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Socioeconomic class and universal healthcare: Analysis of stroke cost and outcomes in US military healthcare

Matthew Blattner[a,1], James Price[a,1], Matthew D. Holtkamp[b,*,2]

[a] Walter Reed National Military Medical Center, Department of Neurology, United States
[b] Carl R. Darnall Army Medical Center, Department of Medicine, United States

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ABSTRACT

Objective: Do socioeconomic disparities exist in the US military healthcare system with ischemic stroke admissions?

Methods: Civilian healthcare in the United States is paid for by a variety of payers. Significant disparities exist in this system based upon socioeconomic status (SES). In contrast, the military healthcare system (MHS) is a universal healthcare system. Military rank is a SES surrogate. Data was collected from the MHS database for years 2010 through 2015. All admissions to military health care facilities with a primary diagnosis of ischemic stroke were reviewed. Military rank was compared for primary outcomes of: Disposition (In-hospital mortality and discharge destination setting) and IV tPA administration and for secondary outcomes of: Total cost of hospitalization and Length of hospital stay (LoS). All adjusted for relevant demographics and co-morbidities.

Results: Military rank was identified with 1895 (52.3%) of the 3623 admissions. The ranks identified were: Junior Enlisted 100 (2.7%), Senior Enlisted/Warrant Officers 1390 (38.4%), Junior Officers 59 (1.6%) and Senior Officers 346 (9.6%). Statistically significant results included: Lower SES group/ranks were more likely to have poor discharge destination setting while the highest SES group/ranks and had lower rates of in-hospital mortality, shorter lengths of stay and higher hospitalization costs after controlling for relevant variables.

Conclusion: Higher military ranks (Higher SES) had shorter hospitalization stays, higher costs and less in-hospital mortality in the military's universal healthcare system. This suggests aggregate characteristics of SES plays a large role in the outcomes among SES groups.

1. Introduction

A leading cause of morbidity and mortality worldwide is Stroke [1,2]. Studies have shown that the quality of care during the initial phases of a stroke affects resultant disability and mortality [3]. The quality of ischemic stroke care varies widely around the world and within the US [4]. Lower socioeconomic status (SES) is correlated with increased mortality [5–7] and less successful recoveries [8]. Some studies show that a lower SES decreases a patient's chances of even being admitted to a hospital [9–11], however not all studies have found this pattern [12,13]. These inconsistences may result from how SES is measured, which variables are controlled and how outcomes are measured.

There have been no studies using Military Health System (MHS) data to look for possible disparities based upon SES with ischemic stroke admissions. Previous studies have validated imputing individual's SES in epidemiologic settings [14–18]. Military rank has been correlated to SES; enlisted personnel having lower SES and officers having higher SES. This holds true pre and post military service [19]. This correlation would include the aggregate characteristics of an SES group, including healthy and unhealthy behaviors and habits.

In this study we look for disparities, similar to those seen in the civilian US healthcare system, among military ranks (SES surrogate) in ischemic stroke admissions within a universal healthcare system (MHS). Primary outcomes of: 1) Disposition (In-hospital mortality and discharge destination setting and 2) IV tPA administration and secondary outcomes of: 1) Total cost of hospitalization and 2) Length of stay. These were reported after adjustment for relevant demographics and co-morbidities.

* Corresponding author at: Carl R. Darnall Army Medical Center, Intrepid Spirit, Traumatic Brain Injury Clinic, 58th Street, Bldg. 36029, Fort Hood, TX 76544, United States.
E-mail addresses: matthew.r.blattner.mil@mail.mil (M. Blattner), james.c.price137.mil@mail.mil (J. Price), Matthew.d.holtkamp.mil@mail.mil (M.D. Holtkamp).

[1] These authors contributed equally to the manuscript.

[2] Statistical Analysis conducted by Dr. Matthew Holtkamp DO, Carl R. Darnall Army Medical Center, Fort Hood, TX.

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2. Methods

Data was obtained from the MHS M2 database from years 2010–2015. The M2 database tracks all admissions to Military Treatment Facilities (MTFs). The MHS has 9.4 million beneficiaries, > 350 health-care clinics and 55 military hospitals around the world. In a single year the MHS has an average of 1 million-hospital admissions [20].

2.1. Study participants

The MHS M2 database has the capacity to document up to 20 diagnoses and procedures for each hospital admission. The primary diagnosis is the first listed diagnosis for the admission. All admissions with a primary diagnosis of ischemic stroke were included in the study. The following ICD-9 codes were used to identify non-embolic ischemic strokes: 433.01, 433.11, 433.21, 433.31, 433.81, 433.91, 434, 434.01, 434.1, 434.10, 434.9, 434.90, 434.91 and 436. The ICD-9 code 434.11 was used to identify embolic ischemic strokes. Stroke co-morbidities were identified using the ICD-9 codes for hypertension (401–405), diabetes mellitus (249–250.XX) and atrial fibrillation (427.31, 427.32). Other comorbidities may also be important: heart failure and coronary disease; however coding for these were sparse and were omitted from the study. Demographic information of military rank, race, marital status, sex, and age were identified along with hospital size (small, medium or large). Information on the primary admitting service, time of admission, the use of IV tPA (ICD-9 procedure code 99.10) and disposition were gathered on all admissions.

The primary variable of interest was the military rank associated with admission, as a surrogate for SES. Military rank may be that of the military member (active or retired) or a dependent i.e. spouse. Race was controlled in the study, as it could be a confounding variable. Rank was divided into four categories: 1. Junior Enlisted, 2. Senior Enlisted/Warrant Officer, 3. Junior Officer and 4. Senior Officer. Race was divided into White, African American, Asian and Other. Ethnicity was not addressed.

2.2. Study outcomes

Disposition (In-hospital mortality and discharge destination setting) and IV tPA administration were the two primary outcomes. Discharge destination setting was defined as a good discharge destination setting being home or a poor discharge destination setting being other than home (these discharges were assumed to be a measure of resultant disability). The secondary outcome measures were hospitalization cost and length of stay (LoS).

2.3. Statistical analysis

Ischemic stroke disposition and use of IV tPA were compared among rank groups using multivariable analysis. Covariates from 3 key factors were selected for analysis: 1. Demographic factors including; age, race, sex, and marital status and 2. Predisposition factors including co-morbidities and 3. In hospital care including; size of hospital, admitting service and time of admission. Three major comorbidities were identified; hypertension, diabetes mellitus, and atrial fibrillation.

Multivariable logistical regression was used to analyze primary outcomes of disposition and IV tPA administration. Statistical significance was defined as a 95% confidence interval (CI) that did not contain 1. Odds ratios, incidences and p values were also reported. Poor discharge destination setting, in-hospital mortality and IV-tPA use were analyzed against the reference group (the entire study population). This provided relative change from baseline after relevant demographics and co-morbidities were controlled. A binary system was assigned to all categorical variables; relevant comorbidities (reference no disease), admitting service (reference non-neurology service), rank (reference not of that rank), sex (reference male), and admission time (reference admission between 5 AM and 8 PM). Continuous variables included age, cost, and LoS.

Multivariable linear regression was used to analyze secondary outcomes of LoS and cost of hospitalization; line of best fit was calculated by coefficient of determination. Statistical significance was defined as a p value < 0.05, coefficients and confidence intervals were also reported. Analysis is reported after controlling for the same variables as with the logistical regression.

All statistical analyses were performed using the statistical software StatPlus v 6 (AnalystSoft). The study was exempt from federal regulations for the protection of human research participants as all data from the M2 database were de-identified. Institutional review board approval was not necessary. This research was conducted according to the principles of the Declaration of Helsinki and a data use agreement with the MHS.

3. Results

During the 6-year period (2010–2015), a total of 3623 admissions with a primary diagnosis of ischemic stroke were identified. The baseline characteristics of the entire study population, stratified by military rank are provided in Table 1. The military rank was available in 1895 (52.3%) of the 3623 admissions. The composition of rank-identified populations was: Junior Enlisted = 100 (2.7%), Senior Enlisted/Warrant Officers = 1390 (38.4%), Junior Officers = 59 (1.6%) and Senior Officers = 346 (9.6%). Females made up 39% (1411/3623100) of study group population, however only 6.4% (121/1895) of rank identified admissions. A majority of admissions with a known rank were White (983/1895, 52%). African Americans constituted 19% (363/1895) and Asian made up 5% (94/1895) of the rank identified sample. Whites made up 73% (252/346) of Senior Officers while African Americans and Asians made up 4.6% (16/346) and 1% (3/346) respectively of this population.

The difference among rank and common comorbidities is shown in Table 1. There is a slight increase in the number of Senior Enlisted/Warrant Officers vs. other rank groups with hypertension and diabetes. There was also a higher number of Senior Officers with atrial fibrillation. A majority (51%) of Senior Officers were elderly (age > 74). This figure (proportion of elderly) was much lower in all other groups, 6% in Junior Enlisted, 29.6% of Senior Enlisted/Warrant Officers and 27.1% of Junior Officers.

The overall administration of IV tPA was similar among all rank groups. It was only administered in a total of 64 times (1.8%) of the 3623 admissions. There was a slight increase in use with Commissioned Officers (Junior and Senior Officers) vs Enlisted/Warrant Officers. A poor discharge destination setting occurred with 16.9% of all ischemic stroke admissions. In-hospital mortality resulted with 2.7% of all ischemic stroke admissions. A poor discharge destination setting was more prevalent for Enlisted/Warrant Officers than with Commissioned Officers. In-hospital mortality was more common in the Senior ranks vs the Junior ranks. This finding vanished after other demographic information and risk factors were considered.

Controlling for demographic variables and risk factors; incidences, odds ratios, confidence intervals and p values for the study's primary outcome measures are depicted in Table 2. There was no statistically significant correlation between military rank and IV tPA administration. Poor discharge destination settings were statistically more likely in Senior Enlisted/Warrant Officers; OR of 1.38 (95% CI of 1.04 to 1.83). Statistically significant in-hospital mortality was less likely with Senior Officers; OR of 0.34 (95% CI of 0.13 to 0.89).

The average LoS (SD) was 4.45 (8.26) days. By the ranks: Junior Enlisted 5.84 (7.55); Senior Enlisted/Warrant Officers 3.62 (3.88); Junior Officers 4.6 (5.38); and Senior Officers 3.7 (3.85). After adjustments for baseline demographic and clinical characteristics Senior Enlisted/Warrant Officers had a statistically significant decrease in LoS;