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Anxiety and Post-Traumatic Stress Disorder among Medicare Beneficiaries Following Traumatic Brain Injury

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Abstract

Objective: To estimate rates of anxiety and post-traumatic stress disorder (PTSD) diagnoses following traumatic brain injury (TBI) among Medicare beneficiaries, quantify the increase in rates relative to the pre-TBI period, and identify risk factors for diagnosis of anxiety and PTSD.

Participants: 96,881 Medicare beneficiaries hospitalized with TBI between 6/1/06 and 5/31/10

Design: Retrospective cohort study

Measures: Diagnosis of anxiety (International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes 300.0x) and/or PTSD (ICD-9-CM code 309.81)

Results: Following TBI, 16,519 (17%) beneficiaries were diagnosed with anxiety and 269 (0.3%) were diagnosed with PTSD. Rates of anxiety and PTSD diagnoses were highest in the first five months post-TBI and decreased over time. Pre-TBI diagnosis of anxiety disorder was significantly associated with post-TBI anxiety (risk ratio (RR) 3.55; 95% confidence interval (CI) 3.42, 3.68) and pre-TBI diagnosis of PTSD was significantly associated with post-TBI PTSD (RR 70.09; 95% CI 56.29, 111.12).

Conclusion: This study highlights the increased risk of anxiety and PTSD following TBI. Routine screening for anxiety and PTSD, especially during the first five months following TBI, may help clinicians identify these important and treatable conditions, especially among patients with history of prior psychiatric illness.

Keywords

anxiety; older adults; posttraumatic stress disorder; traumatic brain injury

INTRODUCTION

Among older adults in the United States, traumatic brain injury (TBI) results in over 142,000 emergency department visits and 81,500 hospitalizations annually.[1] Older adults have the highest rates of hospitalization and mortality following TBI and experience worse outcomes compared to younger adults with similar injury severity.[1–4] Neuropsychiatric disturbances

(e.g., depression, anxiety, agitation, symptoms of post-traumatic stress disorder) are common sequelae of TBI and are associated with decreased cognitive and functional recovery.[5–7]

Prior studies show increased prevalence of depressive disorder (10–46%), anxiety disorder (10–33%), and post-traumatic stress disorder (PTSD) (7–14%) in mixed samples of young and older adults following TBI.[8–13] However, these studies often fail to determine whether the disorders were new or in fact pre-existing before the TBI. It is possible that certain risk-taking behaviors (e.g., alcohol or substance abuse), which are associated with both TBI and neuropsychiatric disorders, may lead to higher post-TBI prevalence estimates.[14–17] While some reports have suggested that older adults are actually more resilient to the development of neuropsychiatric sequelae following TBI[11,18,19]; our earlier study found a 70% increase in the risk of depression among Medicare beneficiaries hospitalized with TBI.[20] This increased risk was sustained over the first year following injury, a critical period for recovery from TBI. However, our previous study was limited in that it didn't examine other common psychiatric disturbances following TBI such as anxiety or PTSD. Furthermore, we did not examine the impact of pre-TBI depression diagnoses on the development of depression post-TBI.

Medicare beneficiaries who experience TBI are older, have more comorbidities than the average Medicare beneficiaries, and may be at increased risk of developing depression unrelated to the TBI.[20,21] Finding a suitable comparison group to determine if and by how much TBI increases risk of neuropsychiatric disorders post-injury among this fragile population is critical. Previously, we overcame this problem by using pre-TBI follow-up time as a control period.[20] Expanding on this work, the objectives of this study were to determine if rates of anxiety and PTSD diagnoses following hospitalization for TBI among Medicare beneficiaries aged 65 and older were higher relative to the pre-TBI period and identify risk factors for diagnosis of anxiety and PTSD following TBI. Based on our previous study examining incidence of depression, we hypothesize that hospitalization for a TBI will subsequently increase rates of newly diagnosed anxiety disorder and PTSD.

METHODS

Study Population

Medicare administrative data was obtained from the Centers for Medicare & Medicaid Services Chronic Condition Data Warehouse (CCW). Medicare beneficiaries with a discharge diagnosis of TBI, defined as International Classification of Disease, 9th Revision, Clinical Modification (ICD-9-CM) codes 800.xx, 801.xx, 803.xx, 804.xx, 850.xx- 854.1x, 950.1–950.3, 959.01, in any position on an inpatient claim between 1/1/2006 and 5/31/2010 and meeting inclusion criteria were included in the study.[22,23] Inclusion criteria were age ≥65 years at TBI hospitalization, minimum six-month observation prior to TBI to permit capture of baseline comorbidities, first TBI hospitalization, and survival to hospital discharge. Beneficiaries contributed only a single TBI hospitalization episode to the study. New claims for TBI occurring within 14 days of a previous TBI discharge were combined to form a single hospitalization episode with an admission date reflecting the earliest TBI claim's admission date and a discharge date reflecting the latest TBI claim's discharge date.

Outcome and Covariates

Anxiety disorder was defined as the presence of ICD-9-CM codes 300.0x on any inpatient or outpatient claim during the study period and PTSD as ICD-9-CM code 309.81. We used dates of first ICD-9 CM code for anxiety disorder and PTSD to identify the first month during the pre- and post-TBI period when the diagnoses appeared.

Dates of first diagnosis for other comorbid conditions contained within the CCW were used to create time-varying indicators for these conditions at the monthly level during the study period.[24] Presence of other psychological disorders could influence development of anxiety disorder or PTSD. The following ICD-9-CM codes were used to indicate the following conditions on any outpatient or inpatient claim: depressive disorder (296.2, 296.3, 300.4, 311); alcohol use or dependence disorders (291.xx, 303.xx, 305.0x, 571.0x, 571.2x, 571.3x); substance abuse or dependence disorders (304.x, 305.1x-305.9x); psychosis (295.xx, 298.xx). We created time-varying indicators for these variables as described earlier.

As in previous studies, we created proxy variables that could indicate increased severity of TBI.[20,25] Discharge to a skilled nursing facility (SNF) was defined as one or more days in a SNF during the 30 days following hospital discharge. Length of stay in an acute care hospital was also used as another proxy measure of TBI severity.

Data Analysis

We assessed clinical and demographic characteristics of Medicare beneficiaries who developed anxiety disorder and PTSD post-TBI and compared them to beneficiaries who did not develop anxiety or PTSD. Differences in distribution of characteristics between these cohorts were tested using chi-square, Wilcoxon rank-sum, or Student’s t-test as appropriate.

Months of Medicare Parts A and B with no Part C (Medicare Advantage) coverage constituted person-months at risk of developing either anxiety or PTSD. Beneficiaries contributed follow-up time in the pre- and post-TBI periods until they developed the diagnosis of interest, enrolled in a Medicare Part C (Medicare Advantage plan), died, or reached the end of the study period (5/31/2010). Once an individual developed the diagnosis of interest, they no longer contributed follow-up time during that period (i.e. either pre- or post-TBI). Anxiety disorder and PTSD were assessed separately. Number of events in the pre- or post-TBI period was the numerator. Annual incidence rates and 95% confidence intervals were reported. To determine if diagnoses rates changed over time, we calculated annualized rates per 30-day month over the year post-TBI hospitalization. For the anxiety rates, we stratified the rates by presence of a pre-TBI diagnosis of anxiety. To aid in interpretation of results, we also counted total follow-up time in the pre- and post-TBI periods for all beneficiaries regardless of anxiety or PTSD diagnosis (without censoring).

We modelled new diagnosis of anxiety disorder or PTSD as a function of pre- or post-TBI status using generalized estimating equations with a Poisson distribution and log link. Log person time (pre- or post-TBI) was used as the offset. Variables associated with anxiety disorder or PTSD in bivariate analysis were considered for inclusion in the adjusted regression model. Covariates that were statistically significant or that resulted in greater than

10% change in the effect estimate of TBI were retained in the model. Rate ratios (RtR) and 95% confidence intervals (CI) were reported.

To evaluate factors associated with diagnosis of anxiety or PTSD following TBI, we conducted a discrete time analysis using generalized estimating equations with a binary distribution and a complementary log-log link.[26] Models were built as described previously and risk ratios (RR) and 95% CI reported. A p-value of <0.05 was considered statistically significant.

This study was approved by the Institutional Review Board at the University of Maryland School of Medicine.

RESULTS

There were 96,881 Medicare beneficiaries meeting inclusion criteria hospitalized with TBI between 6/1/06 and 5/31/10. During the study period, 16,957 (18%) beneficiaries were diagnosed with anxiety pre-TBI and 16,519 (17%) were diagnosed with any anxiety post-TBI. Among those diagnosed with anxiety post-TBI, 6,903 (42%) had a diagnosis of anxiety reported pre-TBI and 9,616 (58%) were new cases. A total of 218 (0.2%) individuals were diagnosed with PTSD pre-TBI and 269 (0.3%) were diagnosed post-TBI. Among the beneficiaries diagnosed with PTSD post-TBI, 62 (23%) had been diagnosed pre-TBI and 207 (77%) were new cases.

Characteristics of the study sample at the time of TBI hospitalization are reported in Table 1, stratified by any diagnosis of anxiety disorder or PTSD post-TBI. Beneficiaries diagnosed with anxiety disorder or PTSD (n=16,652, 17%) were younger (80.0 (standard deviation (SD) 8.0) years vs. 81.3 (SD 8.1) years, p<0.001) and more likely to be female (77% vs. 66%, p<0.001) compared to beneficiaries who did not receive one of those diagnoses. Beneficiaries diagnosed with anxiety disorder or PTSD post-TBI were more likely to have other co-morbid conditions, especially chronic obstructive pulmonary disease (44% vs. 36%, p<0.001) and rheumatoid or osteoarthritis (72% vs. 63%, p<0.001), compared to those without a diagnosis of anxiety disorder or PTSD. They were much more likely to have been diagnosed with depression (43% vs. 25%, p<0.001), anxiety disorder (41% vs. 12%, p<0.001), PTSD (0.6% vs. 0.1%, p<0.001), or psychosis (17% vs. 13%, p<0.001) pre-TBI compared with beneficiaries who did not develop anxiety disorder or PTSD post-TBI. Diagnosis of substance abuse or dependence (14% vs. 9%, p<0.001) and alcohol abuse or dependence (5% vs. 3%, p<0.001) at any time during the study period was also more likely among beneficiaries diagnosed with anxiety disorder or PTSD post-TBI. Individuals who developed anxiety disorder or PTSD pre-TBI had fewer months of follow-up (27.0 (SD 11.0) vs. 28.4 (SD 11.2), p<0.001) compared to those with no pre-TBI diagnoses. Individuals who developed anxiety disorder or PTSD post-TBI had more months of follow-up (25.4 (SD 11.9) vs. 19.1 (SD 13.4), p<0.001) compared to those with no post-TBI diagnoses.

Anxiety

Among beneficiaries hospitalized for a TBI, the annualized rate of anxiety disorder per 1,000 Medicare beneficiaries pre-TBI was 83.3 (95% confidence interval (CI) 82.0, 84.5)) and the rate post-TBI was 114.3 (95% CI 112.6, 116.1), resulting in a crude rate ratio of 1.37. Annualized rates of anxiety disorder per 1,000 person-years peaked during the first month following TBI hospitalization and declined rapidly before leveling out by about five months post-TBI hospitalization (Figure 1, stratified by pre-TBI anxiety diagnosis). By month twelve, the unstratified rate of anxiety disorder (54.9; 95% CI 48.8, 61.6). Beneficiaries with a history of anxiety pre-TBI had much higher rates of anxiety diagnosis post-TBI compared to those with no prior history (Figure 1), yet the same pattern of higher rates in the first few months following TBI was observed. Our final regression model examining risk of developing anxiety disorder associated with TBI contained an indicator term for TBI, age, sex, race, ADRD, anemia, asthma, chronic obstructive pulmonary disease, diabetes, heart failure, glaucoma, ischemic heart disease, liver disease, osteoporosis, rheumatoid/osteo-arthritis, stroke, psychosis, and alcohol abuse/dependence. After adjustment for these covariates, TBI was associated with a slightly increased rate of anxiety diagnoses (rate ratio (RtR) 1.04; 95% CI 1.02, 1.06).

Our final discrete time model assessing factors associated with diagnosis of anxiety disorder following TBI contained terms for age, time, sex, race, acute myocardial infarction, ADRD, asthma, atrial fibrillation, chronic obstructive pulmonary disease, diabetes, heart failure, glaucoma, ischemic heart disease, liver disease, rheumatoid/osteoarthritis, stroke, alcohol abuse or dependence, psychosis, discharge to a skilled nursing facility (SNF), and pre-TBI diagnoses of depression, anxiety disorder, and PTSD. Predictors of anxiety diagnosis following TBI with the largest risk ratios were pre-TBI diagnosis of anxiety disorder (RR 3.55; 95% CI 3.42, 3.68), depression (RR 1.44; 95% CI 1.39, 1.50), and PTSD (RR 1.43; 95% CI 1.12, 1.83)(Table 2). Female sex was a risk factor for anxiety disorder (RR 1.49; 95% CI 1.43, 1.56) while beneficiaries who were black (RR 0.69; 95% CI 0.64, 0.75) and whose race was categorized as ‘other’ (RR 0.73; 95% CI 0.68, 0.78) were less likely to be diagnosed with anxiety disorder compared to beneficiaries who were white.

PTSD

The annualized incidence rate of PTSD diagnosis per 1,000 persons pre-TBI was 0.96 (95% CI 0.84, 1.10) and the post-TBI rate was 1.62 (95% CI 1.44, 1.83), resulting in a crude rate ratio of 1.69. Annualized rates of PTSD diagnoses per 1,000 person-years peaked during the month following TBI hospitalization (5.7; 95% CI 4.3, 7.6) and declined afterwards (Figure 2). Figure 2 should be interpreted with caution due to wide confidence intervals caused by small cell numbers. Our final regression model examining risk of PTSD diagnosis associated with TBI contained an indicator term for TBI, age, sex, race, acute myocardial infarction, ADRD, asthma, rheumatoid/osteoarthritis, psychosis, and alcohol abuse/dependence. After adjustment for these covariates, TBI was associated with an increased rate of PTSD diagnoses (RtR 1.24; 95% CI 1.05, 1.48).

Our discrete time regression model examining factors associated with diagnosis of PTSD post-TBI contained terms for age, time, acute myocardial infarction, asthma, atrial

fibrillation, rheumatoid/osteoarthritis, psychosis, and pre-TBI diagnosis of depression, anxiety, and PTSD (Table 3). Pre-TBI diagnosis of PTSD (RR 70.09; 95% CI 56.29, 111.12) was significantly associated with PTSD following TBI. Pre-TBI diagnosis of depression (RR 1.56; 95% CI 1.18, 2.07) and anxiety (RR 1.48; 95% CI 1.11, 1.98) were also significantly associated with PTSD following TBI, as were rheumatoid/osteoarthritis (RR 1.63; 95% CI 1.17, 2.25) and psychosis (RR 1.44; 95% CI 1.10, 1.90).

DISCUSSION

Rates of anxiety disorder and PTSD spiked during the first five months following hospitalization for TBI in this large national study of Medicare beneficiaries, as had been reported in younger populations.[27,28] Premorbid psychiatric conditions were significantly associated with anxiety disorder and PTSD post-TBI, extending prior reports to older adults.[9,10,27,30] Nonetheless, the majority of individuals diagnosed with anxiety and PTSD following TBI did not have a previous history. Prevalence of anxiety post-TBI (17%) was largely consistent with prior literature while prevalence of PTSD post-TBI (0.3%) was much lower than previous estimates, possibly due to our older population, diagnostic difficulty, or poor capture of PTSD diagnoses in claims data.[8–11, 27–29]

The first few months after TBI are a crucial period for rehabilitation, yet rates of diagnoses for anxiety and PTSD were at their highest levels. Presence of a psychiatric disorder can interfere with rehabilitation and decrease quality of life. Clinicians should be mindful of this and have a low threshold for obtaining psychiatric consultations or providing appropriate therapy in patients who are not compliant with rehabilitation or experiencing symptoms of anxiety disorder and/or PTSD. Routine screening for anxiety disorder and PTSD, especially during the first five months following TBI, may help clinicians identify these important and treatable conditions. While patients with a history of prior psychiatric illness are at highest risk, the majority of those with new anxiety and PTSD diagnoses had no prior history during the pre-TBI study period, which averaged 28 months. While 28 months isn’t sufficient to capture lifetime diagnosis of anxiety or PTSD, it would capture recent or current diagnoses, suggesting that those with ‘new’ diagnoses post-TBI had been free of symptoms for an extended period of time.

Prevalence of anxiety and PTSD post-TBI varies markedly in the literature, likely due to inconsistent diagnostic criteria for TBI, anxiety disorders, and PTSD, failure to consider pre-existing psychiatric disturbances, and differences in methodology.[8–11, 27,28,30] We used a narrow definition of anxiety (ICD-9-CM 300.0x) in this study, yet our prevalence estimates are consistent with prior studies.[8–11] This suggests that inclusion of other anxiety disorders such as obsessive compulsive disorder and social phobia would result in higher prevalence and risk of anxiety disorder among older adults following TBI than reported here. A dual diagnosis of TBI and PTSD has been heavily contested, with some researchers arguing that the post-traumatic amnesia associated with TBI would prevent the encoding of memories essential for forming the intrusive symptoms necessary for a diagnosis of PTSD, and others arguing that with careful clinical interviews the two diagnoses can be reliably detected and differentiated in the same individual.[27,29,31]

An increasingly common way to analyze the uniqueness of TBI symptomatology is to compare these individuals to those with who have traumatic orthopedic injuries without any TBI. This is a relevant comparison group for PTSD as both groups experienced a discrete stressor (are injured), the first criterion for diagnosis of PTSD. In a study comparing individuals with TBI to those with only orthopedic trauma, individuals with TBI reported somewhat greater anxiety as measured on the Hospital Anxiety and Depression Scale (34% vs. 20%) and also PTSD as measured on the PTSD Checklist - Specific (17% vs. 5%), leading to greater psychosocial difficulties in those with TBI.[32]

The majority of TBIs are mild and in contrast to our study do not result in hospitalization.[1] Therefore, generalizability of this study is limited to Medicare beneficiaries hospitalized with TBI. Although we made every effort to identify the earliest TBI hospitalization, some could have occurred outside the study period. This would tend to bias results toward the null. Furthermore, information on the methods employed to diagnose anxiety disorder and/or PTSD isn't available in administrative claims data. Identification of a diagnosis in Medicare claims is dependent on submission of a billable code, and thus may be an underestimate. We were only able to identify anxiety or PTSD diagnoses occurring during the study period and therefore may have missed earlier diagnoses. This may have resulted in an overestimation of the number of 'new' post-TBI diagnoses and contributed person-time. Nonetheless, we had over two years of pre-TBI follow-up during which we could identify diagnoses, supporting the concept of 'new' diagnoses post-TBI. Finally, we had no measures of TBI or psychiatric illness severity, although we have previously used hospital length of stay and discharge to a skilled nursing facility as proxy measures for TBI severity.[20,25]

Nonetheless, ours is the first national study to document a significantly increased risk of anxiety disorder and PTSD following TBI among Medicare beneficiaries. Hospitalization rates for TBI are increasing among older adults, yet little research effort is directed toward improving outcomes in this population. Our study not only highlights the increased risk of a psychiatric illness following TBI, it provides clinicians with a timeframe to identify older patients at greatest risk of poor outcomes.

Future work should focus on validation of screening instruments to assist frontline clinicians in detection of anxiety disorders and PTSD after TBI. There is need for further investigation of treatment for anxiety disorders and PTSD in the setting of TBI, including pharmacotherapy, psychotherapy, and other non-invasive neuromodulatory methods.

Conflicts of Interest and Source of Funding:

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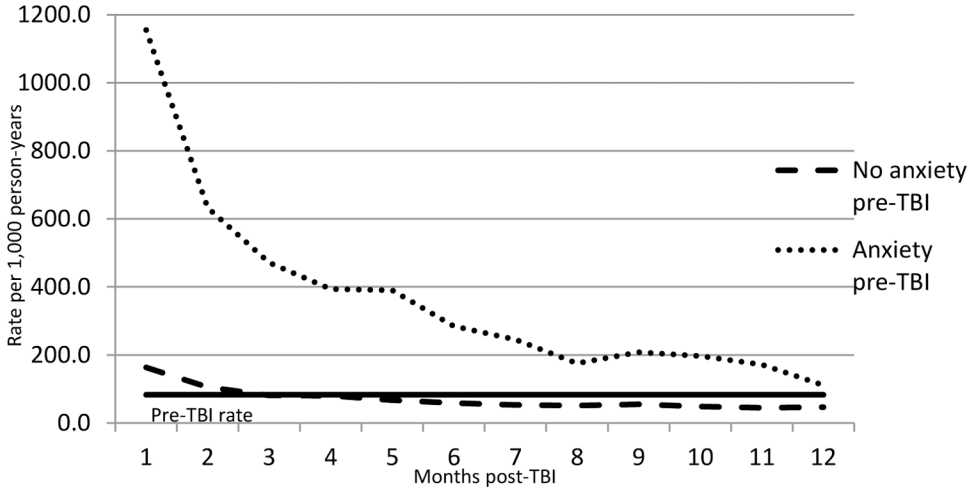

Figure 1.

Annualized Rates of Anxiety Diagnosis among Medicare Beneficiaries During the Year Following Hospitalization for Traumatic Brain Injury (TBI) Stratified by pre-TBI Diagnosis of Anxiety

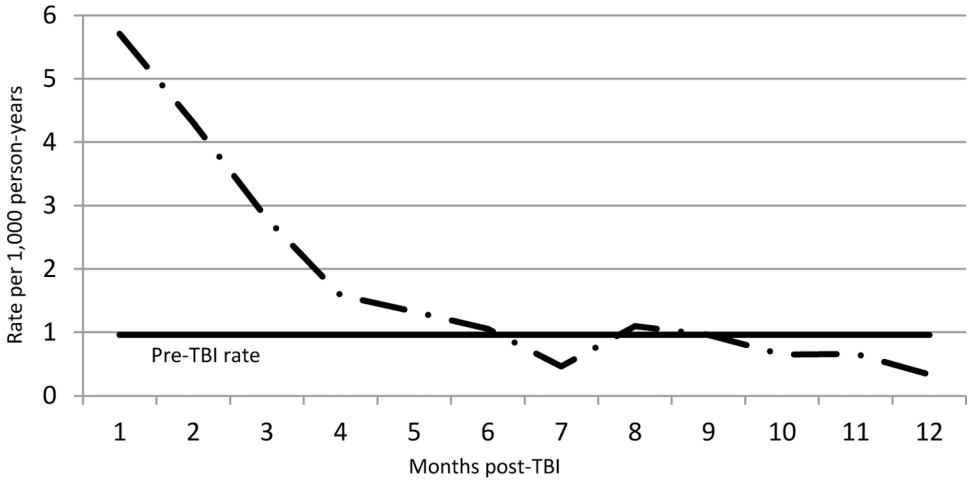

Figure 2.

Annualized Rates of Post-Traumatic Stress Disorder Diagnosis among Medicare Beneficiaries During the Year Following Hospitalization for Traumatic Brain Injury

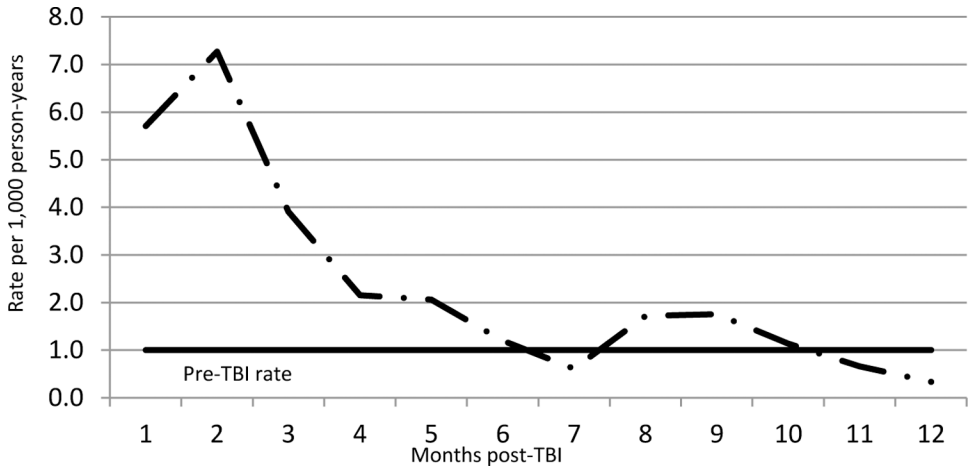

Figure 3.

Annualized Rates of Post-Traumatic Stress Disorder Diagnosis among Medicare Beneficiaries During the Year Following Hospitalization for Traumatic Brain Injury

Table 1.

Baseline Characteristics of Medicare Beneficiaries Hospitalized with Traumatic Brain Injury (TBI) 2006–2010 by Diagnosis of Anxiety or Post Traumatic Stress Disorder (PTSD) Following TBI, n= 96,881

	Total Sample N= 96,881	Anxiety or PTSD post-TBI, N= 16,652	No Anxiety or PTSD post-TBI, N= 80,229	p-value[1]
Age, mean (standard deviation)	81.1 (8.1)	80.0 (8.0)	81.3 (8.1)	<0.001
Female sex, N(%)	63,499 (66)	12,799 (77)	50,700 (63)	<0.001
Race/Ethnicity, N(%)				<0.001
White	84,119 (87)	15,085 (91)	69,034 (86)	
Black	5,750 (6)	680 (4)	5,070 (6)	
Other	7,012 (7)	887 (5)	6,125 (8)	
Comorbid conditions, N(%)				
Alzheimer's disease	35,580 (37)	6,573 (39)	29,007 (36)	<0.001
Asthma	14,041 (14)	3,137 (19)	10,904 (14)	<0.001
Chronic kidney disease	27,485 (28)	4,486 (27)	22,999 (29)	0.12
COPD[2]	36,401 (38)	7,320 (44)	29,081 (36)	<0.001
Diabetes	40,457 (42)	6,920 (42)	33,537 (42)	0.56
Heart failure	48,085 (50)	8,503 (51)	39,582 (49)	<0.001
Ischemic heart disease	65,853 (68)	11,664 (70)	54,189 (68)	<0.001
Rheumatoid arthritis / osteoarthritis	62,754 (65)	11,928 (72)	50,826 (63)	<0.001
Stroke / transient ischemic attack	30,592 (32)	5,396 (32)	25,196 (31)	0.01
Psychological disorders pre-TBI, N (%)				
Depression[3]	27,147 (28)	7,275 (43)	19,872 (25)	<0.001
Anxiety	16,407 (17)	6,753 (41)	9,654 (12)	<0.001
PTSD	200 (0.2)	104 (0.6)	96 (0.1)	<0.001
Psychosis	13,481 (14)	2,903 (17)	10,578 (13)	<0.001
Alcohol use/dependence[4]	3,514 (4)	840 (5)	2,674 (3)	<0.001
Substance use/dependence[4]	6,407 (10)	1,875 (14)	4,532 (9)	<0.001
Original reason for Medicare entitlement, N(%)				<0.001
Age	85,563 (84)	14,079 (85)	71,484 (89)	
Disability	11,084 (11)	2,550 (15)	8,534 (11)	
ESRD[5] +/− disability	234 (<1)	23 (<1)	211 (<1)	
Days of TBI hospital stay, mean (SD)	5.8 (7.8)	5.6 (6.2)	5.8 (8.1)	0.01
Discharge to a skilled nursing facility, N(%)	39,384 (41)	7,527 (45)	31,857 (40)	<0.001
Total months of follow-up, mean (SD)				
Pre-TBI	28.2 (11.2)	27.0 (11.0)	28.4 (11.2)	<0.001
Post-TBI	20.2 (13.4)	25.4 (11.9)	19.1 (13.4)	<0.001

Table 2.

Adjusted Risk Ratios (95% confidence intervals) of Factors Associated with a Diagnosis of Anxiety Following Traumatic Brain Injury (TBI) among Medicare Beneficiaries 2006–2010, n=96,881

Characteristic	Anxiety N=16,519
Age in years	0.99 (0.98, 0.99)
Months post-TBI	0.98 (0.97, 0.98)
Sex	
Men	Reference
Women	1.49 (1.43, 1.56)
Race	
White	Reference
Black	0.69 (0.64, 0.75)
Other	0.73 (0.68, 0.78)
Comorbid Conditions	
Alzheimer's disease	1.21 (1.17, 1.26)
Acute myocardial infarction	0.95 (0.90, 1.00)
Asthma	1.08 (1.03, 1.13)
Atrial fibrillation	0.93 (0.90, 0.97)
Chronic obstructive pulmonary disease	1.18 (1.14, 1.22)
Diabetes	0.94 (0.91, 0.97)
Heart failure	1.08 (1.03, 1.11)
Glaucoma	0.95 (0.92, 0.99)
Ischemic heart disease	1.05 (1.10, 1.17)
Hip fracture	0.98 (0.94, 1.03)
Liver disease	1.10 (1.04, 1.16)
Rheumatoid/Osteo arthritis	1.16 (1.12, 1.22)
Stroke	0.96 (0.91, 0.98)
Alcohol abuse/dependence	1.14 (1.07, 1.21)
Psychosis	1.14 (1.10, 1.19)
Discharge to skilled nursing facility	1.15 (1.12, 1.20)
Pre-TBI diagnosis of	
Depression	1.44 (1.39, 1.50)
Anxiety	3.55 (3.42, 3.68)
PTSD	1.43 (1.12, 1.83)

Table 3.

Adjusted Risk Ratios (95% confidence intervals) of Factors Associated with a Diagnosis of Post Traumatic Stress Disorder (PTSD) Following Traumatic Brain Injury (TBI) among Medicare Beneficiaries 2006–2010, n=96,881

Characteristic	PTSD N=269
Age in years	0.93 (0.91, 0.95)
Months post-TBI	0.96 (0.95, 0.98)
Comorbid Conditions	
Acute myocardial infarction	0.54 (0.30, 0.97)
Asthma	1.36 (1.01, 1.83)
Atrial fibrillation	0.71 (0.52, 0.98)
Rheumatoid/Osteo arthritis	1.63 (1.17, 2.25)
Psychosis	1.44 (1.10, 1.90)
Pre-TBI diagnosis of	
Depression	1.56 (1.18,2.07)
Anxiety	1.48 (1.11,1.98)
PTSD	79.09 (56.29,111.12)