Severe Vision Impairment and Blindness in Hospitalized Patients: A Nationwide Study

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Research article

Keywords: impairment, blindness, SVI/B, Nationwide Inpatient Sample,

Posted Date: December 4th, 2020

DOI: https://doi.org/10.21203/rs.3.rs-66211/v2

Abstract

Background: Outcomes among hospitalized patients with severe vision impairment or blindness have not been extensively explored. This study sought to determine clinical and resource utilization outcomes in patients with severe vision impairment/blindness (SVI/B). Because the obesity epidemic is also on the rise and underrecognized in hospital settings, we also sought to understand its impact among patients with SVI/B.

Methods: We conducted a retrospective study using the National Inpatient Sample for the year 2017; hospitalized adults with and without SVI/B were compared. In addition, for all patients with SVI/B, we compared those with and without obesity. Multiple logistic regression and linear analysis were used to evaluate mortality, disposition, length of stay, and hospital charges. We adjusted for age, sex, race, comorbidities, insurance, and income.

Results: 30,420,907 adults were hospitalized, of whom 37,200 had SVI/B. Patients with SVI/B were older (mean age ± SEM: 66.4±0.24 vs. 57.9±0.09 years, p <0.01), less likely to be female (50% vs 57.7%, p <0.01), more frequently insured by Medicare (75.7% vs 49.2%, p <0.01), and had more comorbidities (Charlson comorbidity score ≥ 3: 53.2% vs 27.8%, p <0.01). Patients with SVI/B had a higher in-hospital mortality rate (3.9% vs 2.2%; p<0.01), and they were less likely discharged home (adjusted Odds Ratio {aOR} =0.54, [Confidence Interval (CI) 0.51-0.58]; p <0.01) compared to those without visual impairment. Hospital charges were not significantly different (adjusted Mean Difference {aMD} = $247 CI [-$2,474-2,929]; p=0.85) but length of stay was longer (aMD= 0.5 days CI [0.3-0.7]; p<0.01) for those with SVI/B. Visually impaired patients who were also obese had higher total hospital charges compared to those without obesity (mean difference: $9,821 [CI $1,375-$18,268]; p =0.02).

Conclusion: Patients admitted to American hospitals in 2017 who had severe vision impairment or blindness had worse clinical outcomes and greater resources utilization. Hospital-based healthcare professionals should recognize that because those with visual impairment are at risk for worse outcomes, extra attention to detail may be warranted to minimize the propagation of such disparity.

Background

It is estimated that between 3.4 - 21 million adults in the United States are visually impaired or blind, and up to 80 million have eye diseases that may ultimately lead to blindness (1). Furthermore, the annual economic impact of blindness is estimated to be over 35 billion dollars (2). As the population ages, the number of Americans with blindness is expected to double by the year 2030 (1). As such, an increasing number of patients with blindness will be hospitalized; hospital providers of all disciplines will invariably become progressively more involved in their care. Unfortunately, few studies have sought to screen for and consider poor vision during hospitalizations when visual disturbances are not related to the chief reason for admission (3). While it has been established that vision impairment is associated with inpatient complications outcomes, such as falls and delirium (4,5), no US based national study has investigated in-hospital mortality in patients with severe vision impairment or blindness (SVI/B). Morse determined that older Medicare recipients with severe vision loss utilized more healthcare resources compared to those without this disability (6). However, the impact on a broader age range of patients with SVI/B has not been studied on a national level. We used the National Inpatient Sample (NIS) database for the year 2017, and hypothesized that hospitalized patients with SVI/B would have higher in-hospital mortality, less likely to be discharged home following hospitalization, have longer hospital stays, and greater hospital charges compared to those who were non-visually impaired. Given the worsening obesity epidemic in United States and the uncertain effect it was having on patients admitted who had SVI/B, a subgroup analysis was also carried out to investigate the additive impact of obesity on these same outcome variables.

Methods

Setting / Database

This study used the 2017 NIS database, available through the Agency for Healthcare Research and Quality provided by the Healthcare Cost and Utilization Project (7). NIS is the largest United States based publicly available all-payer inpatient health care database (7). It approximates a 20% stratified sample of US hospital discharges from 46 participating states. The NIS has data for more than 7 million unweighted hospital stays per year. When weighted to represent all admissions, it estimates more than 35 million hospitalizations annually, and represents about 95% of US hospitalizations. Strata include hospital size/volume, teaching status, geographic region, and hospital ownership. Data from 2017 NIS uses the International Classification of Diseases, 10th Revision, Clinical Modification (ICD-10-CM) coding system for all discharge diagnoses.

Study Population, Patient and Hospital Characteristics, and Outcomes

All patients ≥18 years of age were included in the sample. We then identified selected patients with bilateral severe visual impairment or bilateral blindness as described by their ICD-10 CM codes (eye category 2 through 5 for either eye): https://www.icd10monitor.com/looking-at-new-icd-10-cm-codes-for-blindness (updated September 27th 2017). In addition, ICD-10 code H54.0 was also used for bilateral blindness. Supplementary Table A with ICD-10 codes provides specific descriptions of categories for each level of SVI/B. Severe blindness has been defined as individuals with visual acuity worse than 6/60, and blindness as those with visual acuity worse than 3/60 (8).

ICD-10 codes used for our subgroup analysis to study the impact of obesity as a secondary diagnosis on patients with SVL/B was also retrieved (See Supplementary A table for ICD-10 codes and corresponding diagnoses). For adults, obesity is defined as having a Body Mass Index (BMI) of 30 or greater (9). BMI is calculated by taking the individual's weight in kilograms and dividing it by their height in meters squared.

Data was collected and adjusted for select patient and hospital characteristics including age, gender (male and female only), race (White, Black, Hispanic, Asian or Pacific Islander), insurance (Medicare, Medicaid, Private Insurance, Uninsured), median household income (1. $1-$38,999 2. $39,000-$47,999 3. $48,000-$62,999 4. $63,000 or more), based on home zip code, and the Charlson comorbidity index (CCI: score 0 = no comorbidities score 1= low comorbidity burden, score 2 = moderate comorbidity burden, and score 3 or greater = high comorbidity burden). The CCI has been used extensively in clinical research; it is commonly used to assess mortality risk and it is supported by extensive validity evidence (10). Higher scores have been associated with mortality or greater healthcare resource use (11).

The primary outcome was mortality during hospitalization; secondary outcomes were total hospital charges, length of stay (LOS), and disposition after hospitalization. Disposition indicates the discharge location or where patients go after hospitalization. This is most often home, but not infrequently can be elsewhere including venues such as other hospitals, inpatient hospice, inpatient rehabilitation facilities, and nursing homes (https://www.hcup-us.ahrq.gov/db/vars/sedddistnote.jsp?var=dispuniform).

Our Institutional Review Board designated this work as being exempt from detailed review (IRB review number: 00257552).

Statistical analyses

Comparisons were examined between patients with SVI/B and the general population without visual impairments using Pearson's χ^2 tests and one-way analysis of variance to test categorical and continuous variables. Analyses were also carried out within the SVI/B patient cohort assessing those with and without obesity. The primary and secondary outcomes were adjusted for all of the patient demographics and hospital characteristics shown in Table 1, as well as the CCI and select specific comorbidities described in Table 2.

Adjusted odds ratios [aOR] and adjusted mean differences [aMD] from multivariate logistic and linear regression analyses were obtained. Binary outcomes under logistic regression analyses (in-hospital mortality and discharge disposition) were studied. Linear regression was used to study continuous outcome variables (including total hospital charges and LOS). Stata 15.0 statistical software (Stata Corp, College Station, TX) was used and permitted us to account for design complexity (stratification, weighting, and clustering) (7). The p-values for this study were 2 sided and type I error significance level was set at 0.05.

Results

In 2017, 35,769,613 adults ≥18 years of age were hospitalized in the United States. From this group, 37,200 patients were severely visually impaired or blind (see Figure). Demographic data is shown in Table 1. SVI/B patients were older (mean age ± SEM: 66.4±0.24 vs. 57.9±0.09 years, p <0.01), less likely to be female (50% vs 57.7%, p <0.01), and a higher proportion were insured by Medicare (75.7% vs 49.2%, p <0.01). Table 2 displays that patients with SVI/B had a greater comorbidity burden (Charlson comorbidity score ≥ 3: 53.2% vs 27.8%, p <0.01), as well as higher rates of vascular and pulmonary comorbidities.

Patient Clinical and Resource Utilization Outcomes

Table 3 shows that patients with SVI/B had higher rates of mortality compared to the general population of hospitalized adults (3.9% vs 2.2%; p<0.01). This finding held after adjusting for potential confounders where in-hospital mortality for patients with SVI/B remained higher compared to those without vision impairment (adjusted Odds Ratio (aOR) = 1.2, [Confidence Interval (CI) 1.0-1.4]; p =0.01). Patients with SVI/B were also less likely discharged home (adjusted Odds Ratio {aOR} =0.54, [Confidence Interval (CI) 0.51-0.58]; p <0.01). Total hospital charges were not significantly different (adjusted Mean Difference {aMD} = $247 CI [-$2,474-2,929]; p=0.85) between groups, but LOS was longer (aMD= 0.5 days CI [0.3-0.7]; p<0.01) for those with SVI/B.

Subgroup analysis focused on obesity

Among patients with SVI/B, 32,201 (86.5%) were not obese and 4,999 (13.5%) were classified as obese. Patients with obesity were younger (mean age ± SEM: 61.5±0.53 vs. 67.2±0.27 years, p <0.01) and a higher proportion were female (58.8% vs 48.6%, p<0.01). Patients with obesity had higher comorbidities (Charlson comorbidity scores ≥ 3: 65.0% vs 51.8%, p <0.01). Table 4 shows that obese status was not associated with an altered LOS, odds of mortality, or likelihood of being discharged to home. However, SVI/B patients with obesity had higher total hospital charges compared to those without obesity (mean difference: $9,821 [CI $1,375-$18,268]; p =0.02).

Discussion

Millions of Americans have severe visual impairment or are blind. As rates continue to climb with the aging of the population, inpatient providers will encounter more patients with this disability and they will be expected to effectively manage this vulnerable population. This study shows that compared to those who are not visually impaired, patients with SVI/B who are hospitalized have higher mortality rates, longer LOS, and are less likely to be discharged to home following the admission. Moreover, among patients with SVI/B, those who were obese had higher total hospital charges than their non-obese counterparts, and as the obesity epidemic continues to soar, more patients with SVI/B who are obese can be expected to be hospitalized

A 2013 study from Western Australia discovered that legally blind hospitalized adults had a seven times higher mortality rate compared to patients with normal vision (12). This was carried out using a regional registry; the analysis reviewed over 12,000 hospitalizations of blind adults between study years 1999 and 2010. In a longitudinal study from 2002-2013 using the Korean National Health Insurance database, Choi also found that those with blindness (>1200 individuals) also had a higher mortality than patients with normal sight (13). This association held in distinct analyses assessing both older (> 60 years of age) and younger (< 60 years) patients (13). In 2013, the World Health Organization (WHO) launched a global action plan for universal eye health with specific guidance for caring for those with SVI/B (14). These efforts were intended to heighten awareness and escalate the reporting of vision loss in hopes of modifying clinical practice. The current study provides more recent results compared to those from Australia and Korea, while substantiating their findings within a larger cohort. Further, the associations noted among patients hospitalized in the US illustrate that the WHO's concerns about worse healthcare outcomes among those who are blind are still justified. Though the specific cause of the higher mortality among SVI/B patients cannot be determined in this observational study, plausible possibilities include a higher unmeasured comorbidity burden and presenting to hospital later in the course of illness with more advanced disease.

To explore in-hospital resource utilization, Morse studied two claims databases - Medicare database and Clinformatics DataMart; their objective was to compare the care of older hospitalized patients with and without vision loss (6). The study found that patients with severe vision loss had longer LOS, more readmissions, and higher hospital costs compared to patients without vision loss. Though our study also found that patients with SVI/B had longer LOS, there were not significantly higher hospital charges compared to those without this disability. The differences in the results might be explained by the fact that our patient population was broader, including younger hospitalized adults. Also, if the longer LOS was attributable to time spent on education and coordination of care, the lack of variance in charges accrued over the protracted time span may be linked to Taheri's observations that LOS attributable to the last portion of the hospitalization does not significantly contribute to hospital costs (15). For these very reasons, LOS is not always correlated with hospital costs (16). Given that a significantly higher number of SVI/B patients were discharge to facilities rather than to their homes, it may be reasonable to presume that they did not amass high charges while awaiting placement. Though we cannot be certain why SVI/B patients were less likely to be discharged home, it is not unreasonable to speculate that difficulty complying with post-discharge plans and therapies, either real or imagined by the inpatient care team, may have contributed to the decision. Continuation of some therapies after discharge (particularly those involving injections or infusions) may be especially difficult among those with SVI/B; places with some supervision (e.g. rehabilitation, nursing home…) may have been deemed to be safer and associated with a lower risk of readmission than going home – especially for those living alone or without reliable caregivers (17). While homecare services can be excellent, patients with visual impairments or other disabilities may need more support after discharge necessitating some time in subacute facilities before transitioning back to their homes.

The cohort of hospitalized SVI/B patients who were obese had significantly higher average charges; this result is similar to other studies that have examined the impact of obesity among those who are hospitalized (18). The prevalence of obesity may be higher among visually impaired people compared to the general population and other disabled populations (19, 20). The reasons for this may be related to both challenges with exercising or burning calories, and barriers with securing or preparing a healthful diet. These details may result in hospital-based providers caring for increasing proportions of SVI/B patients who are also obese. Nutritional counseling of these patients while they are in the hospital may be a reasonable intervention.

Several limitations of this study should be considered. First, the NIS is an administrative database wherein data is highly dependent on coding imputations. It is possible that under-coding for SVI/B and obesity may have occurred. Second, the NIS lacks detailed lab data or imaging results, and medications cannot be examined. Thus, an in-depth investigation into the details of our findings was not feasible. Third, special circumstances that might have influenced diagnostic or treatment decisions, such as social factors and patients' preferences, cannot be determined from administrative databases. Lastly, in observational studies there may be unmeasured and unknown confounders that influence outcomes. Observed associations suggest relationships between variables but do not prove causality.

Conclusions

Patients with severe visual impairment or blindness have worse clinical outcomes and higher resources utilization when hospitalized compared to those without this disability. Hospital-based healthcare providers should recognize this vulnerability and consider how to optimally care for and serve this group of patients.

Abbreviations

SVI/B: Severe Vision Impairment/Blindness

NIS: National Inpatient Sample

SEM: Standard Estimated Mean

aOR: adjusted Odds Ratio

aMD: adjusted Mean Difference

CI: Confidence Interval

ICD-10-CM: International Classification of Diseases, 10th Revision, Clinical Modification

US: United States

TX: Texas

LOS: Length of Stay

WHO: World Health Organization

Declarations

Ethics declarations

The study was not submitted for research ethics approval as the activities described were conducted as part of the National Inpatient Sample (NIS), which is part of the family of databases and software tools developed for the Healthcare Cost and Utilization Project (HCUP) and uses de-identified data collected from hospitalized patients. The study activities obtained from NIS are exempt from the Johns Hopkins' Institutional Review Board and do not require informed consent. For additional details, please refer to the following website links: https://www.hopkinsmedicine.org/institutional_review_board/guidelines_policies/guidelines/exempt_research.html;https://www.ecfr.gov/cgi-bin/retrieveECFR?gp=&SID=83cd09e1c0f5c6937cd9d7513160fc3f&pitd=20180719&n=pt45.1.46&r=PART&ty=HTML#se45.1.46_1104.

Consent for Publication

Not applicable. All data using the National Inpatient Sample is de-identified.

Availability of data and materials

Researchers should readily be able to purchase the same databases we did to conduct research here: https://www.distributor.hcup-us.ahrq.gov/Databases.aspx. The authors did not have special access privileges to the NIS databases. Contact information for further guidance on purchase and download at vog.qrha@rotubirtsiDPUCH.

Competing Interests

The authors declare that they have no competing interests (financial and non-financial).

Funding

Dr. Wright receives support as the Anne Gaines and G. Thomas Miller Professor of Medicine through the Johns Hopkins Center for Innovative Medicine.

Acknowledgements

Not applicable

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Tables

Table 1. Patient and Hospital Demographics: Patients with and without blindness from the National Inpatient Sample Database (2017)*

	Patients without Blindness	Patients with Blindness	p-value
Total	30,363,917 (99.8)	37,200 (0.2)	
Age in years, mean SE	57.9 0.09	66.4 0.24	<0.01
Female, n (%)	17,519,980 (57.7)	18,600 (50.0)	<0.01
Race, n (%)			<0.01
White	20,404,552 (67.2)	20,832 (56.0)	
Black	4,615,315 (15.2)	9,114 (24.5)	
Hispanic	3,340,030 (11.0)	5,022 (13.5)	
Asian or Pacific Islander	819,825 (2.7)	818 (2.2)	
Insurance, n (%)			<0.01
Medicare	14,939,047 (49.2)	28,160 (75.7)	
Medicaid	5,799,508 (19.1)	5,056 (14.8)	
Private	8,350,077 (27.5)	3,013(8.1)	
Uninsured	1,214,556 (4.0)	483 (1.3)	
Median income (USD), n (%)			<0.01
$1-$38,999	9,230,630 (30.4)	14,024 (37.7)	
$39,000-$47,999	8,046,438 (26.5)	9,672 (26.0)	
$48,000-$62,999	7,105,156 (23.4)	7,551 (20.3)	
$63,000 or more	5,920,963 (19.5)	5,877 (15.8)	
Hospital Bed size, n (%)			0.14
Small	6,103,147 (20.1)	7,068 (19.0)	
Medium	8,957,355 (29.5)	10,899 (29.3)	
Large	15,273,050 (50.3)	19,158 (51.5)	
Hospital Region, n (%)			<0.01
Northeast	5,678,052 (18.7)	5,840 (15.7)	
Midwest	6,801,517 (22.4)	7,886 (21.2)	
South	11,933,019 (39.3)	15,438 (41.5)	
West	5,890,599 (19.4)	7,960 (21.4)	
Teaching hospital, n (%)			0.17
Non-teaching, n (%)	3,643,670 (12.0)	4,203 (11.3)	
Teaching, n (%)	26720,247 (88.0)	32,996 (88.7)	

*Analyses used Pearson's χ^2 test and one-way analysis of variance for categorical and continuous variables respectively.

TABLE 2: Associated Co-morbidities of Patients with and without Blindness

Co-morbidities	Patients without Blindness N (%)	Patients with Blindness N (%)	p-value
Total	30,363,917 (99.8)	37,200 (0.2)	
Charlson comorbidity score			<0.01
0	11,902,655 (39.2)	5,691 (15.3)	
1	5,860,235 (19.3)	5,914 (15.9)	
2	4,099,128 (13.5)	5,580 (15.0)	
3 or more	8,441,168 (27.8)	19,790 (53.2)	
Opioid use	637,642 (2.1)	446 (1.2)	<0.01
Tobacco use	5,222,593 (17.2)	3,720 (10.2)	<0.01
Alcohol use	1,366,376 (4.5)	706 (1.9)	<0.01
Depression	242,911 (0.8)	334 (0.9)	0.68
Chronic lung disease	4,736,771 (15.6)	5,914 (15.9)	<0.01
Hypertension	15,880,328 (52.3)	26,226 (70.5)	<0.01
Diabetes with complications	4,433,131 (14.6)	14,619 (39.3)	<0.01
Peripheral vascular disease	1,457,468 (4.8)	3,980 (10.7)	<0.01

able 3. Odd ratios and differences for in-hospital outcomes in patients with and without blindness ages 18 years and older from the National Inpatient Sample (2017)

Outcome	Patients without Blindness N=30,363,917	Patients with Blindness N= 37,200	Univariate Odds Ratio	(95% CI)	P-value	Multivariate Odds Ratio	(95% CI)	P-value
-hospital mortality, n (%)	668,008 (2.2)	1,450 (3.9)	1.8	(1.6-2.0)	<0.01	1.2	(1.0-1.4)	0.01
ischarged to home, n (%)	19,250,723 (63.4)	14,656 (39.4)	0.37	(0.35-0.39)	<0.01	0.54	(0.51-0.58)	<0.01
			Univariate Mean Difference			Multivariate Mean Difference		
lean length of stay, days	4.72	6.05	1.33	(1.18-1.48)	<0.01	0.5	(0.3- 0.7)	<0.01
lean charge per case, US dollars	53,388	59,900	$6,512	(4,211-8,811)	<0.01	$247	(-2474 - 2929)	0.85

*Variables adjusted for confounders in multivariate analysis include age, gender, race, median household income, insurance and comorbidities measured using the Charlson comorbidity index), hospital bed size, teaching status, urban location, and region.

Figures

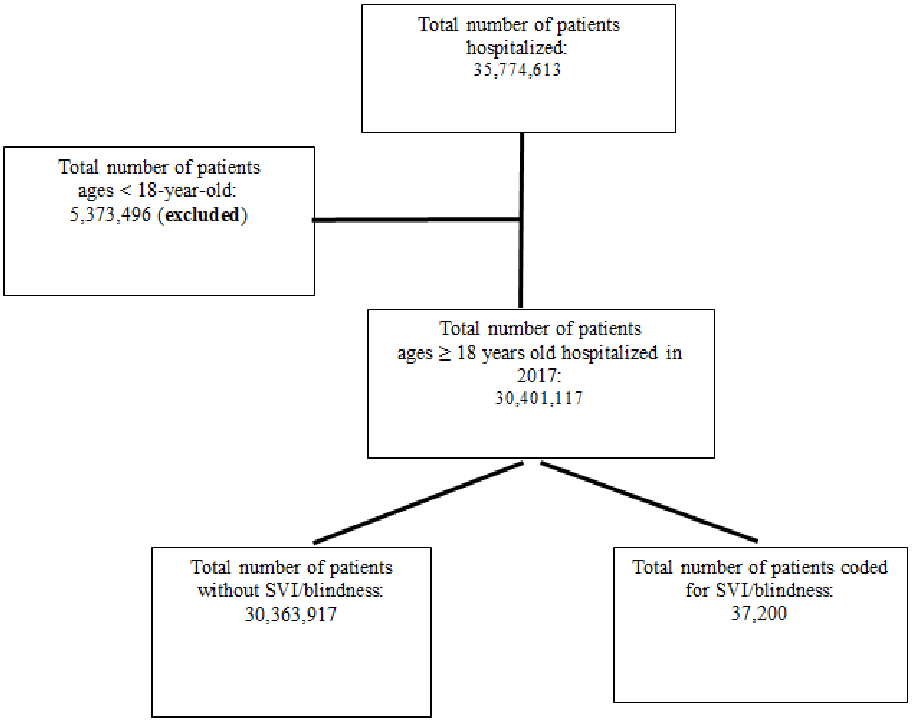

Figure 1

Patient identification flow diagram with data from 2017

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- SupplementaryTableA.docx