1.64]	0.68	[−0.06,1.42]
Born outside the U.S.	−1.43***	[−1.79,−1.07]	−1.17***	[−1.48,−0.85]
Resides in the Northeast	−0.03	[−0.34,0.28]	−0.15	[−0.47,0.18]
Resides in the Midwest	0.18	[−0.11,0.47]	−0.05	[−0.35,0.26]
Resides in the West	−0.13	[−0.39,0.14]	−0.39**	[−0.64,−0.15]
Lives outside an MSA	−0.02	[−0.31,0.26]	−0.16	[−0.43,0.11]
Household income 5–20k	0.55	[−0.38,1.49]	1.02**	[0.27,1.76]
Household income 20–40k	0.50	[−0.40,1.40]	1.36***	[0.64,2.08]
Household income 40–60k	0.65	[−0.28,1.57]	1.52***	[0.75,2.30]
Household income 60–80k	0.77	[−0.16,1.70]	1.22**	[0.46,1.99]
Household income 80–100k	0.91	[−0.07,1.88]	0.76	[−0.05,1.57]
Household income ≥100k	0.47	[−0.45,1.40]	−0.13	[−0.92,0.66]
Divorced/Separated	−0.19	[−0.51,0.14]	−0.73***	[−1.04,−0.41]
Widowed	−0.66**	[−1.15,−0.17]	0.29	[−0.13,0.72]
Never married	−0.52**	[−0.87,−0.16]	0.41*	[0.04,0.78]
Number of children in the household	0.13	[−0.01,0.27]	0.10	[−0.03,0.22]
Young child in the household	−0.40*	[−0.76,−0.04]	0.03	[−0.32,0.39]
High school education	0.10	[−0.28,0.48]	−0.27	[−0.64,0.10]
Some post-secondary education	−0.33	[−0.73,0.07]	−0.56**	[−0.96,−0.16]
University education	−1.03***	[−1.45,−0.61]	−1.72***	[−2.13,−1.32]
Private insurance	0.42**	[0.13,0.70]	−0.34*	[−0.63,−0.06]
Medicare	−0.71**	[−1.20,−0.23]	0.02	[−0.45,0.48]
Medicaid	0.17	[−0.45,0.79]	0.48*	[0.07,0.90]
Other public insurance	0.01	[−0.29,0.30]	0.15	[−0.18,0.49]
Work part time	−0.35	[−0.74,0.04]	−0.77***	[−1.06,−0.47]
Unemployed	0.33	[−0.52,1.18]	0.46	[−0.21,1.13]
Not in the labor force	−0.07	[−0.45,0.31]	−0.40**	[−0.69,−0.12]
Manic episode	−0.52	[−1.34,0.31]	0.29	[−0.48,1.07]
Schizophrenia	1.42	[−0.05,2.88]	1.57*	[0.00,3.14]
Major depression	0.08	[−0.57,0.72]	1.01***	[0.60,1.43]
General anxiety	0.00	[−0.76,0.76]	−0.42	[−0.95,0.11]
Alcohol abuse	−0.15	[−0.45,0.14]	−0.53*	[−1.01,−0.04]
Illicit Drug abuse	−0.95**	[−1.56,−0.34]	−0.36	[−1.36,0.64]
Smoking	−1.20***	[−1.45,−0.94]	−1.32***	[−1.60,−1.04]
High blood pressure	2.18***	[1.91,2.45]	2.72***	[2.44,2.99]
Diabetes	3.02***	[2.61,3.42]	3.84***	[3.40,4.28]
Heart attack	−1.12*	[−2.00,−0.23]	−0.80	[−2.06,0.46]
Arthritis	1.26***	[0.96,1.56]	1.87***	[1.58,2.17]
Stroke	−0.94*	[−1.66,−0.22]	−1.29*	[−2.48,−0.10]
Constant	27.37***	[26.32,28.43]	26.06***	[25.14,26.97]

Notes: All models estimated with ordinary least squares and account for survey design with the Stata MP Version 12 survey commands. Coefficients are adjusted betas.

*** $p < 0.001$.

** $p < 0.01$.

* $p < 0.05$.

Table C
Estimation results for Axis II personality disorders and obesity (BMI ≥ 30) in fully-adjusted model (Model 3).

	Men		Women	
Sample proportion obese	0.31		0.32	
Unweighted *N*	14,368		19,633	
	Risk difference	95% CI	Risk difference	95% CI
Any PD	0.01	[−0.01,0.04]	0.04***	[0.02,0.06]
Age 26–30	0.01	[−0.03,0.06]	0.05*	[0.01,0.09]
Age 31–35	0.03	[−0.01,0.08]	0.06**	[0.02,0.09]
Age 36–40	0.05*	[0.01,0.10]	0.07***	[0.03,0.11]
Age 41–45	0.03	[−0.02,0.07]	0.06**	[0.02,0.10]
Age 46–50	0.04*	[0.00,0.09]	0.07**	[0.03,0.11]
Age 51–55	0.02	[−0.02,0.07]	0.06**	[0.02,0.10]

Table C (*Continued*)

	Risk difference	95% CI	Risk difference	95% CI
Age 56–60	0.05*	[0.00,0.09]	0.03	[−0.01,0.08]
Age 61–65	−0.04	[−0.09,0.02]	0.01	[−0.04,0.06]
Age 66–70	−0.02	[−0.08,0.04]	−0.01	[−0.07,0.04]
Age 71–75	−0.10**	[−0.17,−0.04]	−0.10***	[−0.15,−0.04]
Age 76–80	−0.12**	[−0.19,−0.05]	−0.14***	[−0.20,−0.07]
Age 81–85	−0.21***	[−0.29,−0.13]	−0.25***	[−0.32,−0.18]
Age 86+	−0.32***	[−0.44,−0.20]	−0.36***	[−0.44,−0.28]
African American	0.02	[−0.00,0.05]	0.11***	[0.09,0.12]
Asian	−0.10*	[−0.19,−0.02]	−0.21***	[−0.28,−0.14]
Hispanic	0.03*	[0.00,0.06]	0.05***	[0.02,0.08]
Other non-White race	0.08*	[0.01,0.14]	0.07*	[0.01,0.12]
Born outside the U.S.	−0.12***	[−0.15,−0.09]	−0.07***	[−0.10,−0.04]
Resides in the Northeast	−0.01	[−0.04,0.02]	−0.01	[−0.03,0.01]
Resides in the Midwest	0.02	[−0.00,0.04]	0.01	[−0.01,0.03]
Resides in the West	−0.01	[−0.03,0.01]	−0.01	[−0.03,0.00]
Lives outside an MSA	−0.02	[−0.04,0.01]	−0.01	[−0.03,0.01]
Household income 5–20k	0.04	[−0.04,0.11]	0.05	[−0.01,0.10]
Household income 20–40k	0.02	[−0.05,0.10]	0.07*	[0.01,0.12]
Household income 40–60k	0.04	[−0.04,0.11]	0.08**	[0.02,0.14]
Household income 60–80k	0.04	[−0.03,0.12]	0.07*	[0.01,0.13]
Household income 80–100k	0.04	[−0.05,0.12]	0.05	[−0.01,0.12]
Household income ≥100k	0.01	[−0.07,0.08]	−0.03	[−0.09,0.04]
Divorced/Separated	−0.03*	[−0.06,−0.00]	−0.04***	[−0.06,−0.02]
Widowed	−0.04	[−0.09,0.00]	0.02	[−0.01,0.05]
Never married	−0.04*	[−0.06,−0.01]	0.01	[−0.01,0.03]
Number of children in the household	0.01	[−0.00,0.02]	0.01	[−0.00,0.02]
Young child in the household	−0.04*	[−0.07,−0.01]	0.02	[−0.01,0.04]
High school education	−0.01	[−0.04,0.02]	−0.03	[−0.05,0.00]
Some post-secondary education	−0.03	[−0.06,0.00]	−0.05***	[−0.08,−0.02]
University education	−0.10***	[−0.13,−0.07]	−0.12***	[−0.15,−0.09]
Private insurance	0.03*	[0.01,0.06]	−0.02*	[−0.04,−0.00]
Medicare	−0.05*	[−0.09,−0.01]	−0.00	[−0.04,0.03]
Medicaid	−0.01	[−0.05,0.04]	0.01	[−0.02,0.04]
Other public insurance	0.00	[−0.02,0.03]	0.01	[−0.02,0.03]
Work part time	−0.02	[−0.05,0.01]	−0.05***	[−0.07,−0.03]
Unemployed	0.03	[−0.02,0.09]	0.04*	[0.00,0.08]
Not in the labor force	0.01	[−0.03,0.04]	−0.02	[−0.04,0.00]
Manic episode	−0.01	[−0.07,0.06]	0.01	[−0.04,0.06]
Schizophrenia	0.08	[−0.02,0.18]	0.08	[−0.01,0.16]
Major depression	0.00	[−0.04,0.04]	0.06***	[0.03,0.08]
General anxiety	0.03	[−0.03,0.10]	−0.04	[−0.07,0.00]
Alcohol abuse	−0.01	[−0.03,0.02]	−0.02	[−0.06,0.01]
Illicit Drug abuse	−0.04	[−0.09,0.02]	−0.07	[−0.14,0.00]
Smoking	−0.08***	[−0.10,−0.05]	−0.07***	[−0.09,−0.05]
High blood pressure	0.14***	[0.12,0.16]	0.16***	[0.14,0.18]
Diabetes	0.19***	[0.16,0.22]	0.19***	[0.17,0.22]
Heart attack	−0.04	[−0.12,0.04]	−0.05	[−0.14,0.04]
Arthritis	0.08***	[0.06,0.11]	0.10***	[0.08,0.12]
Stroke	−0.05	[−0.14,0.04]	−0.01	[−0.10,0.08]

Notes: All models estimated with logit and account for survey design with the Stata MP Version 12 survey commands. Coefficients are adjusted risk differences.

*** $p < 0.001$.

** $p < 0.01$.

* $p < 0.05$.

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