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A register-based case-control study of health care utilization and costs in binge-eating disorder[☆]

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ABSTRACT

Objective: Capturing trends in healthcare utilization may help to improve efficiencies in the detection and diagnosis of illness, to plan service delivery, and to forecast future health expenditures. For binge-eating disorder (BED), issues include lengthy delays in detection and diagnosis, missed opportunities for recognition and treatment, and morbidity. The study objective was to compare healthcare utilization and expenditure in people with and without BED.
Methods: A case-control design and nationwide registers were used. All individuals diagnosed with BED at eating disorder clinics in Sweden between 2005 and 2009 were included ($N = 319$, 97% female, M age = 22 years). Ten controls ($N = 3190$) were matched to each case on age-, sex-, and location of birth. Inpatient, hospital-based outpatient, and prescription medication utilization and expenditure were analyzed up to eight years before and four years after the index date (i.e., date of diagnosis of the BED case).
Results: Cases had significantly higher inpatient, hospital-based outpatient, and prescription medication utilization and expenditure compared with controls many years prior to and after diagnosis of BED. Utilization and expenditure for controls was relatively stable over time, but for cases followed an inverted U-shape and peaked at the index year. Care for somatic conditions normalized after the index year, but care for psychiatric conditions remained significantly higher.
Conclusion: Individuals with BED had substantially higher healthcare utilization and costs in the years prior to and after diagnosis of BED. Since previous research shows a delay in diagnosis, findings indicate clear opportunities for earlier detection and clinical management. Training of providers in detection, diagnosis, and management may help curtail morbidity. A reduction in healthcare utilization was observed after BED diagnosis. This suggests that earlier diagnosis and treatment could improve long-term health outcomes and reduce the economic burden associated with BED.

1. Introduction

Binge-eating disorder (BED) is characterized by the regular consumption of unusually large amounts of food accompanied by a sense of loss of control, in the absence of regular compensatory behaviors (e.g., self-induced vomiting) [1]. The lifetime prevalence is 3.5% in women and 2.0% in men [2,3]. BED is associated with obesity, type 2 diabetes, and suicide [2,4–7]. Despite its prevalence and somatic and psychological comorbidities [2,4,7], few studies have considered health care utilization and expenditure in individuals with BED [6,8–11].

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Investigating disease-specific healthcare utilization is crucial for forecasting demands on medical infrastructure and for guiding policy and health service planning.

Grenon et al. [11] determined that average healthcare cost in the six months prior to diagnosis was 36% higher for overweight women with BED (n = 105) relative to the age-and-sex matched national norm. Excluding non-overweight individuals may have biased the sample toward greater utilization, and generalizability was limited by the lack of an appropriate control group. Bellows et al. [8,9] compared electronic health records of veterans with BED (n = 257, 75% female) and without BED. In the year following diagnosis, cases had higher inpatient and psychotherapy use, longer inpatient stays, and more prescriptions than controls. In the year preceding diagnosis, median total health care expenditure did not differ significantly between the groups; however, in the year following BED diagnosis, total cost doubled for cases. Greater medication utilization in the year before and after diagnosis for people with BED (n = 238, 96% female) relative to matched controls was reported in a nationwide Swedish register study [6].

Individuals with BED appear to have significantly greater healthcare utilization, particularly in the year after detection, but evidence is limited. Samples have been selective (i.e., overweight, veterans), and observations were limited to the year before and after diagnosis. We fill the gap in the healthcare utilization literature by studying a large, population-based, longitudinal sample from Swedish nationwide register data. Given the morbidity and typical delay in diagnosis and help-seeking [12,13], we expected significantly greater and accelerating utilization and expenditure among those with BED in the years preceding diagnosis, relative to controls. The analyses regarding the pattern of utilization and expenditure after the index date are exploratory, due to a lack of prior research.

2. Method

2.1. Study population

The sample (319 cases, 3190 controls, total $N = 3509$) represents a total population cohort ($N = 1,949,199$) born between 1979 and 1993 identified in the Swedish registers. BED cases were identified from *Riksät* and *Stepwise*—longitudinal quality assurance registers that capture nearly all individuals receiving inpatient, day patient, or outpatient specialist eating disorder treatment in Sweden [14]. Criteria for inclusion in *Riksät* and *Stepwise* are medical or self-referral to a participating clinic, an eating disorder diagnosis by a medical provider, and intent-to-treat the patient. For the *Stepwise* register, research participation is elective via an opt out procedure (~3% decline participation [15]). All patients with a DSM-IV [16] BED diagnosis between 2005 and 2009 were included as cases. In this study, the date of the first diagnosis of BED represents the index date. The first diagnosis could occur at the initial clinic presentation or at a follow-up evaluation after presentation for another eating disorder. Follow-up eating disorder assessments (available for ~69% of registrants) are annual while treatment is ongoing.

We ascertained 10 controls for each case using the *Multi-Generation Register* [17] matched by sex, and year, month, and county of birth. Controls were also matched on immigration status and time of migration (controls could not immigrate later than their respective cases) if cases were born outside of Sweden. Controls had to be alive and a resident in Sweden for an equivalent time period: from birth or immigration until the end of study follow-up of their index case. Controls were not allowed to have received a BED diagnosis in *Riksät* or *Stepwise*, but they could have had another eating disorder (which was detected in 0.7% of controls) recorded in *Riksät*, *Stepwise*, or the *National Patient Register* [18].

The national personal identification number was used to link registers. The University of North Carolina Biomedical Institutional Review Board and the Regional Ethics Committee of Karolinska Institutet approved this study. Inclusion in Swedish population registers does not require informed consent.

2.2. Measures

2.2.1. Demographics and comorbidity

Demographics were obtained from Sweden's *Total Population Register and Longitudinell Integrationsdatabas för Sjukförsäkrings- och Arbetsmarknadsstudier* (LISA: Longitudinal Integration Database for Health Insurance and Labour Market Studies). Lifetime psychiatric comorbidity was obtained from the *National Patient Register*.

2.2.2. Healthcare utilization and expenditure

Inpatient admissions and hospital-based outpatient visits were coded from the *National Patient Register*. For each participant, data were obtained where available from 8 years prior to 4 years after the index date (denoted $year - 8$ to $year + 4$). The principal *International Classification of Diseases, Tenth Revision* [19] (ICD-10) diagnostic code for each occasion of service use was used to help establish costs. Cost information was obtained from Sweden's *Costs Per Patient* database which provides cost estimates annually based on individual patient contact with hospital care according to the principal ICD diagnosis. ICD comorbidities are recorded, but there is no adjustment to cost for these. Using the principal ICD diagnosis for the healthcare occasion, inpatient and outpatient utilization and expenditure were classified into psychiatric and somatic.

Utilization and expenditure for medication prescriptions fills were obtained from the *Swedish Prescribed Drug Register,* which contains complete data (> 99%) for all medications prescribed and dispensed to the entire Swedish population since July 1, 2005 [20].

Since this a newer database, only utilization four years before and four years after the index date could be included (i.e., $year\ -4$ to $year\ 4$). The register uses the Anatomical Therapeutic Chemical (ATC) classification system. Medication use was classified into psychiatric (N codes) and somatic. See Supplementary Table S1 for information on ATC codes and availability in the Swedish Prescribed Drug Register. Costs equaled dispensed days × dose per day × corresponding unit costs. Utilization and expenditure that occurred on the index date were not included for all healthcare types. For further information on the data, see Supplementary Table S2.

2.2.3. Currency and inflation

Expenditure was calculated in Swedish crowns (SEK) then inflated to 2015 Swedish prices. Costs are reported in the tables and text in US dollars (2015). The purchasing power parity based exchange rate in 2015 was 1.00 US dollar = 9.03 SEK [11].

2.2.4. Covariates

Factors that explain variability in healthcare utilization include low socioeconomic status, advancing age, and female sex [21]. Parental education and income were included as covariates, as proxies for socioeconomic status. Parental education and income were obtained from *LISA* for the index year. Parental education was assessed as the highest level attained by either parent (primary school, secondary school, or tertiary education). Income was assessed as the individual share of disposable family income, and was obtained by calculating the sum of family members' disposable income multiplied by individual consumption weights (0.96 for adults), then divided by the total family consumption weight. Net values in SEK were grouped into median splits for analysis. Age and sex were accounted for already in the study design.

2.3. Statistical analysis

Hurdle models compared annual healthcare utilization and expenditure between cases and controls. The hurdle likelihood function decomposes into two parts. The first part predicted the binary outcome of utilization (or expenditure) and yielded an odds ratio (OR) from a logistic distribution. The second part of the hurdle model, which is conditional on having a strictly positive value for the first part (i.e., at least one occasion of healthcare use), yielded an incident rate ratio (IRR). For utilization outcomes, IRR is interpreted as the ratio of the number of visits (or prescription fills), and for expenditure outcomes, IRR is interpreted as the ratio of mean cost. The second part was fitted with a negative binomial distribution and lognormal linear distribution, for utilization and expenditure outcomes respectively. Because of the low frequency of inpatient hospitalization, only the logistic regression component is reported. Exact likelihood methods were used. The false discovery rate (FDR) procedure corrected for multiple testing [22].

Bootstrap analyses accounted for uncertainty around the expected values of utilization and expenditure. One thousand bootstrap replicates were created for each parameter in the model, and during each simulation one was drawn at random with replacement and used in the calculation of the population mean and 95% confidence interval. For utilization, the estimate represented the mean difference between cases and controls. For expenditure, the ratio of expenditure (cases/controls) was estimated. A positive confidence interval indicates that utilization/expenditure is significantly higher among cases at the $p < 0.05$ threshold. A small portion of the bootstrap iterations failed to estimate the distribution of the estimator because of low base rates of the outcome and/or small cell sizes. Analyses were conducted with R 3.1.1.

3. Results

3.1. Sample descriptives

Three hundred and nineteen cases were identified. The average age at the index date was 22.4 years (*SD* = 3.4; range 14 to 29). Ninety-seven percent (n = 308) were female and 91% (n = 290) were Swedish-born. The average body mass index (BMI) at the time of diagnosis was 26.7 kg/m^2 (SD = 6.8), 28% were overweight (BMI = 25–29.9 kg/m^2), and 23% were obese (BMI > 30 kg/m^2). There were 3190 controls matched to cases on sex, age, and county of birth. Type 2 diabetes was recorded in the *National Patient Register* in 3 (0.9%) cases and 0 controls. The prevalence of lifetime psychiatric comorbidity in cases and controls is shown in Supplementary Table S3. Descriptive statistics for annual healthcare utilization and expenditure are in the Supplement (Table S4). We report means and proportions for comparability with other research [6,8,9,11].

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3.2. Health care utilization and costs

We report the pattern of the outcome over the time period. Hurdle model ORs for utilization (see Fig. 1) and expenditure followed an inverted U-shaped curve across time. Eight years before BED diagnosis, utilization was not significantly different for inpatient (OR_{year-8} = 0.78; 0.10, 6.18, FDR p = 0.81) or hospital-based outpatient treatment (OR_{year-8} = 0.84; 0.33, 2.18, FDR p = 0.81). Four years before BED diagnosis, prescription fills for psychiatric conditions were higher among cases (OR_{year-4} = 2.86; 1.65, 4.96, FDR $p < 0.001$). The same was true for costs (see Fig. 2). Significant differences between cases and controls became apparent in the years before the index BED diagnosis. Psychiatric care predominantly accounted for the pre-index differences. ORs for utilization and expenditure peaked in the index year. For example, cases had significantly higher odds of inpatient psychiatric care ($OR_{year\ 1}$ = 23.06; 9.22, 57.68, FDR $p < 0.001$) and of hospital-based outpatient and prescription fill utilization, both overall and for psychiatric conditions. After the index date, ORs declined annually until there were no significant group differences by the end of the observation period. There was an exception for psychiatric prescription fills; the inverted U-shaped association was present; however, cases had significantly higher odds of utilization and expenditure every year observed.

Among those who had at least one occasion of healthcare use, cases were heavier users than controls of outpatient and medication healthcare in several observed years, and the same for expenditure. An inverted U-shaped pattern was evident for the hurdle model IRRs (see the lower panels in Fig. 1; FDR $ps < 0.05$). Significant group differences were observed prior to, during, and in the years after the index date. The peak differences occurred in the index year for hospital-based outpatient visits (IRR = 3.04, 95% CI = 1.98, 4.66, FDR $p < 0.001$), prescription medication fills (IRR = 2.30, 95% CI = 1.84, 2.88, FDR $p < 0.001$), hospital-based outpatient expenditure (IRR = 1.47, 95% CI = 1.27, 1.71, FDR $p < 0.001$), and prescription medication expenditure (IRR = 1.96, 95% CI = 1.65, 2.34, FDR $p < 0.001$).

3.3. Supplementary analyses

To evaluate whether utilization for psychiatric conditions was at least in part attributable to comorbidities, utilization for non-eating disorder diagnoses only was considered. The same inverted U-shaped pattern was seen. Cases were significantly more likely to visit outpatient care over most observed years (FDR $ps < 0.05$), suggesting that utilization was closely connected with psychiatric comorbidities. The results are shown fully in Supplementary Table S5.

Utilization for non-BED eating disorders was also considered. Cases had a significantly higher odds of outpatient psychiatric care for a non-BED eating disorder from year −4 to 4 (FDR $ps < 0.05$). Thus at least part of the group difference was because BED cases had a greater odds of treatment contact for another eating disorder, and suggests that some cases experienced a crossover from another eating disorder to BED, or BED to another eating disorder. Clinically, this is common, given the similarities between the eating disorders [2]. The full results are shown in Supplementary Table S6.

3.4. Bootstrap predicted group differences in utilization

The mean differences in annual outpatient visits and prescription fills (overall and for psychiatric conditions) were statistically significant in the majority of instances and followed an inverted U-shape over time (Fig. 3). The peaks occurred near the index date and indicated that cases had higher inpatient ($\mu_{year\ 1}$ = 1.36 days, 95% CI = 0.44, 2.41, $p < 0.05$), hospital-based outpatient ($\mu_{year\ 1}$ = 1.38 visits, 95% CI = 1.08, 1.73, $p < 0.05$), and prescription medication utilization (μ_{year-1} = 4.03 fills, 95% CI = 2.92, 5.18, $p < 0.05$). The differences could be attributed to psychiatric conditions for inpatient and hospital-based outpatient utilization, and for psychiatric and somatic conditions for prescription medication fills.

3.5. Bootstrap predicted ratio of expenditure

The ratio of the expenditure (cases/controls) rather than the mean difference was examined, since healthcare costs can vary widely across countries and a ratio might allow for easier cross-country comparison. To give a basic idea of cost, the cost of an inpatient day in the sample was US$1116 (*SD* = $453), $249 (*SD* = $67) for an outpatient-based visit, and $31 (*SD* = $64) for a prescription fill. Expenditure on care was significantly greater for cases than controls several years before and after diagnosis, overall and when restricted to psychiatric illness only (Fig. 4). At the peaks, for instance, cases had 8 times higher expenditure on inpatient care (μ_{year-2} = 8.28; 2.50, 19.63) and 16 times higher expenditure on outpatient care for psychiatric reasons ($\mu_{year\ 1}$ = 16.64; 12.18, 23.69, $p < 0.05$) ($\mu_{year\ 1}$ = 2.32; 1.85, 2.90, $p < 0.05$). Expected expenditure on annual per-person prescription fills was significantly elevated for cases between years −1 to 2 for prescriptions for somatic illness.

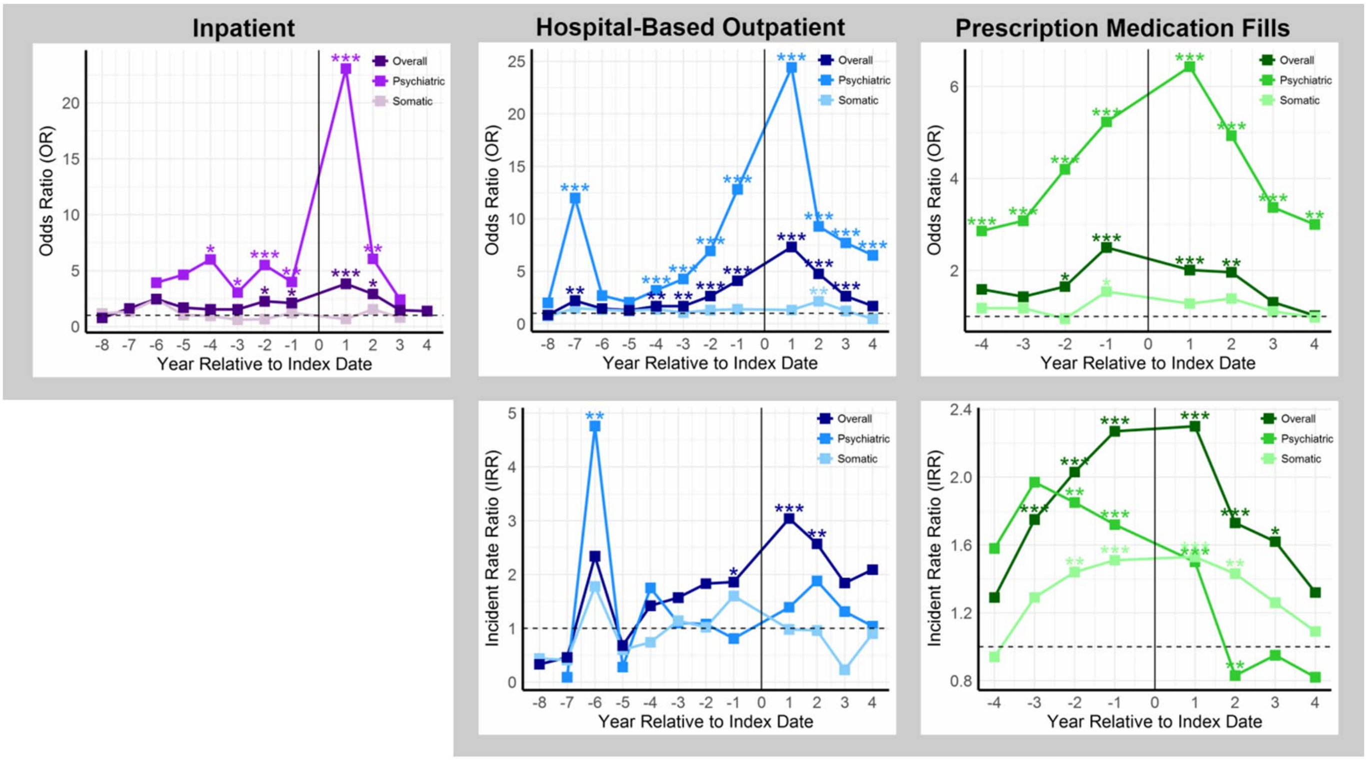

Fig. 1. Healthcare Utilization for Binge-Eating Disorder (BED) Cases Compared with Matched Controls for the Years Surrounding the Index Date (Date of BED Diagnosis).
Note. Controls were matched on age, sex, and location of birth. The upper panels of the figure show odds ratio estimates. The vertical reference line indicates the index date and the horizontal reference line corresponds to a ratio of 1 (i.e., no significant case-control difference if the 95% CI overlaps). For hospital-based outpatient and prescription medication fills hurdle models captured the ratio of frequency of utilization (i.e., incident rate ratios) among those individuals who had at least one occasion of service. These estimates are shown in the lower panels. The figures show an inverted U-shaped pattern, such that healthcare utilization in cases begins to escalate years before BED diagnosis, peaks around the year BED is diagnosed, and begins to decrease thereafter relative to controls.
*False discovery rate (FDR) $p < 0.05$. **FDR $p < 0.01$. ***FDR $p < 0.001$.

4. Discussion

BED became formalized in DSM-5 [1] and is the most common eating disorder. Research documenting extensive comorbidity and debilitating effects has proliferated [2,4,7]. Awareness of BED is lacking in the public and in health care settings and its seriousness remains underappreciated [23]. We show that healthcare burden is observable years before BED was medically detected, as well as years after. While controls' healthcare utilization and expenditure remained relatively low and steady over the observation period, an inverted U-shaped pattern characterized cases, with a reversal occurring after BED diagnosis. If replicated, earlier detection and direct intervention for BED may obviate negative health outcomes and associated costs. Our findings extend previous research limited by shorter observation periods and selected samples [6,8–11].

We hypothesized greater burden for people with BED years before diagnosis, because there is typically a multiyear delay from clinical onset to detection of illness [12,13,24] This prediction was supported and indicates missed opportunities to detect BED. Many primary care providers are unaware of and have never diagnosed BED [13,25]. Most individuals with BED have never been asked about problems with binge eating by a health professional [13]. Unrecognized emotional and biological consequences of having BED may contribute to greater healthcare burden. Failure to enter individuals into care that manages BED symptoms may lead to worse medical outcomes. Binge eating prospectively predicts metabolic syndrome, poorer mental health, and impaired functioning, which increase use of psychiatric and somatic care [2].

Primary care providers and general psychiatrists are well-placed to improve detection of BED [26]. The data from this study showed some reversal of healthcare utilization, suggesting that treating BED when symptoms first emerge may obviate negative health outcomes. Many patients experience recovery or a reduction in symptoms with treatment [4]. Educating providers and the general population about BED and reducing stigma may improve recognition and help-seeking [23].

The analyses of utilization and expenditure post-diagnosis were exploratory. For persons with sleep apnea, healthcare utilization among cases relative to controls increases as the index year (i.e., diagnosis/detection) approaches and reverses after the index year (i.e., with treatment) [27]. In other conditions, such as fibromyalgia and diabetes, utilization is arrested but is not reversed in the years following treatment [28,29]. In the current study, after diagnosis of BED, the trend of a progressive increase in healthcare utilization was reversed, and the difference between cases and controls diminished. Controls showed a steady amount of utilization over the observed timeframe. Although a reversal in use of all forms of healthcare was observed among cases, cases still had significantly higher use of outpatient care and prescriptions for psychiatric illnesses, suggesting healthcare burden years later. Future research comparing healthcare utilization among acute and recovered individuals with BED adjusting for confounds is needed to shed light on the role of eating disorder recovery in healthcare utilization.

Strengths of this study include an examination of the broadest time range to date pre- and post-diagnosis, and the use of an unselected sample of clinically ascertained BED cases from a nationwide registry. Register data were used, eliminating recall bias in utilization and expenditure. The data source comprised a population of ~2 million individuals.

Several limitations are apparent. Males comprise a large portion of those with BED, but were underrepresented [30,31]. We did not have access to data on some healthcare types (i.e., emergency admission,

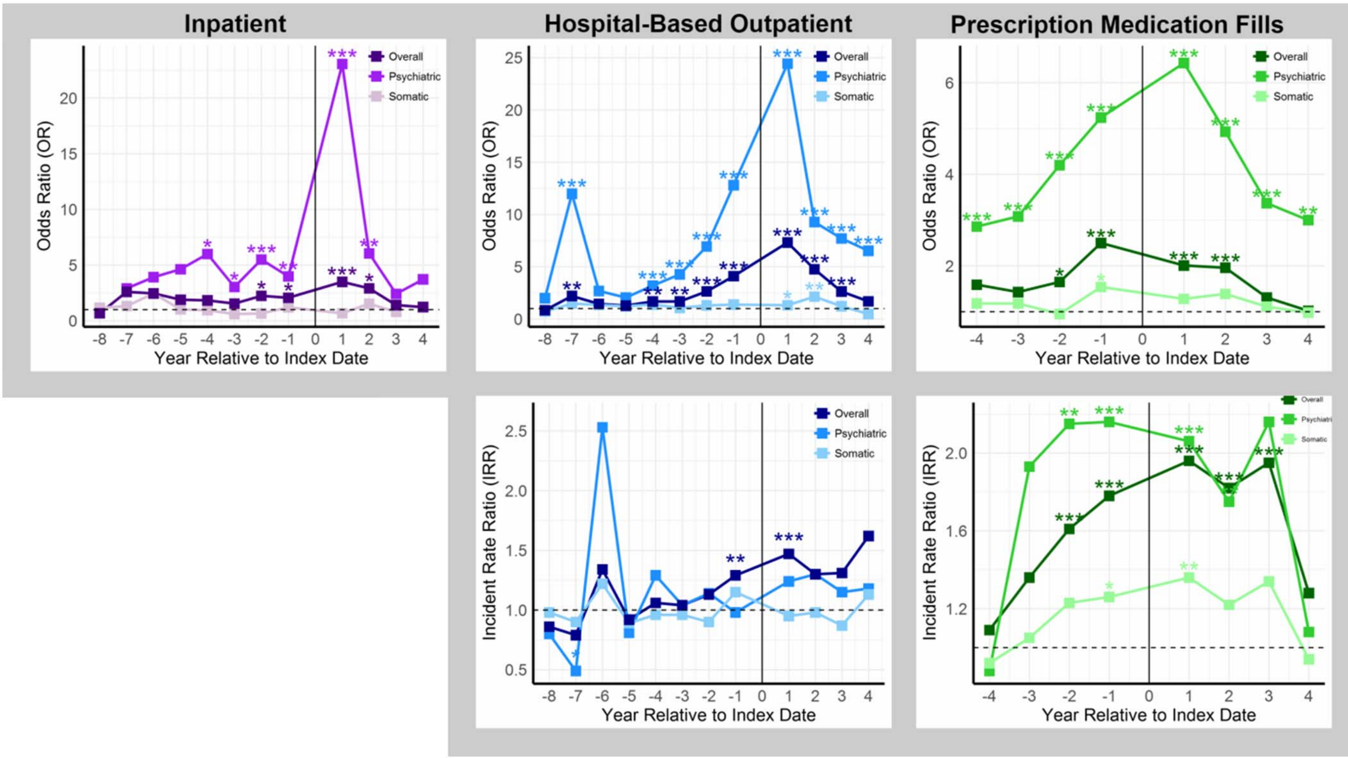

Fig. 2. Healthcare Expenditure for Binge-Eating Disorder (BED) Cases Compared with Matched Controls for the Years Surrounding the Index Date (Date of BED Diagnosis).
Note. Controls were matched on age, sex, and location of birth. The upper panels of the figure show odds ratio estimates. The vertical reference line indicates the index date and the horizontal reference line corresponds to a ratio of 1 (i.e., no significant case-control difference if the 95% CI overlaps). For hospital-based outpatient and prescription medication fills hurdle models captured the ratio of frequency of utilization (i.e., incident rate ratios) among those individuals who had at least one annual expenditure. These estimates are shown in the lower panels. The figures show an inverted U-shaped pattern, such that cases' use of healthcare begins to escalate years before BED diagnosis, peaks around the year BED is diagnosed, and begins to decrease thereafter relative to controls. *False discovery rate (FDR) $p < 0.05$. **FDR $p < 0.01$. ***FDR $p < 0.001$.

non-hospital based outpatient, over-the-counter medications, medications given during hospitalization), and some medication categories (i.e., anti-obesity agents) were not in the data linkage. Cases were clinically ascertained via specialist clinics and results may not generalize to less severe patients treated outside specialist services or to non-treatment seeking individuals [3]. US data suggest that less than half of those with BED (43.6%) have ever sought treatment [2]. Because some healthcare such as inpatient treatment has low base rates, it is harder to detect a difference if it exists. BMI data were unavailable for controls so it was not possible to adjust for obesity in the analyses. The *National Patient Register* does not include eating disorders diagnosed outside specialist services. Increased contacts with the medical system and care providers multiplies opportunities for detection of comorbid illnesses, hence surveillance bias may have contributed to case-control differences. Although cases and controls were matched on age, sex, and county of birth, unmeasured confounders could explain the differences observed.

5. Conclusions and implications

Annual frequency and expenditure on healthcare utilization was higher than controls for inpatient, outpatient, and prescription medication healthcare. Because of evidence of under-diagnosis of BED in primary care [12,13,24,25], elevated resource use before diagnosis of BED reflects the burden of both comorbidity and BED. A decline in clinical status was evident years before BED was diagnosed, and utilization and expenditure progressively increased among cases to the year of BED diagnosis, after which a reversal was apparent. This study calls on the health system to improve detection of BED and for treatment of BED symptoms as they emerge. Early treatment may improve health outcomes and reduce the economic burden of BED.

Role of the funder/sponsor

Research was funded by the sponsor, Shire Development LLC (Lexington, MA). The sponsor was involved in the design and conduct of the study; planning the analysis and interpretation of data; and preparation, review, and approval of the manuscript. The sponsor was not involved in performing the statistical analysis.

Conflicts of interest disclosures

Dr. Bulik has received a research grant from Shire and served on their scientific advisory board. Dr. Larsson has served as a speaker for Eli-Lilly and Shire, and has received a research grant from Shire. Dr. Madhoo is an employee of Shire and holds stock and/or stock options in Shire. Dr. Norring is a consultant on a research grant from Shire. Dr. Watson and Dr. Thornton are investigators on a research grant from Shire. Dr. von Hausswolff-Juhlin is a consultant on a research grant from Shire. Mr. Jangmo has received salary support from a grant from Shire. Dr. Welch and Ms. Wiklund report no financial or other relationships relevant to the subject of this article.

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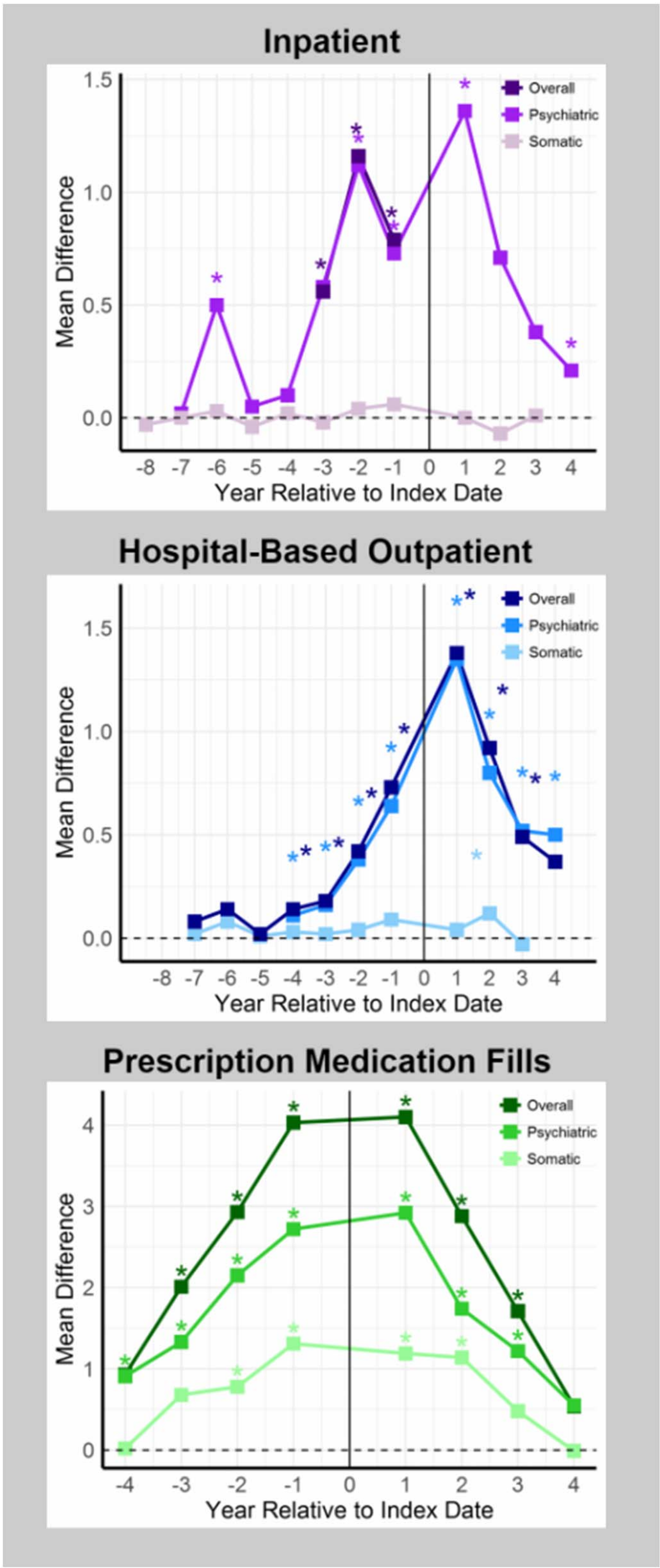

Fig. 3. Bootstrapped Case-to-Control Mean Difference in Utilization Before and After the Index Date (Date of BED Diagnosis).

Note. Controls were matched on age, sex, and location of birth. The vertical reference line indicates the index date and the horizontal reference line corresponds to a mean difference of 0 (i.e., no significant case-control difference if the 95% CI overlaps). Due to sparse data, some models have missing estimates, near the extremities and estimates for inpatient overall converged only in years −3 to −1 only. *$p < 0.05$.

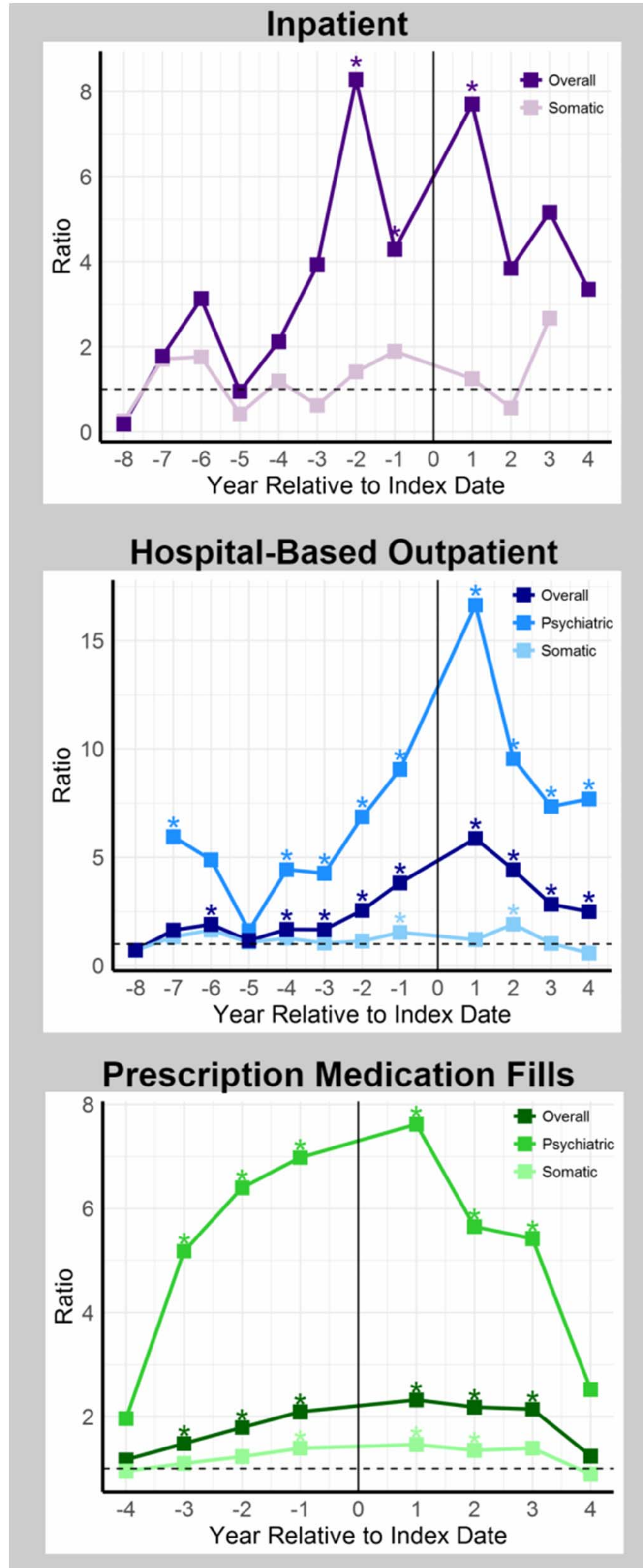

Fig. 4. Bootstrapped Case-to-Control Ratio in Expenditure Before and After the Index Date (Date of BED Diagnosis).

Note. Controls were matched on age, sex, and location of birth. The vertical reference line indicates the index date and the horizontal reference line corresponds to a ratio of 1 (i.e., no significant case-control difference if the 95% CI overlaps). Due to sparse data, the ratio of inpatient psychiatry expenditure could not be estimated. *$p < 0.05$.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jpsychores.2018.02.011.

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