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Insurance Type is a Determinant of Two-Year Mortality After Non-neurologic Trauma

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Abstract

Background—Lack of health insurance (NO-INS) is associated with increased long-term mortality after head and spinal cord injuries (NEURO-TRA). Less is known about the influence of insurance type and long-term mortality following non-NEURO-TRA. We hypothesized that NO-INS would be associated with 2-year mortality after moderate to severe injury.

Methods—Adults (≥ 18) treated at a Level-I trauma center following a moderate to severe blunt injury (ISS > 15) and without NEURO-TRA from 2000 – 2005 and discharged alive were eligible for the study. Two-year mortality was determined utilizing the Social Security Death Index. Logistic regression analysis was used to determine if type of insurance [NO-INS, Private (PRIV-INS), Medicare/Medicaid; GOV-INS), or Other (OTH-INS)] was related to 2-year mortality.

Results—1958 patients met study inclusion/exclusion criteria. Two-year risk of death was 2.96%. On univariate analysis, admission age, lactate and insurance type were associated with 2-year mortality ($p < .25$). However, race was not. After adjusting for admission age and lactate, compared to PRIV-INS, having either NO-INS or GOV-INS was significantly associated with increased 2-year mortality. The analysis was repeated without patients eligible for Medicare (Age ≥ 65) and GOV-INS was still associated with increased 2-year mortality (OR 4.47 $p < 0.05$).

Conclusion—Following moderate to severe blunt, non-NEURO-TRA, having GOVT-INS or NO-INS was associated with increased 2-year mortality. The mechanism by which this association may be explained is unclear. Future research focused on elucidating mechanisms behind poor long-term outcomes should include an examination of socioeconomic status as a potential contributor to reduced long-term mortality after injury.

INTRODUCTION

Care of injured persons at Level I Trauma Centers is superior in terms of in-hospital survival compared to care received at non-trauma centers (1). But, lack of health insurance has been associated with worse in-hospital outcomes after injury compared to those with health insurance even at designated trauma centers (2,3). There has been little focus on determinates of long-term mortality except in select patient populations, namely persons with spinal cord injury and traumatic brain injuries.

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For persons with neurologic injury lack of health insurance, race and socioeconomic status have all been associated with poor outcomes, both in-hospital and after discharge (4–7). This is not surprising given that patients with neurologic injury often require intense rehabilitation and chronic care to maintain the highest levels of quality of life. However, little is known about the influence health insurance has on survival after non-neurologic moderate and severe blunt injury. The purpose of this study is to determine the two-year survival after moderate to severe non-neurologic injury. We hypothesized that lack of health insurance, compared to having health insurance, would be associated with increased two-year mortality following moderate to severe blunt non-neurologic injury.

MATERIALS AND METHODS

Study Setting

The Presley Memorial Trauma Center (PMTC) is the single designated adult Level I trauma center in Shelby County Tennessee and serves an area with a population of approximately 2.5 million people. As a result of this designation, the PMTC receives essentially all significantly injured patients who are residents of Shelby County. Additionally, most other significantly injured persons who require hospitalization are transferred from other hospitals in and around Shelby County to the PMTC for definitive care. Demographic, injury information patient care information and insurance status were collected by trained trauma registrars and entered into NTRACS (ACS, Chicago, IL).

Study Population

After approval from the University of Tennessee Health Science Center Institutional Review Board the trauma registry at the PMTC was queried for patients admitted from 2000 – 2005. To be eligible for inclusion in the retrospective cohort, patients had to be greater than or equal to 18 years old, had to have suffered a blunt injury, and had to have an Injury Severity Score (ISS) > 15. Patients were excluded who were burned, victims of drowning, bites/stings, overexertion, poisoning and suffocation. Also, persons who suffered a significant traumatic brain injury as defined by a Head and Neck Abbreviated Injury Score (AIS) > 2 or quadriplegia or paraplegia were excluded. Finally, persons who did not survive to discharge were excluded. The inclusion and exclusion criteria were designed to yield a cohort of moderate to severely injured blunt trauma patients without significant neurologic injury who survived to discharge.

Insurance Status Determination

Insurance status was determined at the time of discharge and recorded in the trauma registry at the PMTC. Persons with health insurance provided by a commercial carrier were considered to have private insurance (PRIV-INS). Persons with Medicaid, Medicare, or TennCare were considered to have government insurance (GOV-INS). TennCare is unique to Tennessee; it is a system of managed care organizations sponsored and supported by the State of Tennessee that was intended to take the place of Medicaid in Tennessee. Persons with workers compensation, automobile insurance, hurricane insurance and other non-governmental insurance were considered to have other insurance (OTH-INS). Persons who were designated as self-pay were considered to have no insurance (NO-INS).

Outcome Determination

To determine two-year mortality, we searched the Social Security Administration Death Master File (SSADMF) to determine the date of death of persons who met the criteria for inclusion in the cohort. A person is included in the SSADMF if his or her lump sum benefit was paid as a result of a request from, for example, a family member, an attorney, or a

mortuary. To be eligible for such benefits, a person must work for at least 10 years and have paid into the social security system. Additionally, some persons (e.g., federal employees hired before 1984, certain state and local employees, and railroad employees serving for more than 10 years) who contribute voluntarily to social security are also included in the SSADMF. Recent studies indicate that using the widely available SSADMF is equivalent to searching the National Death Index to determine if a person has died (8).

Statistical Analysis

For descriptive analysis, continuous variables are reported as medians with the interquartile range because of non-normal distribution of the variables. Comparisons between groups of continuous variables were carried out using Wilcoxon Rank Sum Test. Categorical variables are reported as a percentage of the group from which they were derived. Using χ^2 test or Fisher's exact test categorical data were compared.

Univariate followed by multivariate logistic regression was used to determine if insurance status was associated with two-year mortality. Factors that could potentially influence two-year mortality were first tested using univariate logistic regression. If a variable had $p < 0.25$ on univariate analysis it was included in the multivariate logistic regression model.

Variables included in the analysis were insurance status, age, gender, race, mechanism of injury, injury severity score, AIS for each body region, admission systolic blood pressure (SBP), admission heart rate (HR), and admission lactate level. After the initial analysis including all patients, it was noted that there was high correlation between age and GOV-INS (likely secondary to Medicare eligibility rules). Because of this, the logistic regression analysis was repeated including persons < 65 . All analyses were carried out using SAS 9.2 (Cary, NC).

RESULTS

Characteristics of the Study Population

From January 1st, 2000 to December 31st, 2005 there were 23,448 injured persons admitted to the PMTC. Of those, 16,945 had an ISS < 15 . Of the remaining 6503 patients, 2803 patients had no significant neurologic injury. Of those, 2171 suffered a blunt injury and 1958 of those survived to discharge. The characteristics of the overall study population are shown in Table 1. The median age of the study population was 38 (IQR 24) and the majority of the population was white (61.6%) males (65.4%). Motor vehicle crashes were the main mechanism of injury (72.5%). Injury Severity Scores indicate that the population was moderately to severely injured with a median ISS of 22 (IQR 9). Medians for admission SBP and heart rate were 130 (IQR 34) and 96 (IQR 27) respectively. Median admission lactate was 1.3 (IQR 3).

Demographics and Injury Mechanism and Severity by Insurance Type

When the characteristics of the study cohort were broken down by insurance type, several significant differences were found. Patients with GOV-INS had higher median age compared to the other groups. Also, there were significantly more males in the OTH-INS and NO-INS categories. Racial differences were also found. Over 70% of the patients with PRIV-INS were white whereas the other groups had significantly less white patients. Mechanism of injury also varied by insurance status. Persons with PRIV-INS and GOV-INS were more likely to have suffered a MVC compared to persons in with OTH-INS or NO-INS. Persons with OTH-INS were more likely to have suffered an assault, a fall or to have suffered some other blunt injury. Finally, persons with PRIVINS were more likely to suffer a MCC and less likely to suffer an assault than the other patient populations. Injury severity was similar, however, across the 4 insurance type categories (Table 1).

Two-Year Mortality Outcome

The overall two-year mortality for the study cohort was 2.96%. Persons who died within two-years of discharge were significantly older than those who lived to two-years after discharge (Table 2). Mechanism of injury and measures of injury severity were similar among those who lived to two-years and those who died. However, insurance type was significantly different between those who lived and those who died within two-years after discharge. Persons with GOV-INS and NO-INS had significantly higher mortality compared to the other two insurance groups (Table 2).

Logistic Regression Analysis

Univariate logistic regression analysis revealed that admission age, lactate and insurance type were associated with two-year mortality ($p < 0.25$). However, race, gender, ISS, AIS body region injured, and admission SBP and HR were not associated with two-year mortality. On multivariate analysis, insurance type was found to be significantly associated with two-year mortality after adjustment for age and admission lactate (Table 3).

Since we found that GOV-INS was positively correlated with age, we wanted to be sure that the association between insurance type and two-year mortality held when we excluded patients < 65 years old. We repeated the univariate and multivariate analysis after excluding 158 patients who were ≥ 65 . The results of this analysis are in Table 4 and they again reveal an association between insurance type and two-year mortality.

DISCUSSION

In this study of over 1900 patients discharged alive after treatment for non-neurologic moderate to severe blunt injury at a Level I Trauma Center we found the overall two-year mortality was 2.96%. Two-year mortality varied by insurance type. Those with PRIV-INS had the lowest two-year mortality (1.22%) and those with NO-INS (2.68%) and GOV-INS (6.61%) had the highest two-year mortality. After adjusting for age and admission lactate, compared to having PRIV-INS, having NO-INS or GOV-INS was associated with two-year mortality. This association held even when persons who were eligible for Medicare were excluded from the analysis.

While this is the first study to demonstrate an association between insurance type and long-term survival after non-neurologic injury, it is not the first study to examine the long-term outcome of injured patients. In Northern Ireland, Redmill et al, in a population based analysis, looked at 12-year outcome following all injury types. They found 15% all cause mortality among those with injuries at 12 years (9). In a 5 year follow-up study from the United Kingdom, Braithwaite and colleagues found that of 212 patients with an ISS > 15 that 5.66% had died at 5 years (10). In a large case-matched population based study from Canada, researchers found that persons with injury were more likely to die within 10 years than those who remain uninjured even while controlling for age, gender and co-morbidities. The Canadian researchers found that among those with moderate and severe injury that the 10-year all cause mortality was 12.9% and 23.1% respectively (11). The results from our study are consistent with these findings in terms of overall mortality.

The European and Canadian systems differ significantly from the United States healthcare system in that the United States system has no provision for a universal healthcare payor. In diseases other than injury, such as some forms of carcinoma including breast carcinoma, having no insurance is associated with decreased survival compared to those with insurance (12). Among the acutely injured, Haider et al found that minorities and those without insurance had higher in-hospital mortality compared to non-minorities and those with insurance (3). These results were similar to the findings of a population-based study in

Massachusetts that found a tendency towards fewer operative interventions and higher in-hospital mortality among the uninsured compared to those with insurance (2).

The mechanism by which insurance status influences long-term outcome among the moderate to severely injured is unknown. As mentioned above, there may be variations in the type of care patients receive while in hospital based on insurance status. These variations in care may have lingering effects that result in lower long-term mortality for the uninsured and those on government insurance. Also, lack of health insurance is associated with increased co-morbidities and lower access to ongoing medical care for chronic illnesses (13). This may lead to worse overall medical condition for those without insurance and, subsequently, worse long term survival after injury. Access to ongoing care may also be a factor in disparities in long-term survival after injury. Hadley found, in an analysis of the Medical Expenditure Panel Surveys (1997 – 2004), that uninsured individuals reported receiving less medical care than those with health insurance following unintentional injury (13).

While access to care in the pre-injury and post-injury timeframes may contribute to long-term outcome it does not explain the finding in this study that those with government insurance were also at risk for long-term mortality. This was true even when those who were eligible for Medicare were excluded. By exclusion of those eligible for Medicare in the GOV-INS group, we selected a population of persons who would have been eligible for TennCare, the Medicaid equivalent in the state of Tennessee. In general, the population of persons enrolled in TennCare during the study period was socioeconomically disadvantaged. In a survey of TennCare users of health care clinics, nearly 75% of TennCare enrollees live below the poverty level. Over 25% of TennCare enrollees do not have a high school education or its equivalent and only 36% are employed more than 30 hours per week (14). Similarly, persons without health insurance tend to be poorer, less educated, underemployed and have worse overall health compared to those with health insurance (15). Thus, the results of this study may reflect variations in socioeconomic status that are associated with health insurance status.

A growing body of literature supports the idea that lack of resources within a society may influence health outcomes. The theory is that those in lower socioeconomic levels have lesser access to power, money, knowledge and prestige and these disadvantages translate into worse health outcomes. This has been shown on a wide scale and is independent of pre-existing health status (16). The lack of resources may result in higher levels of stress among the disadvantaged and differential gene expression resulting in poorer health related outcomes (17).

Unfortunately, the results from this study are unable to show a direct link between insurance status, individual level socioeconomic data, and long-term outcome after non-neurologic moderate to severe injury. In this regard, the results from this study may lead to more questions than it answers. There are some other limitations to this study that should be mentioned. We did use the SSADMF to determine the main study outcome. While the SSADMF has been shown to be equivalent to searching the National Death Index, it is possible there is some misclassification for the outcome (8). Because inclusion in the SSDMF is based on several factors, one of which is the number of years a person pays into the system, persons less than 25 tend to be under represented in the SSDMF. However, over 40% of persons who die in the United States every year who are younger than age 25 are included in the SSDMF despite this limitation (18). Interestingly, the SSDMF includes a higher percentage of those under 25 than does the National Death Index (8,18) Further, by using the SSADMF we are unable to determine the exact cause of death for the persons in this study.

Because of the retrospective nature of the study, we were unable to adequately control for comorbidities among the patients in the study. Since patients who do not have health insurance tend to have poorer overall health, pre-existing comorbidities might confound the relationship between health insurance status and two-year mortality. Prospective studies with well-documented comorbidities would be beneficial in determining the relationship between insurance status and long-term survival after injury.

The results of this study are limited to persons with blunt injury. Persons with penetrating injuries were excluded from analysis in this study for several reasons. The demographics of those suffering penetrating injuries tend to be different than the demographics of persons suffering blunt injuries. Also, the types and severity of injuries that result from penetrating injuries vary significantly from those who suffer blunt injuries. For example, persons who are bluntly injured often have many more organ systems involved and tend to have higher amounts of soft-tissue injury compared to those injured by penetrating mechanisms. Also, the ISS tends to underestimate the seriousness of injury for patients with penetrating injuries and there was no comparable penetrating injury severity score available in the database used for this study.

Despite these limitations, the results of this study are important in that they add to the growing evidence that insurance status is associated with long-term outcome following injury. Further study should focus on the exact mechanism behind this association. Attention should be focused on how insurance status is related to individual socioeconomic level and how socioeconomic level influences health outcomes in the injured patient population. Understanding these relationships is important as we attempt to address health outcome disparities in the injured patient population.

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Table 1

Characteristics of patients discharged alive after moderate to severe non-neurologic blunt injury 2000 – 2005.

<i>Characteristics</i>	<i>Insurance Type</i>				<i>p-value</i>
	Overall (n=1958)	Private (n=737)	Government (n=454)	Other (n=129)	
Age	38.0 (24)	39 (23)	45 (38)	39 (21.7)	33.2 (17.7)
Gender (%)					<0.0001
Male	65.4	60.1	53.9	86.8	76
Race (%)					<0.0001
White	61.6	70.5	58.4	59.7	53.4
Mechanism of Injury (%)					<0.0001
Motor Vehicle Crash	72.5	77.1	75.6	50.4	69.5
Motor Cycle Crash	7.9	11.3	3.7	1.6	7.9
Pedestrian Struck	5.1	2.6	6.2	4.7	7.7
Assault	4.1	1.0	4.0	12.4	6.2
Fall	5.8	4.8	5.7	13.2	5.4
Other	4.6	3.4	4.9	17.8	3.4
Injury Severity Score	22 (9)	22 (8)	22 (9)	20 (8)	21 (9)
Admission SBP	130 (34)	130 (38)	130 (34)	131 (30)	130 (31)
Admission HR	96 (27)	96 (26)	96 (27)	99 (26)	96 (27)
Admission Lactate	1.3 (3)	1.5 (3.1)	1.3 (3.0)	0 (2.7)	1.4 (2.9)

Table 2

Characteristics and outcome of patients discharged alive after moderate to severe non-neurologic blunt injury 2000 – 2005.

<i>Characteristics</i>	<i>2-year outcome</i>		<i>p-value</i>
	Alive (n=1900)	Dead (n=58)	
Age	39 (23.5)	57.5 (26.2)	<0.0001
Gender (%)			0.9879
Male	65.4	65.5	
Race (%)			0.2444
White	61.4	69.0	
Insurance Type (%)			<0.0001
Private	39.2	15.5	
Government	22.8	51.7	
Other	6.7	5.2	
No Insurance	31.3	27.6	
Mechanism of Injury (%)			0.7604
Motor Vehicle Crash	72.4	74.1	
Motor Cycle Crash	8.0	5.2	
Pedestrian Struck	5.1	5.2	
Assault	4.1	5.2	
Fall	5.7	8.6	
Other	4.7	1.8	
Injury Severity Score	21.0 (9)	23.0 (9)	0.3615
Admission SBP	130 (34)	127 (38)	0.8148
Admission HR	96 (27)	84 (25.5)	0.9472
Admission Lactate	1.3 (3.0)	1.6 (3.5)	0.2232

Table 3

Odds ratio of two-year mortality by insurance status after adjustment for admission lactate and age.

Insurance Type	OR	95% CI	p-value
Private	REF		
Government	3.08	1.39, 6.84	0.0058
Other	2.29	0.60, 8.67	0.2247
No Insurance	3.16	1.36, 7.33	0.0076

Table 4

Odds ratio of two-year mortality by insurance status after adjustment for admission lactate and age for patients < 65.

Insurance Type	OR	95% CI	p-value
Private	REF		
Government	4.47	1.77, 11.31	0.0015
Other	2.68	0.67, 10.60	0.1619
No Insurance	3.29	1.31, 8.22	0.0110