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The Population of Patients with Traumatic Brain Injury (TBI) in Skilled Nursing Facilities: A Decade of Change

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Abstract

Objective—To describe the natural history of patients with traumatic brain injury(TBI) admitted to SNFs following hospitalizations.

Setting—2005–2014

Participants—Adults who had incident admissions to skilled nursing facilities(SNF) with a diagnosis of TBI.

Design—Retrospective review of the Minimum Data Set (MDS).

Main Measures—Main variables were cognitive and physical function, length of stay, presence of feeding tube, terminal condition, and dementia.

Results—Incident admissions to SNFs increased annually from 17,247 patients to 20,787 from 2005–2014. The percentage of patients with ADL score ≥ 23 decreased from 25% to 14% ($p<0.05$). The overall percentage of patients with severe cognitive impairment decreased from 18% to 10% ($p<0.05$). More patients had a diagnosis of dementia in 2014 compared to previous years ($p<0.05$) and the presence of a terminal condition increased from 1% to 1.5% over the 10-year period ($p<0.05$). The percentage of patients that stayed fewer than 30 days was noted to increase steadily over the 10 years, starting with 48% in 2005 and ending with 53% in 2013 ($p<0.05$).

Conclusion—Understanding past trends in TBI admissions to SNFs is necessary to guide appropriate discharge, predict future demand, as well as inform SNF policy and practice necessary to care for this sub-group of patients.

Introduction

Annually, 1.7 million traumatic brain injuries (TBI) occur in the United States and are a contributing factor in about one third (30.5%) of all injury-related deaths.(1) The incidence of TBI has steadily risen from 2001 to 2010(2). From 2001 to 2005, the TBI rates increased from 521 to 616 per 100,000 people and, in 2010, increased to 824 per 100,000 people.(3) During the same time period, hospitalization rates increased by 11%(3) and emergency room visits for sports-related TBI increased 65.9% between 2006–2011.(4) Of those patients admitted to the hospital with severe TBI, approximately 43% have a related disability one-year later(5). Estimates of between 3.2 and 5.3 million persons (1.1–1.7% of the U.S. population) live with long-term disabilities from TBI. These numbers likely underestimate the prevalence of TBI as persons with TBI sequelae who were treated and released from emergency departments, those who sought care in other health-care settings, and those who did not seek treatment at all are not included.(5) The majority of this growing incidence in traumatic brain injury is among the youngest (ages 0–15) and the oldest (ages 60+ years), as well as the most vulnerable age groups.(6) Additionally, the overall population is aging, resulting in an increase in the incidence of TBI among older adults age 60 years and older(3, 7).

Factors such as automobile safety, seat belt use, helmet use, and improved overall management of severe TBI have mitigated the severity of injury and the mortality of patients suffering from such injuries. With the improvement in patient morbidity and survival, there is an increasing need for post-acute care following an inpatient acute event. The most common sites of post-acute care include inpatient rehabilitation facilities (IRF), SNFs and Long-term Acute Care Hospitals (LTACH), each with their own specifications for admitting and caring for patients with TBI. SNFs are designed to fulfill basic healthcare needs of residents while offering 24-hour round the clock nursing care and assistance with daily activities. They are healthcare institutions where all patients have a supervising physician, there is at least one registered nurse 24 hours a day, and have facilities for storing and dispensing drugs.(8) LTACHs are designed to deliver more complex clinical care than a SNF. An LTACH is a hospital providing care for hospital-level medical conditions long-term. Inpatient Rehabilitation Facilities (IRF) fall between SNF and LTACH in terms of ability to manage complex conditions. However, the focus at IRF is on rehabilitation and

therapy. Patients are managed by a physiatrist rather than internist or geriatrician as seen at most SNFs with a requirement that patients be able to tolerate at least 3 hours of physical therapy a day.(9) All types of professional therapists are available at an IRF which is limited at SNF(10). In short, patients with TBI who are discharged to IRF are able to participate in 3 hours of physical therapy. Long-term Acute Care Hospitals tend to admit patients who continue to require some form of hospital level of supportive care. Skilled nursing facilities can admit patients with TBI who are unable to participate in 3 hours of therapy and do not require hospital level of care. In the past, SNFs have had a small percentage of patients with TBI with most patients being diverted to IRFs. (11, 12) However, with an overall increase in survivors with TBI, it is possible there has been a growth in the number of patients admitted to SNFs for post-acute or long-term care. Understanding past trends in TBI admissions to SNFs is necessary to guide appropriate discharge, predict future demand, as well as inform SNF policy and practice necessary to care for this sub-group of patients. Therefore, the current study aims to fill this gap by describing trends in the admission of patients with TBI to federally certified U.S. SNFs from 2005–2014.

Method

We conducted a retrospective cohort study of patients with TBI admitted to SNFs for post-acute care from 2005 to 2014 using the Minimum Data Set (MDS). The MDS is a federally mandated comprehensive clinical assessment of all patients in a Medicare or Medicaid certified SNFs. The MDS contains items that measure physical, psychological and psychosocial functioning that give a multidimensional view of the patient's functional capacities. The MDS is required to be collected at admission, quarterly, annually, at discharge and whenever there is a significant change in a patient's status. Information for the MDS is collected by licensed healthcare professionals employed by the respective facilities.

We used the MDS to identify adult patients, age ≥ 18 years, newly admitted to SNF from the hospital (without a SNF stay in the previous two years) with an active diagnosis of TBI. The MDS defined TBI as “damage to the brain that resulted from physical injury to the head”. To identify the active diagnoses, we relied on the TBI item in the diagnoses section of the MDS. If this was present, the TBI item was marked by the assessor. The assessor could then add an additional 10 active diagnoses in the MDS..(13) We included patients with the TBI item as well as the TBI-specific ICD-9 codes: 800-801.99, 803-804.99, 850-854.99, 293.0, 310.2, 959.01, 907.0.(3) (14)

Data come from the initial MDS assessment. We examined patients' age, sex, most frequent comorbid conditions, Activities of Daily Living (ADL) scores, cognitive performance scores, presence of a feeding tube, 6-month prognosis, and the diagnosis of dementia upon admission to the SNF. We also calculated the length of stay for each patient. Length of stay is a measure of time from admission to discharge. Discharge from SNF includes discharge to home, readmission to hospital or death.

The ADL score is a 28-point scale that helps establish a patient's functional ability.(15, 16) This is determined by assessing a patient's ability to complete daily tasks such as transferring in and out of bed, eating and toileting.(16) Higher scores indicate more impaired

function. We reported average ADL score in each year as well as the percentage of patients with an ADL score ≤ 23 , indicating severe impairment. The ADL score was used as a marker of severity of TBI. The measures of cognitive function scales changed over the 10-year period. From 2005–2010 the MDS employed the Cognitive Performance Score (CPS) to report patients' cognition.(16) CPS scores range from 0–6 with 0 being intact and 6 being the most severely impaired. In October 2010, with the advent of the MDS 3.0, these measures changed. We therefore use the Cognitive Function Scale(17) to report patients' cognitive function for years 2011–2014. The CFS provides a functional view of cognitive performance incorporating information from the Brief Interview for Mental Status and the Cognitive Performance Scale.(18) With this, the CFS provides a description of a patient's cognitive status and ranges from 1 (cognitively intact) to 4 (severely impaired). Again, the cognitive scores were markers for the severity of the TBI.

We evaluated the number of patients with feeding tubes as an additional marker for severity of impairment. We also evaluated the number of patients with a terminal condition.. A terminal condition was defined as a prognosis of less than 6 months as assessed by a physician at the SNF.(19)

Research has suggested that the MDS items have high levels of reliability.(15, 20, 21)

We summarized the characteristics of patients with TBI indicated on the MDS admission assessment with standard measures including means, standard deviations, and percentages. We tested for statistical significance between 2005 and 2014 using Chi-square for categorical data and unpaired t-test for continuous data.

Results

The number of patients with TBI admitted to SNFs steadily increased over the 10-year period, from 17,247 in 2005 to 20,787 patients in 2014. In 2005, patients with TBI admitted to SNF made up approximately 1% of the patients admitted during the year. This number increased to 1.4% by 2014 with a peak of 1.4% in 2011 (See Figure 1).

The age of patients with TBI in SNFs steadily increased from 2005–2014 with an average age of 72 years to an average age of 75 in 2014 (see Table 1). The percentage of patients with TBI under the age of 65 decreased from 29% in 2005 to 21% in 2014. The percentage of patients older than 85 years of age rose from 28% to 32% from 2005 to 2014. The percentage of women with TBI in SNFs did not differ significantly during this time period.

Comorbid conditions included Alzheimer's Dementia, Other Dementia (Non-Alzheimer), cerebrovascular accident, congestive heart failure (CHF), peripheral vascular disease (PVD), other cardiovascular disease, asthma, Diabetes Mellitus (DM), renal failure, hemiplegia/hemiparesis, arthritis, cancer. DM was the most common co-morbidity among patients with TBI in SNFs over the 10-year study period. In 2005, 23% of patients with TBI in SNFs also had DM. By 2014, 26% of patients had DM. Dementia (Non-Alzheimer) was the second most common co-morbidity in this population with 17% of patients carrying this diagnosis in 2005. This number increased to 23% by 2014. See Table 2.

Patients' average ADL scores slightly increased over the ten-year period with an average ADL scale score of 16.9 in 2005 and 17.7 in 2014. However, when looking at patients with severe functional impairment, defined as ADL ≤ 23 , the proportion of these patients decreased over time with 25% of TBI patients having a score ≤ 23 in 2005 compared to 14% in 2014. The change in CPS scores between 2004 and 2010 showed the percentage of patients with severe cognitive impairment (a CPS score of 5–6) decreased from 18% in 2005 to 16% in 2010. The percentage of cognitively intact patients (CPS scores of 0–2) increased from 46% (2005) to 49% (2010). Starting in 2011, the percentage of patients with severe cognitive impairment according to the CFS decreased from 13% in 2011 to 10% in 2014. In contrast, there was an increase in cognitively intact patients from 38% to 41% between 2011 and 2014.

The percentage of patients with TBI who had a feeding tube steadily decreased over the ten-year study period. In 2005, 18% of patients had a feeding tube; by 2014, only 11% of patients with TBI admitted to a SNF had a feeding tube. More patients with TBI also carried a diagnosis of dementia in 2014 (26%), compared to previous years; 21% in 2005. The presence of a terminal condition increased from 1 to 1.5% over the decade.

The length of stay for patients admitted with TBI to SNF decreased over the study period: 48% of patients in 2005 were discharged from the SNF within 30 days compared to 53% of patients in 2013. Similarly, in 2005, 88% of TBI patients were discharged within one year of admission compared to 92% by 2013 (Figure 2).

Discussion

TBI is a significant public health issue that leads to long-term and/or permanent disabilities in addition to post-acute care. Nevertheless, trends in admission demographics over time in these patients admitted to SNF have not been well-studied. In this study, we found that there has been an increase in the incidence of patients with TBI admitted to SNFs over a decade. However, we also found that the overall severity of cognitive and physical impairment among this population decreased. Future research is needed to understand what is driving these changes.

In this national study, we found that the age of patients with TBI admitted to SNF increased by approximately 4 years over the 10-year period. This could reflect a number of trends: the aging of the overall population, an increase in the incidence of TBI among older adults, or a diversion of older adult TBI patients to SNFs in lieu of other post-acute care settings(22). We know that the population is living longer and therefore increasing the age of patients across all care settings.(23, 24) In addition, the older adults are a growing trauma population. Most notably, falling has become a fast growing mechanism of injury among patients with TBI. Recent data shows that 94% of patients, age > 85 years, had injuries resulting from fall. Therefore, as the population ages, it is likely that we will continue to see more falls and ultimately more injuries from these falls.(25–27) In further explanation, research has demonstrated that younger brains recuperate better than older brains. Greater than 80% of patients with TBI between 18–29 years of age show improvement at 1 year whereas less than 40% of patients, age ≤ 60 years with TBI show improvement. This might be explained

by the increased deterioration in the elderly or the increased number of comorbidities they carry. Young patients with the most severe head injuries showed more improvement in Functional Independence Measure scores as compared to patients with the least severe head injuries over the age of 60. (28, 29) Therefore, due to their increased ability to rehabilitate, younger patients might be diverted to alternative settings such as inpatient rehabilitative facilities. Conversely, older patients are more likely to have comorbid conditions contributing to their admission to SNF rather than or prior to undergoing rehabilitation. For example, dementia patients are unlikely to rehabilitate as this is a chronic progressive disease thus diverting them to SNF and more specifically SNF dedicated to dementia care. All three of these explanations might help to explain the increased age of the TBI patients in SNFs.

The increased age among TBI patients found in SNF might also help to explain the change in gender distribution during the study period. We found that patients with TBI in SNFs were evenly distributed between males and females. In the past, young males suffered the majority of traumatic brain injury due to more high-risk behaviors. When compared to females, males were four times more likely to die from TBI.(30) Though men continue to have higher rates of TBI, the incidence among women is increasing. This increase was first seen as women were participating in more sports and the military.(31, 32) We now see this increase in the elderly population as well. As many as 62% of trauma patients among the elderly are female.(25) Previous work conducted in the late 1990s found that men comprised approximately 2/3 of the TBI population in SNFs.(33) However, in our analysis of more recent data, we found that men were approximately half the population with TBI admitted to SNFs.

We also demonstrated the severity of impairment in this population of TBI cases admitted to a NH decreased during the study period. This is potentially due to the overall improvements in the acute care of TBI. Literature suggests that early and aggressive care of TBI improves outcomes including improved functional level, discharge to home and even returning to work.(29, 34) Protocolled acute care of TBI has helped decrease both morbidities and mortalities. When comparing outcomes before and after guided care of patients with TBI, patients treated by the guidelines had 9-fold increased odds of a good outcome compared to patients who did not receive guided care.(35, 36) Additionally, protocols surrounding the acute care of TBI have decreased length of stay in acute settings and improved outcomes such as motor function and communication as well as decreasing mortality at six months in hospitals.(36–38) This directed and organized acute hospital care might also help to explain the increased admissions of patients with TBI to SNF. If they are surviving and thriving, they are better suited for post-acute care than prolonged stay in hospital or transfer to LTACH.

Decreased rates of severe functional and cognitive impairment might also be explained by more organized and successful acute care. Similarly, the presence of feeding tubes in this population decreased over the study period. This supports our finding that patients with TBI in SNF are less impaired on admission as feeding tubes are generally reserved for patients who are unable to eat or unable to meet their caloric goals independently.(39) We still need to determine if this decreased impairment is due to the initial injury or changes in acute and post-acute discharge patterns.

Lengths of stay decreased over the study period. Most notably was the percentage of patients who stayed in SNF for less than 30 days. There are multiple explanations for this such as improved discharge planning from acute care to post-acute care, improvement in treatments and therapies for these patients in both the acute and post-acute setting as well as patients who are less impaired as our study suggests.

Finally, further explanation for a decrease in the severity of impairments among patients with TBI in SNF might be the increased utilization of other post-acute care facilities, such as LTACHs and IRF, during the same time period as our study. LTACHs provide care to patients who need hospital level-of-care for an extended period. Similarly, IRFs offer specific rehabilitative modalities to patients who no longer meet criteria to be in the hospital setting and can tolerate at least 3 hours of physical therapy per day. Perhaps the more impaired patients could possibly have been admitted to LTACHs instead of SNFs explaining some of the fluctuations that we demonstrated. This possibility coincides with the increase in new LTACHs as well as an increase in the number of beds in existing LTACHs. Moreover, the study decade overlaps with the explosion of new IRFs and IRF-units, which might further dilute the SNF population.(40, 41) Future work should investigate the post-acute care patterns of patients with TBI admitted to various settings and whether or not the decreases in levels of impairment can be attributed to changes in the post-acute care market.

It is difficult to further speculate the reason for the increase in the number of patients with TBI being admitted to SNF. However, nursing homes have shifted from providing primarily long-term custodial care to more post-acute, rehabilitative services over the last two decades. (22) Furthermore, it has been documented that the number of older adults who experience and live with TBI has been increasing.(42) Many of these older adults may have multiple comorbidities, require 24-hour nursing services, and may not be able to participate in the required number of hours required in an inpatient rehabilitation setting, thereby making SNF often the preferred location for post-acute care.

Limitations

This paper relied on the diagnosis of TBI by the MDS. It is possible this introduced ascertainment bias. Additionally, we were unable to determine whether patients were admitted to SNF for a primary diagnosis of TBI versus patients with a diagnosis of TBI but some other primary diagnosis warranting SNF admission. Along the same lines, we did not examine or exclude co-morbid conditions that might alter patients' cognitive scores and ADLs such as dementia, which increased over our study period. Further work is needed to account for the changing rates of patients with a dementia diagnosis and whether or not this could be driving the changes we observed.

Conclusion

In conclusion, the number of patients with TBI in the United States admitted to SNFs over a ten-year period has increased; at the same time, the functional impairments and clinical severity of this population has decreased over the decade. These data suggest that the TBI

population in SNFs has changed and lays the groundwork for future studies examining the potential drivers of these changes and patients' outcomes.

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Figure 1.
Percentage of patients with TBI newly admitted to SNF (2005–2014)

Figure 2.
Length of Stay in Patients with TBI Admitted to SNF (2005–2013)

Table 1

Variables of Patients with Traumatic Brain Injury Newly Admitted to Skilled Nursing Facilities (2004–2014)

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Chi-square*	T-statistic*	P-value*
No. of patients with TBI in SNF	17,247	17,661	18,629	19,793	21,026	20,408	21,243	19,018	20,340	20,787	557.8		< 0.05
Percent of patients with TBI in SNF	1.1%	1.1%	1.2%	1.2%	1.3%	1.3%	1.4%	1.3%	1.3%	1.3%			
Age- mean years (sd)	71.6±18.9	71.6±18.8	72.0±18.4	72.7±18.0	72.7±17.8	73.9±1.9	74.9±16.2	74.3±16.2	74.5(16)	75.2±15.4		20.5	< 0.05
Age <65 yrs	30%	29%	29%	28%	27%	24%	22%	23%	23%	21%			< 0.05
Age <65 yrs	28.00%	28.00%	29.00%	29.00%	30.00%	31.00%	34.00%	31.00%	31.00%	33.00%			< 0.05
Female	48%	48%	49%	49%	49%	50%	50%	48%	48%	48%			0.7
ADL Score, mean(sd)	16.9±7.8	17.0±7.5	17.3±7.3	17.4±7.1	17.6(6.8)	17.3±6.7	17.1±6.9	17.966.1	17.9±5.8	17.7±5.7		11.5	
ADL 23	25%	24%	23%	23%	21%	19%	17%	17%	15%	14%			< 0.05
Feeding tube	18%	18%	17%	17%	16%	14%	13%	12%	12%	11%			< 0.05
CPS score 5–6	18%	16%	16%	16%	15%	16%					417.8		< 0.05
CPS score 0–2	46%	47%	48%	48%	49%	49%	38%	39%	39%	41%	63.6		< 0.05
CFS=1						38%	38%	39%	39%	41%			
CFS=4						12%	13%	12%	11%	10%			

Note: TBI= Traumatic Brain Injury, SNF= Skilled Nursing Facility, ADL= Activities of Daily Living (on a scale of 0–28 with 28 indicating severe functional impairment), CPS= Cognitive Performance Scale, CFS= Cognitive Function Score

* Test statistics compare 2005 to 2014.

Table 2
Most Common Co-morbidities of Patients with Traumatic Brain Injury Newly Admitted to Skilled Nursing Facilities

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
	17247	17661	18629	19793	21026	20408	21243	19018	20340	20787
Alzheimer's Dementia, %	5.4%	5.2%	5.4%	5.2%	5.4%	5.2%	5.6%	5.4%	4.8%	4.9%
Dementia (other than Alzheimer's), %	16.7%	17.1%	17.5%	18.4%	18.3%	20.0%	23.1%	21.4%	22.1%	22.7%
Cerebrovascular Accident (stroke), %	14.2%	14.5%	14.0%	14.0%	13.9%	13.2%	12.8%	12.3%	12.6%	12.2%
Congestive Heart Failure, %	11.3%	11.0%	10.5%	10.6%	10.6%	10.7%	11.5%	11.1%	11.6%	12.1%
Peripheral Vascular Disease, %	4.6%	4.0%	4.2%	4.3%	4.7%	4.2%	2.6%	3.8%	4.2%	4.6%
Other Cardiovascular Disease, %	13.6%	13.9%	14.5%	14.7%	15.0%	14.4%	13.0%	14.7%	14.6%	15.2%
Asthma, %	2.7%	2.8%	3.0%	2.9%	3.0%	6.2%	14.9%	15.0%	15.2%	15.7%
Diabetes Mellitus, %	22.8%	24.7%	25.8%	25.8%	25.4%	25.8%	26.4%	25.9%	25.5%	26.2%
Renal Failure, %	3.9%	4.4%	4.4%	5.0%	5.1%	5.1%	6.2%	6.6%	7.2%	7.6%
Hemiparesis-Hemiplegia, %	9.5%	9.2%	9.2%	9.0%	8.9%	8.0%	7.0%	7.3%	7.0%	6.2%
Arthritis, %	14.0%	14.6%	15.0%	15.3%	16.1%	15.4%	12.0%	14.2%	13.4%	14.0%
Cancer, %	6.1%	6.4%	6.0%	6.7%	6.2%	5.6%	4.0%	4.6%	4.9%	5.0%