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### Title

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### Permalink

<https://escholarship.org/uc/item/23d5290v>

### Journal

General Hospital Psychiatry, 37(2)

### ISSN

0163-8343

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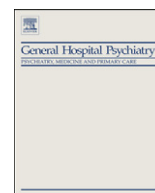
### Publication Date

2015-03-01

### DOI

10.1016/j.genhosppsy.2014.12.005

Peer reviewed



## Psychiatric–Medical Comorbidity

The Psychiatric–Medical Comorbidity section will focus on the prevalence and impact of psychiatric disorders in patients with chronic medical illness as well as the prevalence and impact of medical disorders in patients with chronic psychiatric illness.

## Prevalence of behavioral health disorders and associated chronic disease burden in a commercially insured health system: findings of a case–control study<sup>☆</sup>



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## ARTICLE INFO

## Article history:

Received 12 July 2014

Revised 10 December 2014

Accepted 15 December 2014

## Keywords:

Behavioral/mental health disorders

Co-occurring conditions

Chronic conditions

Epidemiology

Health system

## ABSTRACT

**Objective:** The objective was to examine prevalence of behavioral health disorders (BHDs) and co-occurring chronic medical conditions in a 3.4 million-member integrated health system.

**Method:** Clinical databases identified 255,993 patients diagnosed with the most prevalent BHDs (cases): depression, anxiety, substance use, bipolar spectrum and attention deficit and hyperactivity (ADHD); non-BHD matched controls were created for all unique cases. Cases and controls were compared for prevalence of general medical conditions and specific chronic diseases and the Charlson Comorbidity Index (CMI).

**Results:** The five most common BHDs were depression (58%), anxiety (42%), substance use (16%), bipolar spectrum (6%) and ADHD (4%). Compared to controls, patients with depression (80.1% vs. 66.3%), anxiety (78.0% vs. 63.0%), substance use (74.0% vs. 59.9%), bipolar (75.3% vs. 60.7%) and ADHD (60.6% vs. 53.1%; all  $P < .001$ ) had significantly higher prevalence of any medical comorbidities. Excluding ADHD, BHD cases had higher prevalence of selected chronic diseases and average CMI.

**Conclusions:** BHDs in a largely commercially insured, employment-based health system are common and associated with a disproportionately higher burden of chronic medical disease and associated 10-year mortality risk rate. Given that co-occurrence of behavioral and medical conditions leads to elevated symptom burden, functional impairment, and healthcare costs, these findings highlight the importance of developing effective collaborative models of care in (nonpublic) employment-based health systems.

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## 1. Introduction

The nation's health care system faces a mandate to improve quality in multiple dimensions, including those identified by the Institute of Medicine: safety, timeliness, effectiveness, efficiency, equitability and patient centeredness [1]. Expenditures and gaps in health care delivery in general are not evenly distributed throughout the population; only 5% of the population account for half of all health care spending [2], and quality varies considerably across conditions and settings [3]. An effective response to the quality mandate will require a focus on subgroups of patients who have severe or multiple health conditions associated with significantly higher costs and poorer outcomes [4]. Patients with co-occurring behavioral and medical

conditions represent such a population. In the National Comorbidity Survey Replication, more than 68% of adults with a behavioral disorder report having at least one general medical disorder, and 29% of those with a medical disorder had a comorbid mental health condition [5–7].

Research has documented the high rates of psychiatric comorbidity among specific medical conditions, such as HIV [8], diabetes [9,10], asthma [11] and chronic medical illnesses [12]. Conversely, studies have reported high rates of medical comorbidity among patients with psychiatric illness [13–16]. The co-occurrence of behavioral and medical conditions leads to elevated symptom burden, functional impairment, decreased length and quality of life, and increased costs [5,6]. For patients with comorbid behavioral and medical conditions, problems with quality of care occur when they are treated in a primary care and/or specialty mental health setting [5]. Even more concerning, premature mortality is elevated two- to four-fold [17–19]. In response to these findings, care delivery models have been developed for patients with comorbid medical and psychiatric conditions. The most effective have been collaborative care approaches that use a

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multidisciplinary team to screen and track mental health conditions in primary care [20–22]. These models build on the Chronic Care Model [23]. Yet, even as these models are promoted, the gaps in our knowledge about co-occurrence may have important implications for how these collaborative models are structured.

Research to date on the prevalence of co-occurring medical and psychiatric conditions has focused on national surveys, specific illnesses, disease-focused clinics (such as depression or diabetes) or claims data for health insurance populations, such as Medicaid or Medicare. To our knowledge, no prior study has focused on a large patient population with a predominately (nonpublic) employment-based insurance that receives treatment in an integrated health care system. Examining co-occurrence in this setting addresses several important gaps in the existing literature. First, employed patients in an integrated health care system represent an important and distinct subpopulation of patients receiving care in the delivery model promoted by health care reform. Second, this kind of system generates encounter-based rather than claims-based data. The data are generated from all clinical departments (e.g., primary care, specialty clinics and emergency rooms) within a comprehensive system of care.

To address these gaps, we examine the prevalence of behavioral health (and co-occurring medical) conditions in a large integrated health system that primarily serves patients with employment-based insurance. We compare the burden of medical co-morbidity and chronic diseases among those health plan members with a behavioral health condition to matched members without. This provides the opportunity to examine the robustness of the behavioral and medical disease nexus in this subpopulation compared to the other subpopulations more commonly studied.

## 2. Methods

### 2.1. Setting

Kaiser Permanente of Northern California (KPNC) is a nonprofit, integrated health care delivery system providing comprehensive health services to more than 3.4 million members, 44% of the commercially insured population in the region. Eighty-eight percent of members are commercially insured, 10% through Medicare and 2% through Medicaid. KPNC operates over 54 outpatient clinics and 16 hospitals. Most behavioral health services are provided internally rather than contracted to outside vendors. All persons included in this study were drawn from KPNC membership.

### 2.2. Study participants

Institutional review board approval was obtained from the Kaiser Research Foundation Institute for this retrospective database-only study. Initially, all KPNC patients aged 18+ with any behavioral health diagnoses (BHDs) in 2010 were identified. Automated clinical databases were used to identify all outpatient visits (including those in specialty clinics), hospitalizations and emergency department visits at KPNC facilities between January 1, 2010, and December 31, 2010, where a patient had a BHD. The BHDs used for this study included both mental health and substance use disorders: depressive disorders, bipolar spectrum disorders, anxiety disorders, attention deficit hyperactivity disorders (ADHD), autism spectrum disorders, personality disorders, substance use disorders, dementia, schizophrenia spectrum disorders and other psychoses [see Appendix A for *International Classification of Diseases, Ninth Revision* (ICD-9) codes relevant to this paper]. These categories were selected based on collaborations with NIMH's Mental Health Research Network [24] and KPNC's Regional Mental Health leadership. The first mention for each BHD during the study period was included, so patients in the sample could have multiple BHDs over the 1-year study period (i.e., the BHD groups are not mutually exclusive). The prevalence rates of BHDs were examined among all adult KPNC patients. Patients insured by Medicare or Medicaid were excluded from the study.

### 2.3. Analytical sample

The subsequent analyses were limited to a subsample of KPNC patients, comprised of those with the five most prevalent BHDs (SubBHD Cohort): depressive disorder, anxiety disorder, substance use disorder, bipolar spectrum disorder and ADHD. Controls were created for all unique patients in the SubBHD cohort matching one-to-one on gender, age and medical home facility — the latter accounting for any potential differences in services offered or types of conditions by geographic region. Matched controls were non-BHD KPNC patients pulled from the same automated clinical databases above using similar logic. The analytical sample resulted in 255,993 unique mental health cases and 255,993 unique matched controls for a total sample size of 511,986.

### 2.4. Measures

#### 2.4.1. Patient characteristics

Demographic variables pulled from the KPNC automated clinical databases included gender, age, race/ethnicity and patient's medical home facility. Median household income was geocoded based on the member's address and should be considered a characteristic of the member's neighborhood, not individual data.

#### 2.4.2. Psychiatric diagnoses

To understand the burden of psychiatric illness among those patients with one of the five most prevalent BHDs, we examined comorbid psychiatric conditions in the SubBHD sample; all psychiatric diagnoses noted during visits made to any department in the health plan over the course of the study period were included. We examined depressive disorders, bipolar spectrum disorders, anxiety disorders, ADHDs, autism spectrum disorders, personality disorders, substance use disorders, dementia, schizophrenia spectrum disorders and other psychoses. ICD-9 codes for these conditions can be found in the appendix (see Appendix A).

#### 2.4.3. Medical comorbidities

The ICD-9 categories were used to examine the medical comorbidities for the SubBHD sample and their matched controls. First, frequencies for all of the ICD-9 categories were run against the SubBHD sample only; all medical diagnoses noted during visits in 2010 were included. After examining these results, the most pertinent categories were selected and used for the final analyses. The final ICD-9 categories were as follows: infectious and parasitic diseases (ICD-9-CM codes: 001–139 inclusive); neoplasms (ICD-9-CM codes: 140–239 inclusive); endocrine, nutritional and metabolic diseases, and immunity disorders (ICD-9-CM codes: 240–279 inclusive); diseases of the blood and blood-forming organs (ICD-9-CM codes: 280–289 inclusive); diseases of the nervous system and sense organs (ICD-9-CM codes: 320–389 inclusive); diseases of the circulatory system (ICD-9-CM codes: 390–459 inclusive); diseases of the respiratory system (ICD-9-CM codes: 460–519 inclusive); diseases of the digestive system (ICD-9-CM codes: 520–579 inclusive); diseases of the genitourinary system (ICD-9-CM codes: 580–629 inclusive); diseases of the skin and subcutaneous tissue (ICD-9-CM codes: 680–709 inclusive); diseases of the musculoskeletal system and connective tissue (ICD-9-CM codes: 710–739 inclusive). We examined the prevalence of each of final ICD-9 categories. We also created an indicator for the percent of patients who had any medical comorbidity by BHD.

#### 2.4.4. Chronic medical conditions

As with the psychiatric and medical comorbidities, diagnoses noted during visits made over the course of the study period were used to code the chronic medical conditions for both the SubBHDs and matched controls. Fourteen chronic conditions were investigated and coded as follows: arthritis if ICD-9-CM codes were in the range of 710–719 inclusive; hypertension if ICD-9-CM codes were in the range of 401–405 inclusive, with the exception of diagnosis codes 402.01, 402.11, 402.91, 404.01 and 404.11; chronic pain if ICD-9-CM code was 338.2; diabetes

mellitus if ICD-9-CM code was 250; asthma if ICD-9-CM code was 493; ischemic heart disease if ICD-9-CM codes were in the range of 410–414 inclusive; congestive heart failure if ICD-9-CM codes were equal to 402.01, 402.11, 402.91, 404.01, 404.11 or 428; stroke/cerebrovascular accident if ICD-9-CM codes were in the range 430–434 inclusive; epilepsy if ICD-9-CM code was 345; Parkinson’s disease if ICD-9-CM code was 332; end-stage renal disease if ICD-9-CM code was 585.6; HIV if patient was in the HIV registry; osteoporosis if ICD-9-CM code was 733.3; chronic obstructive pulmonary disease if ICD-9-CM codes equal 490–492 inclusive, 494–496 inclusive or 500–508 inclusive. These conditions are all common chronic conditions among the mental health population [12,25]. We examined the prevalence of each chronic condition by specific BHD. In addition, the Charlson Comorbidity Index was calculated to examine the cumulative burden of medical comorbidity. The Charlson Comorbidity Index is a weighted score of 17 conditions which predicts the risk of 10-year mortality for patients with a range of these diagnosis-based comorbid conditions [26,27].

2.5. Analysis

All analyses were performed using SAS software, version 9.3 (SAS Institute Inc., Cary, NC, USA); statistical significance was defined at  $P < .05$ . The BHD prevalence rate was first calculated for each BHD among all adult KPNC patients. We then focused on our subsample (SubBHDs) and used frequencies to examine the psychiatric comorbidities. Differences in patient characteristics, medical comorbidities and chronic medical conditions for each of the five BHDs in the SubBHD sample were examined comparing the SubBHD patients to their matched controls. Frequencies and means were used to summarize the patient characteristics, medical comorbidities and chronic conditions.  $\chi^2$  tests were used to examine differences between the SubBHDs and matched controls for the categorical variables, and  $t$  tests were used to examine differences in the means of the continuous covariates.

3. Results

3.1. Patient characteristics

Sixty-two percent of the combined SubBHD cohort and matched controls sample were women, the average age was 47, and median household income was \$61,946. Fifty-six percent of the sample was white, 8% African American, 12% Asian, 17% Hispanic, 1% American Indian or a Pacific Islander, and 6% unknown (not shown). The SubBHD cohort and the matched controls had similar demographic characteristics with a few

exceptions. The matched controls had higher median household income (\$62,499 vs. \$61,385;  $P < .001$ ), more Asian patients (17% vs. 8%) and fewer white patients (51% vs. 61%) than the SubBHD cohort. All other race categories were similar ( $P < .0001$ , not shown). There were no significant differences in gender or age between the SubBHD cohort and the matched controls as they were matched based on these characteristics.

3.2. Psychiatric diagnoses

In 2010, BHDs were common among adult KPNC members with a health plan visit; 15% had at least one BHD; of those, 28% had multiple BHDs. Among all of those with a BHD, the five most common disorders (the SubBHD sample) were depression (58%), anxiety (42%), substance use (16%), bipolar spectrum (6%) and ADHD (4%) (not shown). In our SubBHD sample (patients with at least one of the five most prevalent BHDs), 29% had at least one psychiatric comorbidity. Among those, individuals with bipolar disorder had more psychiatric comorbidities than any other psychiatric condition examined in the SubBHD sample (Table 1).

3.3. Medical comorbidities and chronic conditions

Compared to the matched controls, each of the most prevalent BHDs [depression (80.1% vs. 66.3%), anxiety (78.0% vs. 63.0%), substance use (74.0% vs. 59.9%), bipolar spectrum disorder (75.3% vs. 60.7%) and ADHD (60.6% vs. 53.1%; all  $P < .001$ )] had significantly more patients with any medical comorbidities based on the ICD-9 categories. This was true across all ICD-9 categories examined, with the exception being Diseases of the Circulatory system and Neoplasms for the ADHD comparison, which did not differ (Table 2).

We had similar findings with respect to the burden of chronic conditions. With the exception of ADHD and bipolar disorder, each specific BHD had a significantly higher prevalence of each chronic condition compared to the matched controls. Those with ADHD diagnoses did not significantly differ in the chronic conditions related to the circulatory system (hypertension, ischemic heart disease, congestive heart failure and stroke/cerebrovascular accident), Parkinson’s disease or osteoporosis. However, there were significant differences between those with ADHD and their matched controls for the other chronic conditions. Patients with bipolar disorder did not significantly differ from their matched controls in prevalence of end-stage renal disease or osteoporosis. We also examined the Charlson Comorbidity Index and found that patients in the SubBHD sample had a significantly higher average Charlson Comorbidity index compared to their controls across all conditions examined (Table 3).

**Table 1**  
Co-occurring psychiatric comorbidity among each of the five most prevalent behavioral health disorders

	SubBHD cohort					Total SubBHD cohort (n = 255,993)
	Depression spectrum (n = 151,815)	Anxiety spectrum (n = 114,886)	Substance use (n = 45,461)	Bipolar spectrum (n = 14,943)	ADHD (n = 11,846)	
<b>BHD disorders</b>						
Depression disorder (%)	–	42.5	33.0	28.2	40.4	59.3
Anxiety disorder (%)	32.1	–	24.6	31.7	30.1	44.9
Substance use (%)	9.9	9.7	–	19.2	9.2	17.8
Bipolar spectrum (%)	2.8	4.1	6.3	–	7.9	5.8
ADHD (%)	3.2	3.1	2.4	6.3	–	4.6
Dementia (%)	1.3	1.0	0.8	1.0	0.9	1.0
Other psychoses (%)	1.2	1.2	3.1	5.7	1.0	1.2
Schizophrenia spectrum (%)	0.6	0.7	1.7	4.7	0.6	0.8
Personality disorder (%)	2.0	2.2	3.0	8.2	2.6	1.6
Autism (%)	0.1	0.2	0.1	0.4	1.2	0.2
<b>Psychiatric comorbidities<sup>a</sup></b>						
1 or more psychiatric comorbidities	41.8	50.0	47.4	58.7	59.5	29.4 <sup>a</sup>
2 or more psychiatric comorbidities	9.0	11.5	20.5	29.8	25.4	6.1
3 or more psychiatric comorbidities	1.9	2.4	5.3	11.7	6.6	1.3

Diagnoses are not mutually exclusive, and therefore comparisons between behavioral health disorder groups cannot be made.

<sup>a</sup> Among all patients with a BHD, 29% had one or more psychiatric comorbidities. Among the five most prevalent BHDs, the proportion of patients with at least one psychiatric comorbidity ranged from 42% to 60%.

**Table 2**  
Medical comorbidity associated with the five most prevalent behavioral health disorders

	Depression spectrum (n= 151,815)	Matched controls	Anxiety spectrum (n= 114,886)	Matched controls	Substance use (n= 45,461)	Matched controls	Bipolar spectrum (n= 14,943)	Matched controls	ADHD (n= 11,846)	Matched controls	Total SubBHD sample (n= 255,993)	Total matched controls
Infectious and parasitic diseases (%)	17.7	11.3***	17.3	11.2***	19.9	11.2***	18.5	11.3***	15.6	12.3***	17.1	11.2***
Neoplasms (%)	13.7	10.8***	12.9	9.8***	10.7	9.1***	10.7	9.2***	8.2	7.6	12.8	10.3***
Endocrine, nutritional, and metabolic diseases and immunity disorders (%)	50.5	36.2***	44.7	32.4***	45.2	32.0***	46.8	30.3***	25.6	22.0***	46.8	34.3***
Diseases of the blood and blood-forming organs (%)	9.6	4.3***	8.0	4.0***	14.3	3.3***	8.3	4.0***	3.7	3.0**	9.0	4.0***
Diseases of the nervous system and sense organs (%)	54.4	41.1***	50.5	38.7***	45.8	36.7***	51.2	37.2***	39.8	32.0***	50.2	39.6***
Diseases of the circulatory system (%)	39.8	30.5***	36.4	26.6***	41.5	26.7***	32.1	24.1***	17.0	16.3	38.1	28.7***
Diseases of the respiratory system (%)	37.9	26.1***	37.9	25.7***	33.8	24.5***	36.1	25.2***	32.2	24.9***	36.3	25.7***
Diseases of the digestive system (%)	35.5	20.4***	36.3	18.9***	36.8	18.2***	32.4	17.9***	20.7	14.4***	34.4	19.6***
Diseases of the genitourinary system (%)	33.9	24.6***	31.9	23.3***	27.3	19.8***	32.0	22.5***	22.0	18.2***	31.3	23.3***
Diseases of the skin and subcutaneous tissues (%)	32.2	26.8***	31.6	25.8***	26.6	25.0***	30.4	25.0***	28.4	24.7***	30.8	26.3***
Diseases of the musculoskeletal system and connective tissue (%)	50.2	37.0***	47.5	34.6***	43.8	33.0***	45.6	33.1***	35.6	27.8***	47.0	35.5***
Any medical comorbidities (%)	80.1	66.3***	78.0	63.0***	74.0	59.9***	75.3	60.7***	60.6	53.1***	77.3	64.21 ***

\* < .05.

\*\* < .01.

\*\*\* < .001.

#### 4. Discussion

BHDs are highly prevalent in this health system. Fifteen percent of members with a health plan visit in 2010 had at least one BHD. By far, the most common were depression and anxiety. Moreover, among patients with BHD, psychiatric comorbidity is common; of those patients with a BHD, 28% had multiple BHDs. Among the five most prevalent BHDs, the proportion of patients with at least one psychiatric comorbidity ranged from 42% to 60%. Finally, those patients with a BHD carry a disproportionately high medical disease burden. With only a few exceptions, the proportion of BHD patients with a medical illness, including common chronic conditions, was significantly higher than non-BHD patients. Risk of 10-year mortality as calculated by the Charlson Index was found to be significantly higher for those with any of the BHDs examined compared to their matched controls. Thus, similar to studies of other patient subpopulations, BHDs in a largely commercially insured, employment-based health system are common and associated with a higher burden of chronic medical disease.

At the same time, these results differ from some of the other large data sets. For example, disabled Medicaid beneficiaries have a prevalence rate of psychiatric illness ranging from nearly 29% to 49%, depending on

whether the claims-based data include pharmacy data in addition to diagnostic codes [28]. This higher proportion likely reflects both a more vulnerable patient population and methodology that better captures patients being treated for a psychiatric illness without an associated diagnostic code. In that same data set, the Medicaid (nondisabled) aged population's prevalence of psychiatric illness more closely mirrored the prevalence in this study: 10.4% (diagnostic data only) or 35.9% (diagnostic plus pharmacy data). Our encounter data were based on ICD-9 coding and therefore are more similar to the diagnosis-only data from the Medicaid data set. The US National Comorbidity Survey Replication, which is based on a face-to-face household survey, reported a 26% any *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition*, disorder prevalence [29], and others have reported around 30% [30]. Given that fewer than half of people with a psychiatric illness receive treatment [31,32], these estimates are fairly consistent with the 15% prevalence observed in this study, which includes a patient population more representative of the general US population but only captures those who made a health plan visit.

This study has several limitations. As with other studies that have used claims-based data, our study only captures patients with behavioral health disorders noted in their visits during the study period. This

**Table 3**  
Chronic conditions associated with the five most prevalent behavioral health disorders

	Depression spectrum (n= 151,815)	Matched controls	Anxiety spectrum (n= 114,886)	Matched controls	Substance use (n= 45,461)	Matched controls	Bipolar spectrum (n= 14,943)	Matched controls	ADHD (n= 11,846)	Matched controls	Total SubBHD sample (n= 255,993)	Total matched controls
Arthritis (%)	24.8	17.2***	21.7	15.3***	20.4	14.6***	21.7	14.8***	15.6	11.6***	22.4	16.2***
Hypertension (%)	32.2	24.8***	28.5	21.2***	33.1	21.4***	24.0	19.1***	11.5	12.0	30.5	23.2***
Chronic pain (%)	12.4	3.0***	11.2	2.7***	15.6	2.8***	12.9	2.9***	6.6	2.2***	10.8	2.8***
Diabetes mellitus (%)	12.8	9.3***	9.1	8.1***	10.8	8.7***	10.9	7.5***	3.7	4.6**	11.1	8.8***
Asthma (%)	14.6	8.0***	14.0	7.5***	12.2	7.1***	15.9	7.4***	12.7	7.2***	13.4	7.7***
Ischemic heart disease (%)	5.1	2.6***	3.8	2.0***	5.4	2.8***	2.7	1.8***	1.0	1.0	4.6	2.5***
Congestive heart failure (%)	2.5	0.9***	1.7	0.7***	3.3	0.8***	1.5	0.6***	0.3	0.3	2.2	0.8***
Stroke/cerebrovascular accident (%)	1.4	0.5***	1.0	0.4***	1.9	0.4***	0.8	0.3***	0.3	0.2	1.3	0.4***
Epilepsy (%)	1.3	0.4***	1.1	0.4***	2.1	0.4***	2.0	0.4***	1.0	0.5***	1.2	0.4***
Parkinson's disease (%)	0.4	0.1***	0.3	0.2***	0.2	0.1***	0.7	0.1***	0.1	0.0	0.4	0.1***
End-stage renal disease (%)	0.4	0.2***	0.2	0.1*	0.4	0.2***	0.2	0.2	0.0	0.1*	0.3	0.2***
HIV (%)	0.9	0.2***	0.6	0.3***	1.0	0.4***	1.0	0.3***	0.7	0.3***	0.8	0.3***
Osteoporosis (%)	2.4	2.1***	2.1	1.6***	1.2	0.8***	1.2	1.3	0.5	0.5	2.1	1.8***
Chronic obstructive pulmonary disease (%)	6.5	3.1***	5.6	2.8***	8.5	2.8***	6.7	2.4***	3.0	1.8***	6.1	3.0***
Charlson Index [mean (SD)]	.5 (1.1)	.3 (.8)***	.4 (0.9)	.3 (.8)***	.4 (1.1)	.3 (.8)***	.4 (0.9)	.3 (.8)***	.20 (.6)	.17 (.6)**	.4 (1.1)	.3 (.8)***

\* < .05.  
\*\* < .01.  
\*\*\* < .001.

methodology is vulnerable to under-estimation especially with regards to behavioral health disorders. Moreover, we know that a significant proportion of patients with behavioral disorders do not receive treatment [33]. Therefore, the BHD prevalence data in our study likely underestimate the actual prevalence. Future studies could address whether the addition of pharmacy-based prescription data improves the prevalence estimates. Another possible limitation of our method is that we only required a single mention of a diagnosis to link the patient with that diagnosis. This could result in an overestimation of the true prevalence if diagnoses only mentioned one time are more likely to be inaccurate. However, we do not suspect this. The single-mention methodology is well established [34–37]. And even if this methodology resulted in an overestimation, it would affect both arms of the case control and, therefore, would likely not affect our finding of a difference between the two arms. In addition, this study also does not examine whether there are specific diagnostic dyads and/or triads that are especially common – a possible focus for future studies. Finally, it is unclear whether the impact of these comorbidities on health care costs and outcomes is attenuated in an integrated health system like the one studied in which care is already highly managed, especially in comparison to study populations that are treated in largely a fee-for-service environment. This knowledge gap will be important for future studies to address.

Regardless of how these results compare to other patient populations and health systems, the finding is striking – BHDs are highly prevalent, and even more concerning, these patients have a significantly higher medical comorbidity burden and associated risk of 10-year mortality rate. Given how the co-occurrence of behavioral and medical conditions leads to elevated symptom burden, functional impairment, decreased length and quality of life, and increased costs [5,6], these findings highlight the importance of developing and implementing collaborative models of care in (nonpublic) employment-based health systems that are effective at treating patients with comorbid BHD and medical conditions. Many models have emerged ranging from enhanced coordination to colocation of services to full integration [38]. All of these efforts share

the concept of organizing care in a medical home in which a health care team (not one individual) provides stepped care with disease and population health management protocols. The high prevalence of multiple psychiatric disorders also argues for lifestyle interventions that focus on behavioral issues in general rather than specific diagnoses, a focus that would be greatly welcomed by primary care physicians. In the employment-based insurance population captured in this study, it is important to focus on depression and anxiety disorders. Important questions include whether outcome measures and even treatment protocols can be developed that are transdiagnostic (i.e., include both anxiety and depression together), the role of Internet-based cognitive behavioral therapy, the relative mix of individual versus group-based treatments and the extent to which the medical record is fully open.

**Acknowledgments**

This study was supported by Sidney R. Garfield Memorial Fund. We thank Agatha Hinman, B.A., for editorial assistance.

**Appendix A**

Anxiety disorders	
300.00	Anxiety disorder NOS
300.01	Panic disorder without agoraphobia
300.02	Generalized anxiety disorder
300.2	Phobia, unspecified
300.21	Panic disorder with agoraphobia
300.22	Agoraphobia without history of panic disorder
300.23	Social phobia (social anxiety disorder)
300.29	Specific phobia
300.3	Obsessive compulsive disorder

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		Depressive disorders	
Anxiety disorders		296.2	Major depression, single episode, unspecified
309.20	Adjustment disorders with anxiety	296.20	Major depression, single episode, unspecified
309.21	Separation anxiety disorder	296.21	Major depression, single episode, mild
309.24	Adjustment disorder with anxiety	296.22	Major depression, single episode, moderate
309.81	Posttraumatic stress disorder	296.23	Major depression, single episode, severe without psychosis
308.3	Acute stress disorder	296.24	Major depression, single episode, severe with psychosis
Attention deficit disorders		296.25	Major depression, single episode, in partial remission
314.00	Attention deficit disorder, inattentive type	296.26	Major depression, single episode, in full remission
314.01	Attention deficit disorder, hyperactive/impulsive or combined type	296.3	Major depression, recurrent, unspecified
314.1	Hyperkinesis with developmental delay	296.30	Major depression, recurrent, unspecified
314.2	Hyperkinetic conduct disorder of childhood	296.31	Major depression, recurrent, mild
314.8	Other specific manifests hyperkinetic syndrome, child	296.32	Major depression, recurrent, moderate
314.9	Attention deficit disorder NOS	296.33	Major depression, recurrent, severe without psychosis
Autism spectrum disorders		296.34	Major depression, recurrent, severe with psychosis
299.01	Autistic disorder, residual state	296.35	Major depression, recurrent, in partial remission
299.10	Childhood disintegrative disorder	296.36	Major depression, recurrent, in full remission
299.11	Childhood disintegrative disorder, residual state	296.82	Atypical depressive disorder
299.80	Asperger's disorder/pervasive developmental disorder	298.0	Depressive-type psychosis
299.00	Autistic disorder, current or active state	300.4	Dysthymia
Bipolar spectrum disorders		301.12	Chronic depressive personality disorder
296.00	Bipolar I disorder, single manic episode, unspecified	311	Depressive disorder NOS
296.01	Bipolar I disorder, single manic episode, mild	309.0	Adjustment disorder with depressed mood
296.02	Bipolar I disorder, single manic episode, moderate	309.1	Prolonged depressive reaction
296.03	Bipolar I disorder, single manic episode, severe without psychosis	309.28	Adjustment disorder with mixed anxiety and depressed mood
296.04	Bipolar I disorder, single manic episode, severe with psychosis	Other psychoses	
296.05	Bipolar I disorder, single manic episode, in partial remission	297.1	Delusional disorder
296.06	Bipolar I disorder, single manic episode, in full remission	297.3	Shared psychotic disorder
296.1	Manic recurrent episode	298.8	Brief psychotic disorder
296.10	Manic disorder recurrent episode unspecified	298.9	Psychotic disorder NOS
296.11	Recurrent manic disorder, mild	Personality disorder	
296.12	Recurrent manic disorder, moderate	301.0	Paranoid personality disorder
296.13	Recurrent manic disorder, severe	301.1	Affective personality disorder, unspecified
296.14	Manic affective disorder, recurrent episode, severe, specified as with psychotic behavior	301.11	Chronic hypomanic personality disorder
296.15	Manic affective disorder, recurrent episode, in partial or unspecified remission	301.12	Chronic depressive personality disorder
296.16	Recurrent manic disorder, full remission	301.13	Cyclothymic disorder
296.40	Bipolar I disorder, most recent episode manic, unspecified	301.2	Schizoid personality disorder
296.41	Bipolar I disorder, most recent episode manic, mild	301.20	Schizoid personality disorder, unspecified
296.42	Bipolar I disorder, most recent episode manic, moderate	301.21	Introverted personality
296.43	Bipolar I disorder, most recent episode manic, severe without psychosis	301.22	Schizotypal personality disorder
296.44	Bipolar I disorder, most recent episode manic, severe with psychosis	301.3	Explosive
296.45	Bipolar I disorder, most recent episode manic, in partial remission	301.4	Obsessive compulsive (personality disorder)
296.46	Bipolar I disorder, most recent episode manic, in full remission	301.5	Histrionic personality disorder
296.50	Bipolar I disorder, most recent episode depressed, unspecified	301.50	Histrionic personality disorder, unspecified
296.51	Bipolar I disorder, most recent episode depressed, mild	301.51	Chronic factitious illness with physical symptoms
296.52	Bipolar I disorder, most recent episode depressed, moderate	301.52	Other histrionic personality disorder
296.53	Bipolar I disorder, most recent episode depressed, severe without psychosis	301.6	Dependent personality disorder
296.54	Bipolar I disorder, most recent episode depressed, severe with psychosis	301.7	Antisocial personality disorder
296.55	Bipolar I disorder, most recent episode depressed, in partial remission	301.8	Other personality disorder
296.56	Bipolar I disorder, most recent episode depressed, in full remission	301.81	Narcissistic personality disorder
296.60	Bipolar I disorder, most recent episode mixed, unspecified	301.82	Avoidant personality disorder
296.61	Bipolar I disorder, most recent episode mixed, mild	301.83	Borderline personality disorder
296.62	Bipolar I disorder, most recent episode mixed, moderate	301.84	Passive-aggressive personality
296.63	Bipolar I disorder, most recent episode mixed, severe without psychosis	301.89	Other personality disorders
296.64	Bipolar I disorder, most recent episode mixed, severe with psychosis	301.9	Unspecified personality disorder
296.65	Bipolar I disorder, most recent episode mixed, in partial remission	Schizophrenia spectrum disorders	
296.66	Bipolar I disorder, most recent episode mixed, in full remission	295.0	Simple-type schizophrenia
296.7	Bipolar I disorder, most recent episode unspecified	295.00	Simple-type schizophrenia, unspecified
296.80	Bipolar disorder NOS	295.01	Simple-type schizophrenia, subchronic
296.81	Atypical manic disorder	295.02	Simple-type schizophrenia, chronic
296.89	Bipolar II disorder	295.03	Simple-type schizophrenia, subchronic with acute exacerbation
301.11	Chronic hypomanic disorder	295.04	Simple-type schizophrenia, chronic with acute exacerbation
301.13	Cyclothymic disorder	295.05	Simple-type schizophrenia, in remission
Dementia		295.1	Disorganized-type schizophrenia
290.0	Senile dementia uncomplicated	295.10	Disorganized-type schizophrenia, unspecified
290.1	Presenile dementia	295.11	Disorganized-type schizophrenia, subchronic
290.2	Senile dementia with depressive features	295.12	Disorganized-type schizophrenia, chronic
290.3	Senile dementia with delirium	295.13	Disorganized-type schizophrenia, subchronic with acute exacerbation
290.4	Vascular dementia	295.14	Disorganized-type schizophrenia, chronic with acute exacerbation
290.8	Other specified senile psychotic conditions	295.15	Disorganized-type schizophrenia, in remission
290.9	Unspecified senile psychotic condition	295.2*	Catatonic-type schizophrenia
780.93	Memory loss	295.20	Catatonic-type schizophrenia, unspecified
		295.21	Catatonic-type schizophrenia, subchronic
		295.22	Catatonic-type schizophrenia, chronic
		295.23	Catatonic-type schizophrenia, subchronic with acute exacerbation
		295.24	Catatonic-type schizophrenia, chronic with acute exacerbation
		295.25	Catatonic-type schizophrenia, in remission

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Schizophrenia spectrum disorders	
295.3	Schizophrenia, paranoid type
295.30	Paranoid-type schizophrenia, unspecified
295.31	Paranoid-type schizophrenia, subchronic
295.32	Paranoid-type schizophrenia, chronic
295.33	Paranoid-type schizophrenia, subchronic with acute exacerbation
295.34	Paranoid-type schizophrenia, chronic with acute exacerbation
295.35	Paranoid-type schizophrenia, in remission
295.4	Schizophreniform disorder
295.40	Schizophreniform disorder, unspecified
295.41	Schizophreniform disorder, subchronic
295.42	Schizophreniform disorder, chronic
295.43	Schizophreniform disorder, subchronic with acute exacerbation
295.44	Schizophreniform disorder, chronic with acute exacerbation
295.45	Schizophreniform disorder, in remission
295.5	Latent schizophrenia
295.50	Latent schizophrenia, unspecified
295.51	Latent schizophrenia, subchronic
295.52	Latent schizophrenia, chronic
295.53	Latent schizophrenia, subchronic with acute exacerbation
295.54	Latent schizophrenia, chronic with acute exacerbation
295.55	Latent schizophrenia, in remission
295.6*	Schizophrenia, residual type
295.60	Schizophrenic disorders, residual type, unspecified
295.61	Schizophrenic disorders, residual type, subchronic
295.62	Schizophrenic disorders, residual type, chronic
295.63	Schizophrenic disorders, residual type, subchronic with acute exacerbation
295.64	Schizophrenic disorders, residual type, chronic with acute exacerbation
295.65	Schizophrenic disorders, residual type, in remission
295.7	Schizoaffective disorder
295.70	Schizoaffective disorder, unspecified
295.71	Schizoaffective disorder, subchronic
295.72	Schizoaffective disorder, chronic
295.73	Schizoaffective disorder, subchronic with acute exacerbation
295.74	Schizoaffective disorder, chronic with acute exacerbation
295.75	Schizoaffective disorder, in remission
295.8	Other specified types of schizophrenia
295.80	Other specified types of schizophrenia, unspecified
295.81	Other specified types of schizophrenia, subchronic
295.82	Other specified types of schizophrenia, chronic
295.83	Other specified types of schizophrenia, subchronic with acute exacerbation
295.84	Other specified types of schizophrenia, chronic with acute exacerbation
295.85	Other specified types of schizophrenia, in remission
295.9	Unspecified schizophrenia
295.90	Unspecified schizophrenia, unspecified
295.91	Unspecified schizophrenia, subchronic
295.92	Unspecified schizophrenia, chronic
295.93	Unspecified schizophrenia, subchronic with acute exacerbation
295.94	Unspecified schizophrenia, chronic with acute exacerbation
295.95	Unspecified schizophrenia, in remission
Substance use disorders	
291	Alcohol-induced mental disorders
291.0	Alcohol withdrawal delirium
291.1	Alcohol-induced persisting amnesic disorder
291.2	Alcohol-induced persisting dementia
291.3	Alcohol-induced psychotic disorder with hallucinations
291.4	Idiosyncratic alcohol intoxication
291.5	Alcohol-induced psychotic disorder with delusions
291.8	Other specified alcohol-induced mental disorders
291.81	Alcohol withdrawal
291.82	Alcohol-induced sleep disorders
291.89	Other alcohol-induced mental disorders
291.9	Unspecified alcohol-induced mental disorders
292	Drug-induced mental disorders
292.0	Drug withdrawal
292.1	Drug-induced psychotic disorders
292.11	Drug-induced psychotic disorder with delusions
292.12	Drug-induced psychotic disorder with hallucinations
292.2	Pathological drug intoxication
292.8	Other specified drug-induced mental disorders
292.81	Drug-induced delirium
292.82	Drug-induced persisting dementia
292.83	Drug-induced persisting amnesic disorder
292.84	Drug-induced mood disorder

(continued)

Substance use disorders	
292.85	Drug-induced sleep disorders
292.89	Other specified drug-induced mental disorders
292.9	Unspecified drug-induced mental disorder
303	Alcohol dependence syndrome
303.0	Acute alcoholic intoxication
303.00	Acute alcoholic intoxication in alcoholism, unspecified
303.01	Acute alcoholic intoxication in alcoholism, continuous
303.02	Acute alcoholic intoxication in alcoholism, episodic
303.03	Acute alcoholic intoxication in alcoholism, in remission
303.9	Other and unspecified alcohol dependence
303.90	Other and unspecified alcohol dependence, unspecified
303.91	Other and unspecified alcohol dependence, continuous
303.92	Other and unspecified alcohol dependence, episodic
303.93	Other and unspecified alcohol dependence, in remission
304	Drug dependence
304.0	Opioid-type dependence
304.00	Opioid-type dependence, unspecified
304.01	Opioid-type dependence, continuous
304.02	Opioid-type dependence, episodic
304.03	Opioid-type dependence, in remission
304.1	Sedative, hypnotic or anxiolytic dependence
304.10	Sedative, hypnotic or anxiolytic dependence, unspecified
304.11	Sedative, hypnotic or anxiolytic dependence, continuous
304.12	Sedative, hypnotic or anxiolytic dependence, episodic
304.13	Sedative, hypnotic or anxiolytic dependence, in remission
304.2	Cocaine dependence
304.20	Cocaine dependence, unspecified
304.21	Cocaine dependence, continuous
304.22	Cocaine dependence, episodic
304.23	Cocaine dependence, in remission
304.3	Cannabis dependence
304.30	Cannabis dependence, unspecified
304.31	Cannabis dependence, continuous
304.32	Cannabis dependence, episodic
304.33	Cannabis dependence, in remission
304.4	Amphetamine and other psychostimulant dependence
304.40	Amphetamine and other psychostimulant dependence, unspecified
304.41	Amphetamine and other psychostimulant dependence, continuous
304.42	Amphetamine and other psychostimulant dependence, episodic
304.43	Amphetamine and other psychostimulant dependence, in remission
304.5	Hallucinogen dependence
304.50	Hallucinogen dependence, unspecified
304.51	Hallucinogen dependence, continuous
304.52	Hallucinogen dependence, episodic
304.53	Hallucinogen dependence, in remission
304.6	Other specified drug dependence
304.60	Other specified drug dependence, unspecified
304.61	Other specified drug dependence, continuous
304.62	Other specified drug dependence, episodic
304.63	Other specified drug dependence, in remission
304.7	Combinations of opioid-type drug with any other drug dependence
304.70	Combinations of opioid-type drug with any other drug dependence, unspecified
304.71	Combinations of opioid-type drug with any other drug dependence, continuous
304.72	Combinations of opioid-type drug with any other drug dependence, episodic
304.73	Combinations of opioid-type drug with any other drug dependence, in remission
304.8	Combinations of drug dependence excluding opioid-type drug
304.80	Combinations of drug dependence excluding opioid-type drug, unspecified
304.81	Combinations of drug dependence excluding opioid-type drug, continuous
304.82	Combinations of drug dependence excluding opioid-type drug, episodic
304.83	Combinations of drug dependence excluding opioid-type drug, in remission
304.9	Unspecified drug dependence
304.90	Unspecified drug dependence, unspecified
304.91	Unspecified drug dependence, continuous
304.92	Unspecified drug dependence, episodic
304.93	Unspecified drug dependence, in remission
305	Nondependent abuse of drugs
305.0	Nondependent alcohol abuse
305.00	Alcohol abuse, unspecified

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Substance use disorders	
305.01	Alcohol abuse, continuous
305.02	Alcohol abuse, episodic
305.03	Alcohol abuse, in remission
305.2	Nondependent cannabis abuse
305.20	Cannabis abuse, unspecified
305.21	Cannabis abuse, continuous
305.22	Cannabis abuse, episodic
305.23	Cannabis abuse, in remission
305.3	Nondependent hallucinogen abuse
305.30	Hallucinogen abuse, unspecified
305.31	Hallucinogen abuse, continuous
305.32	Hallucinogen abuse, episodic
305.33	Hallucinogen abuse, in remission
305.4	Nondependent sedative, hypnotic or anxiolytic abuse
305.40	Sedative, hypnotic or anxiolytic abuse, unspecified
305.41	Sedative, hypnotic or anxiolytic abuse, continuous
305.42	Sedative, hypnotic or anxiolytic abuse, episodic
305.43	Sedative, hypnotic or anxiolytic abuse, in remission
305.5	Nondependent opioid abuse
305.50	Opioid abuse, unspecified
305.51	Opioid abuse, continuous
305.52	Opioid abuse, episodic
305.53	Opioid abuse, in remission
305.6	Nondependent cocaine abuse
305.60	Cocaine abuse, unspecified
305.61	Cocaine abuse, continuous
305.62	Cocaine abuse, episodic
305.63	Cocaine abuse, in remission
305.7	Nondependent amphetamine or related acting sympathomimetic abuse
305.70	Amphetamine or related acting sympathomimetic abuse, unspecified
305.71	Amphetamine or related acting sympathomimetic abuse, continuous
305.72	Amphetamine or related acting sympathomimetic abuse, episodic
305.73	Amphetamine or related acting sympathomimetic abuse, in remission
305.8	Nondependent antidepressant-type abuse
305.80	Antidepressant-type abuse, unspecified
305.81	Antidepressant-type abuse, continuous
305.82	Antidepressant-type abuse, episodic
305.83	Antidepressant-type abuse, in remission
305.9	Nondependent other mixed or unspecified drug abuse
305.90	Other, mixed, or unspecified drug abuse, unspecified
305.91	Other, mixed, or unspecified drug abuse, continuous
305.92	Other, mixed, or unspecified drug abuse, episodic
305.93	Other, mixed, or unspecified drug abuse, in remission

## Appendix B. Supplementary data

Supplementary data to this article can be found online at <http://dx.doi.org/10.1016/j.genhosppsych.2014.12.005>.

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