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Prevalence and Correlates of *DSM-5* Eating Disorders in Nationally Representative Sample of United States Adults

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Abstract

Background—There exist few population-based data on the prevalence of eating disorders (EDs) and this is especially needed because of changes to diagnoses in the *DSM-5*. This study aimed to provide lifetime and 12-month prevalence estimates of *DSM-5* anorexia nervosa (AN), bulimia nervosa (BN), and binge-eating disorder (BED) from the 2012–2013 National Epidemiologic Survey Alcohol and Related Conditions (NESARC-III).

Methods—A national sample of 36,306 U.S. adults completed structured diagnostic interviews (AUDADIS-5).

Results—Prevalence (standard error) estimates of lifetime AN, BN, and BED were 0.80% (0.07%), 0.28% (0.03%), and 0.85% (0.05%). 12-month estimates for AN, BN, and BED were 0.05% (0.02%), 0.14% (0.02%), and 0.44% (0.04%). Adjusting for age, race/ethnicity, education, and income, odds of lifetime and 12-month diagnoses of all three EDs were significantly greater for women than men. Adjusted odds ratios (AORs) of lifetime AN were significantly lower for non-Hispanic Black and Hispanic than for White respondents. AORs of lifetime and 12-month BN did not differ significantly by race/ethnicity. AOR of lifetime BED, but not 12-month, was significantly lower for non-Hispanic Black relative to non-Hispanic White respondents; AORs of BED for Hispanic and non-Hispanic White respondents did not differ significantly. AN, BN, and BED were characterized by significant differences in ages of onset, persistence and duration of episodes, and rates of current obesity and psychosocial impairment.

Conclusions—These findings for *DSM-5*-defined EDs, based on the largest national sample of U.S. adults studied to date, indicate some important similarities and differences to earlier smaller nationally representative studies.

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Disclosure

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Keywords

anorexia nervosa; bulimia nervosa; binge-eating disorder; obesity; prevalence; impairment

There exist few nationally representative population-based data on the prevalence of eating disorders (EDs) (1). In the United States, the National Institutes of Mental Health Collaborative Psychiatric Epidemiological Studies (CPES; 2) comprised three nationally representative samples of adults assessed with diagnostic interviews: National Comorbidity Survey-Replication (NCS-R; 3), National Survey American Life (NSAL; 4), and National Latino and Asian American Study (NLAAS; 5). NCS-R used structured lay-administered diagnostic interviews (Composite International Diagnostic Interview; CIDI) to generate *DSM-IV*-based psychiatric diagnoses, including anorexia nervosa (AN), bulimia nervosa (BN), and binge-eating disorder (BED; which was not a "formal" diagnosis but included as a provisional diagnosis category and criteria set). Hudson and colleagues (6) analyzed data from a subset of *N*=2980 respondents (randomly selected from larger NCS-R pool of *N*=5692), and reported lifetime prevalence estimates for AN, BN, and BED as 0.6%, 1.0%, and 2.8% (0.9%, 1.5%, and 3.5% among women, and 0.3%, 0.5%, and 2.0% among men). Marques and colleagues (7) compared ED prevalence rates across ethnic/racial groups by pooling CPES data, including NCS-R (6) aggregated with *N*=3750 African-American from NSAL and *N*=2554 Latinos and *N*=2095 Asian-Americans from NLAAS. Similar prevalence estimates for AN and BED across ethnic/racial groups but higher estimates for BN among Latino and African-American than White respondents were reported (7).

Data from large-scale nationally-representative samples assessed with diagnostic interviews is required to update prevalence estimates of EDs in the U.S. Expert reviews of worldwide ED epidemiology have emphasized the need for larger rigorous studies to produce a better understanding of prevalence and distribution of EDs (1). This is especially needed because of recent changes in diagnoses and criteria of EDs in *DSM-5* (8), which could impact prevalence estimates. In *DSM-5*, AN diagnosis no longer requires amenorrhea and now defines low-weight as less than minimally normal/expected. The BN diagnosis now has a frequency requirement of once-weekly for binge-eating and weight-compensatory behaviors, a lower frequency than twice-weekly in the *DSM-IV*. BED, now a "formal" diagnosis, is also defined with a lower frequency requirement of once-weekly binge-eating for 3-months to parallel the BN diagnosis.

Research on the impact of changes between *DSM-IV* and *DSM-5* on prevalence of EDs has been limited. One study from Switzerland, which used diagnostic interviews to assess a nationally representative sample of 10,038 residents, examined differences between *DSM-IV* and *DSM-5* for AN (9). A Swedish Twin Study re-analyzed data from diagnostic interviews with 13,295 female twins to estimate impact of reduced frequency/duration criteria for binge-eating on estimates for BN and BED (10). One U.S.-based internet survey study of 22,397 respondents used self-reports to estimate prevalence of BED based on *DSM-IV* and *DSM-5* (11). These studies suggested *DSM-5*-based criteria yielded higher estimates for AN (9), BN (10), and BED (11). To date, however, no study has estimated the *DSM-5*-

defined prevalence of EDs using diagnostic interviews with a large-scale nationally representative U.S. sample.

This study aimed to provide lifetime and 12-month prevalence estimates of *DSM-5* AN, BN, and BED in a nationally-representative sample of U.S. adults using data from 2012–2013 National Epidemiologic Survey Alcohol and Related Conditions (NESARC-III). NESARC-III, which included 36,309 respondents assessed with lay-administered diagnostic interviews, is by far the largest nationally-representative sample of U.S. adults to allow for estimating prevalence of AN, BN, and BED following the *DSM-5* (8).

Methods and Materials

Sample

NESARC-III included 36,309 non-institutionalized U.S. civilians 18 years and older (12, 13). Respondents completed computer-assisted face-to-face personal interviews between April 2012 and June 2013. NESARC employed multi-stage probabilistic sampling with counties or groups of contiguous counties as primary sampling units, groups of Census-defined blocks as secondary sampling units, and households within secondary sampling units as tertiary sampling units. Within each household, eligible adults were randomly selected but with Hispanic, Black, and Asian household members oversampled (i.e., two respondents from households with more than four eligible minority members) relative to White household members. Household response rate was 72% and person-level response rate was 84%, yielding an overall response rate of 60.1% (13). Data were adjusted for non-response and weighted to represent the U.S. population based on Bureau of the Census 2012 American Community Survey. NESARC-III was approved by the NIH IRB and respondents provided oral informed-consent which was electronically recorded (13). The authors obtained IRB exempt approval from SUNY-Albany to perform analyses.

Measurement

Sociodemographic Characteristics—Respondents provided sociodemographic information including age, sex, ethnicity/race (non-Hispanic White, non-Hispanic Black, Hispanic, non-Hispanic Asian/Pacific Islander, and non-Hispanic American-Indian/Alaska Native, and Hispanic [any race]), education (categorized as less than H.S., H.S./GED, at least some college), and income (categorized as <$25,000, $25,000–39,999, $40,000–69,999, ≤$70,000).

Body mass index (BMI)—Self-reported height and weight were used to calculate BMI.

Diagnostic Assessment—NESARC-III used the NIAAA Alcohol Use Disorder and Associated Disabilities Interview Schedule-5 (AUDADIS-5; 14) to assess *DSM-5*-defined psychiatric disorders and their criteria, including AN, BN, and BED. The AUDADIS-5 assessed age at onset and age for most recent episode in order to calculate 12-month and lifetime prevalence estimates and assessed for *impairment in social function* due to EDs, including: (1) interference with normal daily activities, (2) serious problems getting along with others, and (3) serious problems fulfilling responsibilities.

AUDADIS-5 was administered by 970 trained lay assessors who had an average of five years of experience with health-related surveys (13). Good test-retest reliability and fair-to-moderate concordance levels for the AUDADIS-5 with a *semi*-structured diagnostic interview administered by independent/blinded research-clinicians have been reported for substance use and psychiatric disorders (15, 16). Reliability for NESARC-III ED diagnoses has not been reported.

Creation of Eating Disorder Diagnoses[1]

We created specific ED diagnostic groups (AN, BN, BED) based on *DSM-5* criteria using NESARC-III respondents' responses to relevant AUDADIS-5 items[2]. We did *not* utilize NESARC-III-generated ED diagnosis variables because inspection of the dataset revealed various errors[3]. Thus, it seemed clearly indicated to re-score NESARC-III variable data to create *DSM-5*-based ED categories for our analysis[4, 5].

For AN, respondents were required to meet the following: (1) Self-reported lowest BMI less than 18.5; (2) Tried not to gain weight or restrict food intake despite low weight; (3) Afraid of gaining weight or "getting fat" despite low weight; and (4) Reported at least one of the following while their BMI was lowest: (a) thought they "looked fat"; (b) thought their weight or shape was one of the most important things about them; (c) did not think they might have been unhealthy; (d) did not believe others who thought their weight was unhealthy; or (e) constantly weighing themselves or measuring body parts.

For BN and BED, respondents were required to report recurrent binge-eating, determined based on three questions: (1) Ever eaten an unusually large amount of food within 2-hour period, not including the holidays; (2) Ever eating unusually large amounts of food on average at least once weekly for at least 3 months; and (3) While eating an unusually large amount of food, felt unable to stop eating or control how much/what eating.

For BN, in addition to meeting criteria for recurrent binge-eating, respondents were required to report that during any of those times that they were binge-eating they: (1) Tried to keep from gaining weight by vomiting, using enemas, laxatives, diuretics/other medicines, fasting, or exercising excessively; (2) Engaged in the weight-compensatory behaviors at

[1]The NESARC III was the first wave of this nationally-representative survey study that included eating disorders (EDs). To our knowledge, reliability and validity of the AUDADIS-5 for specific EDs have not been reported.

[2]Supplemental Table S1 lists *DSM-5* criteria for AN, BN, and BED, alongside the exact AUDADIS-5 items in the NESARC-III dataset used to create each specific ED criterion including how each item was scored. The Supplemental Table 1 footnotes describe the clinical/empirical rationale for scoring decisions.

[3]During our preliminary analyses, we found errors in how the NESARC-III co shows every "marked distress" regarding binge-eating, which is required for the BED diagnosis, and categorized many respondents with 12-month AN despite having *current* BMIs in the obese range, among other errors. Thus, for this study, we re-created lifetime and 12-month diagnosis variables for AN, BN, and BED based on the criteria described in the method section (and elaborated further in Supplemental Table S1).

[4]Supplemental Table S2 shows every coding discrepancy between the ED diagnosis variables in our study and the NESARC-III data set.

[5]It is possible that the 12-month persistence finding could be influenced by age of onset. For example, for two individuals with the same length (or total years) of an ED episode, one individual having an earlier onset of that ED would have different persistence relative to a second individual having a later onset. Thus, it might be possible for increased "persistence" to reflect not only the ED persisting longer but also partly confounded by later onset. Thus, we performed multiple logistic regression analyses to compare the risk for reporting 12-months diagnosis among those with lifetime diagnosis by age of onset, with current age, sex, education, race, and income as covariates. For AN, due to the small number of positive cases, the model was not valid. For both BN and BED, however, later age of onset was associated with significantly greater likelihoods of meeting 12-month diagnosis (for BN: AOR = 1.12, 95% CI = 1.03–1.21, $p < .05$; for BED: AOR = 1.03, 95% CI = 1.01–1.06, $p < .05$).

least once weekly for at least 3 months; and (3) Thought their weight/shape was one of the most important things about them.

For BED, in addition to meeting criteria for recurrent binge-eating, respondents were required to report: (1) Eating an unusually large amount of food made them very upset, and (2) At least three of the following five features *during* the times they ate unusually large amounts of food: (a) Eating much more quickly than usual; (b) Eating until uncomfortably full; (c) Eating despite not being hungry; (d) Eating alone because embarrassed by how much they were eating; and (e) Felt disgusted, depressed, or very guilty about the overeating.

Statistical Analysis

Analyses were performed using Statistical Analysis System (SAS) (release 9.4, 2002–2012) and accounted for NESARC-III survey design by using Proc Survey procedures with Taylor series-variance-estimation method. Weighted means, frequencies, and cross-tabulations were computed for 12-month and lifetime *DSM-5*-based diagnosis for the three specific EDs overall (total sample) and separately for specific sociodemographic groups (sex, ethnicity/race, age, education, income).

For each ED, weighted means, medians, and frequencies were computed for age, BMI, age of onset, years with episode, persistence of ED, and ED-related impairment; Analysis of covariance (ANCOVA) was used to examine whether current age, current BMI, age of onset, and years with episode differed between AN, BN, and BED, adjusting for sociodemographic variables. Rao-Scott Chi-Square test was used to compare the proportion reporting persistence of ED and ED-related impairment across ED groups. Significant omnibus chi-square tests were probed by comparing cells to identify significant differences between ED groups (17, 18). For these inferential statistics comparing *lifetime* ED groups, we followed well-established diagnostic “hierarchy” of AN>BN>BED (i.e., lifetime BN excluded those with lifetime AN, lifetime BED excluded those with lifetime AN/BN). Multiple logistic regression was used to calculate adjusted odds ratios (AORs) comparing risk of lifetime and 12-month diagnoses of EDs by sociodemographic variables, adjusting for the other sociodemographic variables not being tested. Cox proportional hazardous models were used to test for differences in age-cohort effects on ED, adjusting for sociodemographic variables. Multiple logistic regression was used to examine whether the likelihoods of having BMI<18.5 (underweight), 18.5≤BMI< 25 (normal weight), 25≤BMI< 30 (overweight), 30≤BMI< 40 (obese), and 40≤ BMI (extremely obese) differed significantly between EDs (12-month and lifetime), relative to respondents without lifetime history of any ED; these analyses adjusted for a sociodemographic variables (except for 12-month AN diagnosis which required BMI<18.5).

Results

Prevalence Estimates of Eating Disorders: Lifetime and 12-month Rates: Overall and by Sociodemographic Characteristics

Prevalence (standard error [SE]) estimates of lifetime AN, BN, and BED were 0.80% (0.07%), 0.28% (0.03%), and 0.85% (0.05%), respectively (Table 1). Prevalence (SE) estimates of 12-month AN, BN, and BED were 0.05% (0.02%), 0.14% (0.02%), and 0.44% (0.04%), respectively (Table 2). Supplemental Table S3 summarizes sensitivity analyses showing the impact of discrepancies between our coding with that of the NESARC-III (listed in Supplemental Table S2) as well as to exploring the impacts of "broadening" various specific criteria on the prevalence estimates for EDs.

Lifetime prevalence estimate for "comorbid" EDs (i.e., having lifetime diagnoses of two or more specific EDs) was 0.22% (0.03%). Of those, 0.01% (0.01%) reported lifetime "comorbidity" between AN and BN, 0.02% (0.01%) between AN and BED, 0.13% (0.02%) between BN and BED, and 0.05% (0.02%) amongst all three EDs. Tables 1 and 2 also show (unadjusted) prevalence estimates of lifetime and 12-month diagnoses, respectively, of AN, BN, and BED by sex, ethnicity/race, age, education, and income categories.

Adjusted Prevalence Estimate of Eating Disorders by Sex, Race/Ethnicity, Education, and Income

Table 3 shows AORs and 95% CIs by sex, ethnicity/race (non-Hispanic White, non-Hispanic Black, and Hispanic respondents), education, and income groups. AORs of lifetime and 12-month diagnoses of all three EDs were significantly greater for women than men (Tables 1 and 2 show unadjusted estimates). AORs of lifetime AN were significantly lower for non-Hispanic Black and Hispanic than non-Hispanic White respondents. AORs of 12-month AN were significantly lower for Hispanic than non-Hispanic White respondents. There were no cases of 12-month AN in non-Hispanic Black respondents; thus, it was not possible to generate valid estimates of AORs for non-Hispanic Black vs. non-Hispanic White groups. AORs of lifetime and 12-month BN did not differ significantly by race/ethnicity. AOR of lifetime BED was significantly lower for non-Hispanic Black than non-Hispanic White; AORs of BED for Hispanic and non-Hispanic White did not differ significantly. There were no racial differences in AORs of 12-month BED. Education level was not significantly associated with any ED prevalence. Higher income categories were associated with significantly increased odds of lifetime AN.

Age of Onset, Duration, and Persistence of Eating Disorders—Table 4 summarizes mean and median age of onset across the EDs (current age at interview is shown to provide context). Compared with lifetime AN or BN, those with lifetime BED had later age of onset of ED and longer duration of ED episodes. 12-month persistence, defined as the proportion of those with 12-month diagnosis among those with the lifetime diagnosis, was 63.5% for BED and 54.7% for BN which were significantly higher than for AN (9.4 %)[5].

Cohort Effects

Cox proportional hazard models revealed an inverse association between age cohort (age at interview) and lifetime risk for EDs (Table 5). Adjusting for age, sex, ethnicity/race, and educational level, hazard ratios (HR) of AN and BED in younger age groups (ages 18–29, 30–44, 45–59) were significantly higher relative to older group (ages 60+); AHRs increased as age decreased. AHRs of BN were significantly higher in ages 18–20 and 30–44, relative to 60+, but not in ages 45–59.

Impairment in Psychosocial Functioning Associated with Disordered Eating

Table 6 summarizes rates of impairment in psychosocial functioning in three domains and overall ("any") associated with disordered eating reported by respondents categorized with the EDs shown separately for lifetime and 12-month diagnoses. For lifetime diagnoses, rates of any impairment in social function were significantly greater for BN (61.4%) and BED (53.7%) than AN (30.7%). Rates of reporting interference with normal daily activities was significantly greater for BED (52.5%) and BN (49.5%) than AN (23.5%). For 12-month diagnoses, the three EDs differed little; only significant difference observed was BN reporting greater rate of difficulties setting along with others than BED.

Associations with Current BMI

Table 7 shows current mean (SE) and median (IQR) BMI and current BMI categories (prevalence rates and AORs with 95% CIs) across the ED groups for both lifetime and 12-month diagnoses. For both lifetime and 12-month diagnoses, AN had significantly lower *current* BMI than BN and BED (for 12-month diagnosis this was as expected given the required criterion of BMI less than 18.5 for AN). For both lifetime and 12-month diagnoses, BN had significantly lower *current* BMI than BED.

Relative to no history of ED, lifetime AN had significantly greater odds of being categorized *currently* with underweight and normal weight, and significantly reduced odds of *currently* having overweight, obesity, and extreme obesity; AORs reduced as BMI increased. Relative to no history of ED, lifetime BED was associated with significantly reduced odds of being categorized as *currently* having normal weight and overweight, but significantly increased odds of *currently* having obesity and extreme obesity. Similarly, 12-month BED was associated with significantly reduced odds of being categorized as *currently* having normal weight and overweight, but significantly increased odds of *currently* having obesity and extreme obesity. For both lifetime and 12-month BED, AORs increased as BMI increased. Relative to no lifetime history of ED, BN (lifetime and 12-month diagnoses) did not differ significantly in odds of any weight/obesity categories

Discussion

This study, with a nationally-representative sample of U.S. 36,309 adults assessed with lay-administered diagnostic interviews, provides new prevalence estimates of EDs based on *DSM-5*. Prevalence estimates of lifetime AN, BN, and BED were 0.80%, 0.28%, and 0.85%, respectively, and 12-month estimates were 0.05%, 0.14%, and 0.44%. These prevalence estimates are based on our re-coding of NESARC-III ED data because inspection of the

original NESARC-III data revealed errors; Supplemental Tables summarize coding discrepancies and sensitivity analyses exploring impacts of discrepancies on prevalence estimates. Findings for *DSM-5*-defined EDs, which included several changes from the *DSM-IV*, are based on the largest national sample of U.S. adults studied to date, and suggest some important similarities and differences to earlier smaller nationally-representative studies.

Our prevalence estimates of *DSM-5*-defined BN and BED are lower than reported by Hudson and colleagues (6) from the NCS-R based on a subset of *N*=2,980 respondents for *DSM-IV*-defined BN and BED (1.0% and 2.8%, for lifetime and 0.3% and 1.2%, for 12-month). Our lifetime prevalence estimate of *DSM-5*-defined AN (0.8%) is slightly higher than that of *DSM-IV*-defined AN in the NCS-R (0.6%; 6); for 12-month AN, we observed 0.05% whereas NCS-R (6) found no cases. Our lower prevalence estimates for BN and BED relative to NCS-R (6) estimates are surprising given the changes in criteria from *DSM-IV* to *DSM-5* which would be expected to yield higher rates, as found in a population-based Swiss sample of 10,028 adults (9). Lifetime prevalence was higher for AN than BN while the pattern was opposite for 12-month.

Both the current and NCS-R studies used lay-administered structured interviews, albeit different ones, and used rigorous sampling methods; thus, exact reasons for the varied findings are uncertain. Much larger sampling in our study, roughly 12 times more respondents than the NCS-R, may allow for more stable estimation. Kessler and colleagues (19), in comparing differences across *DSM-IV*-based studies, addressed important methodological considerations such as how even different versions of the same interview can yield differences. Moreover, different structured interviews for psychiatric disorders vary in how diagnostic criteria are asked, strictness of wording, the survey administration order (e.g., NCS-R assesses EDs mid-way whereas NESARC-III assesses EDs at the end, which conceivably lead to lower responding because of fatigue), and in how diagnostic hierarchies are applied. We explored impacts of “broadening” several specific criteria (i.e., “marked distress” about binge-eating for BED and overvaluation of shape/weight for BN) because of differences in the structured interviews in NCS-R and NESARC-III. Our sensitivity analyses (detailed in Supplemental Tables) revealed slight increases in lifetime estimates for BED, but not BN; however, even with broadened definitions, our prevalence estimates remained lower than the NCS-R (6). Sensitivity analyses performed for NCS-R (6) testing stricter definitions of overvaluation revealed little effect on reducing BN prevalence estimates. Thus, neither our present analyses nor the NCS-R (6) suggested much impact based on either overly broad/stringent measures of overvaluation on BN prevalence estimates. Our prevalence estimates are at odds with critics’ views of the *DSM-5* who used BED as an illustration of over-pathologizing. Discrepancies in prevalence estimates underscore the need of more population-based studies with large samples using diagnostic interviews.

Our findings extend knowledge regarding the distribution and sociodemographic correlates of EDs. Adjusting for age, ethnicity/race, education, and income categories, odds of lifetime and 12-month diagnoses of all three EDs were significantly greater for women than men, particularly for AN and BN. We also found that risk of: (1) lifetime AN was significantly lower for Hispanic and non-Hispanic Black than for non-Hispanic White respondents; (2)

lifetime and 12-month BN did not differ significantly by ethnicity/race; (3) lifetime BED, but not 12-month BED, was significantly lower for non-Hispanic Black than non-Hispanic White respondents; (4) lifetime and 12-month BED for Hispanic and non-Hispanic White respondents did not differ significantly; and (5) lifetime AN was associated with higher income. Overall, it is important to recognize that EDs occur across all ethnic/racial groups and that the rates for some diagnoses (e.g., BN and BED to a lesser extent) are comparable across groups. However, 12-month AN was most prevalent among non-Hispanic White, women, and 18–29 years old. The findings are broadly consistent with previous *DSM-IV*-defined EDs (6, 7). Kessler and colleagues (19) - in their analysis of 24,124 adult respondents from the WHO World Mental Health Survey – reported roughly comparable prevalence estimates for BN and BED across 14 countries. Collectively, such findings highlight the importance of actively considering all forms of diversity across prevention and intervention clinical/research work, which to date, appears to be at odds with our findings (e.g., 20).

Findings regarding the mean ages of onset for AN, BN, and BED were nearly identical to the NCR-S (6): ages 19.3, 20.0, and 24.5, respectively versus 18.9, 19.7, and 25.4. The chronic nature of EDs was suggested by long illness durations and rates of 12-month persistence, which highlight the importance of early recognition and intervention. Percentage of 12-month persistence in AN was significantly lower than BN or BED, which is at odds with NCR-S (6) findings and reports on the course of AN (21). We found some support for the view that EDs might be increasing in incidence. We observed an inverse association between age cohort (age at interview) and lifetime risk particularly for BN and BED, echoing earlier findings for BN (1, 6, 22) and BED (6). Odds of AN showed slight increase with cohort, adding to the mixed literature, primarily case register data. As noted by Hudson and colleagues (6), cohort effects overlaps with age effects, and thus prospective studies should investigate whether incidence of EDs is on increasing trend.

Impairment in psychosocial functioning associated with disordered eating was common. The majority of lifetime BN (61.4%) and BED (53.7%) groups reported “any” impairment; these rates were significantly higher than reported by lifetime AN (30.7%). However, the rates of reporting “any” impairment were not significantly different for 12-month diagnoses (AN=47.1%, BN=64.6%, and BED=54.7%). Comparison with the NCS-R (6) is difficult due to different measurement of impairment and because their smaller study precluded analysis of AN. Nonetheless, these two studies converge in suggesting that roughly half of persons with BN and BED suffer from impaired functioning associated with their disordered eating. Our findings for AN, might seem surprising given the established seriousness and even life-threatening nature of this disorder. Alternatively, it is possible that the findings for AN reflect, in part, under-reporting associated with the well-known minimization of severity and ego-syntonic nature of the underweight state in persons with AN.

We observed significant but varied associations between EDs and obesity. Lifetime AN had significantly lower current BMI than lifetime BN and BED and lifetime BN had significantly lower BMI than lifetime BED. Consistent with the NCS-R (6) and clinical studies (19, 21), we found lifetime AN had significantly greater odds of currently having underweight/normal weight and lower odds of having overweight/obesity/extreme-obesity,

with AORs increasing with increasing BMI. Conversely, lifetime and 12-month BED was associated with significantly reduced odds of currently being categorized as normal weight/overweight, but increased odds of being currently categorized with obesity/extreme obesity. Substantially elevated odds of having current extreme obesity in those with lifetime BED (AOR=4.67) and 12-month BED (AOR=5.42) echo previous NCS-R (6) and WHO (19) findings and clinical reports regarding steep weight-gains among persons with BED prior to seeking treatment (23). Finally, in contrast to significant, albeit opposite, associations with weight for AN versus BED, BN (lifetime and 12-month) did not differ significantly in associations with different weight/obesity categories.

We note strengths and limitations as context for our findings. A major strength is the large epidemiological data-set with a representative sample of U.S. adults assessed with trained interviewers using structured interviews. A relative weakness is the use of lay interviewers, rather than clinicians; standardized training and structured assessments may offset this limitation to some extent. The AUDADIS-5 has not been evaluated for reliability/validity for ED diagnoses, although it has been validated for other psychiatric conditions. We note that even different diagnostic interviews or even versions of the same interview can produce different diagnostic estimates (24). EDs are thought to be associated with shame and secrecy, and some specific types such as AN are ego-syntonic and these factors might result in under-reporting and lower estimates. Different reference time points used to define lowest BMI across studies may also result in different prevalence estimates of AN. The use of telephone interviews might have offset this to some degree by allowing for greater honesty when reporting sensitive or embarrassing issues. The AUDADIS-5 does not assess EDs using the exact wording of the *DSM-5*; as we detailed in the methods, we re-scored specific AUDADIS-5 items to map very closely to criteria and performed sensitivity analyses which revealed relatively limited impacts of loosening criteria on prevalence estimates. BMI was calculated based on self-reported height and weight, which may be biased (25)[6].

Conclusions

Our findings for *DSM-5*-defined EDs, based on the largest national sample of U.S. adults studied to date, indicate these are prevalent disorders distributed across age groups, both men and women, and across different ethnic/racial groups. Although substantial differences between EDs exist, overall, they appear to be persistent and associated with substantial rates of impairment in psychosocial functioning. EDs show differential associations with obesity and our findings highlight substantial associations between BED and extreme obesity. Thus, our findings indicate that *DSM-5* EDs represent an important public health problem.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

[6]When errors in self-report of weight/height occur, they tend to be in the direction of under-reporting weight and over-reporting height (25); in community-based studies, for example, this can produce on average a BMI estimate of 1.3 units lower than based on measured values (26). Nonetheless, large-scale studies generally report high correlations between self-reported and measured height and weight (28) and studies with patients with EDs have found that errors in self-reported height and weight tend to be very slight (27, 29) and the discrepancies between self-report and measured values are not associated with eating-disorder psychopathology or psychological features (29).

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Although Dr. Grilo reports no relevant direct or indirect conflicts of interest with respect to this study, he reports the following: For the past 12-months, Dr. Grilo reports receiving honoraria for lectures delivered for CME-related activities and plenaries and lectures at professional academic conferences and reports royalties from academic books published by Guilford Press and Taylor & Francis Publishers. Beyond 12-months, Dr. Grilo reports having received consultant fees from Shire and Sunovion, and honoraria for CME-related lectures and for lectures delivered at grand rounds and professional academic conferences nationally and internationally.

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Table 1

Lifetime Prevalence of *DSM-5* AN, BN, and BED by Sociodemographic Characteristics

	AN		BN		BED	
	n	**% (SE)**	***n***	**% (SE)**	***n***	**% (SE)**
Total	276	0.80 (.07)	92	0.28 (.03)	318	0.85 (.05)
Sex						
Men	23	0.12 (.04)	12	0.08 (.03)	68	0.42 (.06)
Women	253	1.42 (.12)	80	0.46 (.06)	250	1.25 (.10)
Race or ethnicity						
Non-Hispanic White	206	0.96 (.08)	54	0.31 (.05)	206	0.94 (.08)
Non-Hispanic Black	17	0.19 (.05)	14	0.20 (.07)	41	0.62 (.14)
Hispanic	36	0.46 (.08)	19	0.24 (.07)	56	0.75 (.13)
Other [1]	17	1.05 (.32)	5	0.17 (.08)	15	0.59 (.16)
Age (years)						
18–29	66	0.86 (.13)	26	0.40 (.10)	75	0.89 (.12)
30–44	89	1.02 (.14)	43	0.42 (.07)	97	0.96 (0.12)
45–59	89	0.96 (.12)	17	0.21 (.07)	97	1.00 (0.13)
≥ 60	32	0.34 (.07)	6	0.10 (.05)	49	0.54 (.10)
Education level						
Less than high school	22	0.47 (.09)	14	0.22 (.07)	43	0.79 (.12)
High school or GED	48	0.48 (.09)	18	0.20 (.07)	67	0.72 (.11)
Some college or higher	206	1.00 (.09)	60	0.32 (.05)	208	0.92 (.08)
Income level						
<$25,000	62	0.58 (0.09)	28	0.34 (0.90)	100	0.98 (0.05)
$25,000–39,999	47	0.55 (0.10)	21	0.21 (0.05)	62	0.78 (0.11)
$40,000–69,999	74	0.88 (0.13)	23	0.30 (0.07)	86	0.80 (0.10)
≥$70,000	93	1.04 (0.13)	20	0.25 (0.06)	70	0.85 (0.12)

Notes. AN = anorexia nervosa; BN = bulimia nervosa; BED = binge eating disorder. Calculations of prevalence and standard errors were adjusted for survey weights.

[1]Other included Asian, Native Hawaiian, or other Pacific Islander, and Native American.

Table 2

12-Month Prevalence of *DSM-5* AN, BN, and BED by Sociodemographic Characteristics

	AN		BN		BED	
	n	**% (SE)**	***n***	**% (SE)**	***n***	**% (SE)**
Total	13	0.05 (.02)	44	0.14 (.02)	166	0.44 (.04)
Sex						
Men	2	0.01 (.01)	6	0.05 (.02)	41	0.26 (.05)
Women	11	0.08 (.03)	38	0.22 (.05)	125	0.60 (.07)
Race or ethnicity						
Non-Hispanic White	11	0.07 (.02)	24	0.15 (.04)	107	0.48 (.06)
Non-Hispanic Black	0	0.00 (.00)	7	0.09 (.04)	20	0.28 (.09)
Hispanic	1	0.01 (.01)	10	0.14 (.05)	31	0.40 (.09)
Other	1	0.03 (.03)	3	0.11 (.06)	8	0.39 (.16)
Age (years)						
18–29	4	0.08 (.05)	13	0.23 (.08)	43	0.46 (.08)
30–44	3	0.04 (.03)	23	0.23 (.06)	46	0.46 (.09)
45–59	5	0.06 (.03)	4	0.03 (.02)	48	0.50 (.09)
≥ 60	1	0.01 (.01)	4	0.08 (.05)	29	0.33 (.07)
Education level						
Less than high school	0	0.00 (.00)	10	0.17 (.07)	25	0.51 (.12)
High school or GED	3	0.05 (.04)	11	0.15 (.06)	36	0.38 (.07)
Some college or higher	10	0.06 (.02)	23	0.13 (.03)	105	0.45 (.05)
Income level						
<$25,000	4	0.08 (0.05)	14	0.19 (0.07)	51	0.48 (0.09)
$25,000–39,999	1	0.01 (0.01)	10	0.10 (0.03)	34	0.42 (0.10)
$40,000–69,999	3	0.02 (0.02)	12	0.12 (0.04)	46	0.38 (0.06)
≥$70,000	5	0.07 (0.03)	8	0.14 (0.05)	35	0.47 (0.09)

Notes. AN = anorexia nervosa; BN = bulimia nervosa; BED = binge eating disorder. Calculations of prevalence and standard errors were adjusted for survey weights.

Table 3

Adjusted Odds Ratios (AOR) and 95% Confidence Interval (95% CI) of *DSM-5* AN, BN, and BED by gender, by race/ethnicity, and by educational level

	AN	BN	BED
	AOR (95% CI)	**AOR (95% CI)**	**AOR (95% CI)**
Lifetime diagnosis			
Women vs. Men	12.00 (6.45–22.34) ‡	5.80 (2.82–11.92) ‡	3.01 (2.17–4.16) ‡
Race			
Hispanic vs. non-Hispanic White	0.48 (0.33–0.72) ‡	0.65 (0.33–1.29)	0.75 (0.38–0.92)
Non-Hispanic Black vs. non-Hispanic White	0.19 (0.11–0.33)‡	0.54(0.25–1.19)	0.60 (0.38–0.92) †
Education			
High school/GED vs. less than HS	0.82 (0.50–1.36)	0.83 (0.34–2.12)	0.87 (0.59–1.29)
Some college or higher vs. less than HS	1.31 (0.87–1.97)	1. 25 (0.64–2.44)	1.05 (0.72–1.53)
Income			
$25,000–39,999 vs. <$25,000	0.97 (0.60–1.57)	0.68 (0.34–1.34)	0.82 (0.56–1.20)
$40,000–69,999 vs. <$25,000	1.47 (1.01–2.15) †	0.94 (0.49–1.84)	0.83 (0.58–1.21)
≥$70,000 vs, <$25,000	1.60 (1.07–2.38) †	0.76 (0.39–1.48)	0.87 (0.59–1.25)
12 months diagnosis			
Women vs. Men	6.48 (1.72–24.45) †	5.16 (1.83–14.56) ‡	2.37 (1.57–3.59) ‡
Race			
Hispanic vs. non-Hispanic White	0.11 (0.01–1.00) †	0.64 (0.27–1.56)	0.76 (0.45–1.27)
Non-Hispanic Black vs. non-Hispanic White[1]	---	0.47 (0.16–1.41)	0.55 (0.28–1.06)
Education			
High school/GED vs. less than HS[1]	---	0.77 (0.24–2.46)	0.70 (0.39–1.28)
Some college or higher vs. less than HS[1]	---	0.57 (0.26–1.27)	0.76 (0.44–1.31)
Income			
$25,000–39,999 vs. <$25,000	0.06 (0.01–0.56) †	0.63 (0.23–1.72)	0.92 (0.51–1.65)
$40,000–69,999 vs. <$25,000	0.26 (0.06–1.23)	0.83 (0.29–2.37)	0.84 (0.52–1.35)
≥$70,000 vs, <$25,000	0.67 (0.21–2.15)	1.05 (0.40–2.57)	1.04 (0.58–1.89)

Notes. AN = anorexia nervosa; BN = bulimia nervosa; BED = binge eating disorder. Adjusted for age and other sociodemographic variables.

† significant at $p < .05$;

‡ significant at $p < .01$. Calculations of ORs and 95% CIs were adjusted for survey weights.

1 Estimate was not valid due to no case in non-Hispanic Black and high school/GED.

Table 4

Age of Onset, Duration, and Persistence of *DSM-5* Eating Disorders

	AN	BN	BED
Current age			
Mean (SE)	41.8 (0.96)	39.1 (2.45)	45.2 (1.21) [a]
Median (IQR)	42.2 (29.5–51.7)	38.3 (27.3–46.8)	46.0 (31.8–56.8)
Age of onset of ED			
Mean (SE)	19.3 (0.06)	20.0 (0.55)	24.5 (0.31) [a, b]
Median (IQR)	17.4 (15.2–20.5)	16.0 (13.9–21.5)	21.1 (14.6–30.4)
Years with episode			
Mean (SE)	11.4 (0.40)	12.2 (0.67)	15.9 (0.36) [a, b]
Median (IQR)	4.9 (1.6–16.3)	8.0 (3.6–18.3)	10.6 (3.5–24.4)
% 12-month persistence (SE)	9.4 (2.41)	54.7 (6.79) [a]	63.5 (3.87) [a]

Notes. ED = eating disorder; AN = anorexia nervosa; BN = bulimia nervosa; BED = binge eating disorder. SE = standard error; IQR = interquartile range. The analysis included those with lifetime diagnosis of AN, BN without lifetime AN, or BED without lifetime AN or BN;

[a] significantly different from anorexia nervosa at $p < .05$ based on Tukey-Kramer post-hoc test or comparison of cells (17);

[b] significantly different from bulimia nervosa at $p < .05$ based on Tukey-Kramer post-hoc test. Calculations of means, medians, and standard errors were adjusted for survey weights.

Table 5

Inter-Cohort Differences in Lifetime Risk (Adjusted Hazard Ratios) of *DSM-5* Eating Disorders

	AN	BN	BED
Age (years)	**AHR (95% CI)**	**AHR (95% CI)**	**AHR (95% CI)**
18–29	3.86 (2.21–6.74) ǂ	5.81 (1.83–18.42) ǂ	3.86 (2.21–6.74) ǂ
30–44	2.77 (1.60–4.78)ǂ	5.45 (1.63–18.24) ǂ	2.77 (1.61–4.78)ǂ
45–59	2.52 (1.57–4.02) ǂ	2.37 (0.65–11.55)	2.52 (1.63–3.32)ǂ
60+	Reference	Reference	Reference

Notes. AN = anorexia nervosa; BN = bulimia nervosa; BED = binge eating disorder. AHR = adjusted hazard ratios, adjusting for age, sex, race/ethnicity, education and income. CI = confidence interval.

† significant at $p < .05$;

ǂ significant at $p < .01$.

Table 6

Report of Clinical Impairment in Psychosocial Functioning Associated with Disordered Eating (% [SE]) by *DSM-5* Eating Disorders

	AN	BN	BED
Lifetime			
Interfere with normal daily activities	23.5 (3.34)	49.5 (7.23) [a]	52.5 (3.88) [a]
Serious problems getting along with others	21.2 (3.04)	32.9 (6.57)	20.9 (3.10)
Serious problems fulfilling responsibilities	17.5 (2.81)	25.1 (4.63)	28.2 (3.55)
Any Form	30.7 (3.49)	61.4 (7.54) [a]	53.7 (3.99) [a]
12 months			
Interfere with normal daily activities	47.1 (14.10)	46.8 (9.56)	54.7 (4.35)
Serious problems getting along with others	43.9 (14.00)	41.8 (10.50)	19.8 (3.29) [b]
Serious problems fulfilling responsibilities	45.4 (14.39)	32.9 (7.28)	25.6 (4.01)
Any Form	47.1 (14.10)	64.6 (10.12)	54.7 (4.35)

Notes. ED = eating disorder; AN = anorexia nervosa; BN = bulimia nervosa; BED = binge eating disorder. SE = standard error; The analysis included those with lifetime diagnosis of AN, BN without lifetime AN, or BED without lifetime AN or BN;

[a] significantly different from anorexia nervosa at $p < .05$ based on comparison of cells (17). All analyses were adjusted for the NESARC complex survey design.

1 no standard error was computed due to small sample size.

Table 7

Differences in Current BMI and BMI Categories in Lifetime and 12-month ED Groups

	AN		BN		BED	
Current BMI by Lifetime ED diagnosis						
Mean (SE)	24.1 (0.42)		27.7 (0.75) [a]		33.9 (0.64) [a, b]	
Median (IQR)	22.2 (20.0–26.7)		27.2 (22.9–30.8)		32.6 (27.3–38.4)	
Current BMI Group by Lifetime ED diagnosis	**%**	**AOR (95% CI)**	**%**	**AOR (95% CI)**	**%**	**AOR (95% CI)**
< 18.5	3.19 (1.03) 15	2.71 (1.57–4.68) ≠	0.40 (0.40) 1	--- *1*	0.52 (0.41) 2	0.22 (0.03–1.58)
18.5–24.9	1.40 (0.14) 161	2.29 (1.80–2.92) ≠	0.36 (0.07) 38	0.94 (0.59–1.49)	0.53 (0.08) 63	0.29 (0.20–0.41) ≠
25–29.9	0.42 (0.06) 55	0.61 (0.45–0.82) ≠	0.23 (0.06) 22	0.87 (0.52–1.46)	0.55 (0.08) 74	0.70 (0.52–0.95) †
30–39.9	0.43 (0.09) 37	0.49 (0.35–0.70) ≠	0.25 (0.06) 28	1.31 (0.82–2.08)	1.38 (0.16) 125	2.09 (1.61–2.70) ≠
≥ 40	0.31 (0.21) 4	0.28 (0.10–0.74) †	0.10 (0.06) 3	---- *2*	2.82 (0.47) 51	4.61 (3.34–6.37) ≠
Current BMI by 12 months ED diagnosis						
Mean (SE)	17.4 (0.39)		27.1 (0.82) [a]		34.9 (0.84) [a, b]	
Median (IQR)	18.0 (16.6–18.1)		26.8 (22.8–29.1)		34.3 (29.0–39.0)	
Current BMI Group by 12-month ED diagnosis	**%**	**AOR (95% CI)**	**%**	**AOR (95% CI)**	**%**	**AOR (95% CI)**
< 18.5	2.91 (1.02) 13	---*3*	0.40 (0.40) 1	---*1*	0.12 (0.12) 1	---*1*
18.5–24.9	---	---	0.15 (0.15) 16	0.88 (0.49–1.60)	0.10 (0.03) 14	0.15 (0.09–0.26) ≠

	AN		BN		BED	
25–29.9	---	---	0.15 (0.05)	1.24 (0.65–2.40)	0.28 (0.06)	0.65 (0.45–0.95) †
			14		37	
30–39.9	---	---	0.12 (0.04)	0.99 (0.52–1.88)	0.86 (0.12)	2.58 (1.88–3.54) ‡
			12		76	
≥40	---	---	0.03 (0.03)	---[2]	1.95 (0.43)	5.36 (3.67–7.83) ‡
			1		36	

Notes. AN = anorexia nervosa; BN = bulimia nervosa; BED = binge eating disorder; SE = standard error; IQR = interquartile range. AOR = adjusted odds ratios, adjusting for sociodemographic variables.

[1] collapsed with BMI=18.5–24.5;

[2] collapsed with BMI=30–39.9;

[3] the model was not valid due to low positive response frequencies. In all analyses, a reference group was individuals without lifetime history of any ED. All analyses were adjusted for the NESARC complex survey design.

† significant at $p < .05$;

‡ significant at $p < .01$.