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Self-inflicted Injuries and Adolescents: Are Specialized Resources Needed in Adult Trauma Centers?

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Bachelor of Science
Georgetown University
2014

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An abstract of
A thesis submitted to the Faculty of the
Rollins School of Public Health of Emory University
in partial fulfillment of the requirements for the degree of
Master of Public Health
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Abstract

Self-inflicted Injuries and Adolescents: Are Specialized Resources Needed in Adult Trauma Centers?

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Background: Suicide is the second leading cause of adolescent death suicide attempts outnumber deaths 50:1 for adolescents 15 to 19 years of age. This study examines differences in outcomes between adolescents and adults treated at an adult trauma center in an effort to guide recovery and prevention strategies following adolescent suicide attempt.

Methods: The data were obtained from a retrospective review of charts for patients aged ≥14 years treated at an urban, Level 1 trauma center for self-inflicted injuries between January 1, 2009 and October 31, 2018. The cohort was divided into two age groups: adolescents (14-19 years) and adults (≥20 years) and two economic distress groups: group A (distressed) and group B (non-distressed). Demographic characteristics, injury mechanism and clinical outcomes were compared between groups. Geospatial analysis was also performed.

Results: Among 723 patients, 60 (8%) were adolescents of which 92% were male, 55% black, and 45% white/other. In the adult group, 76% were male, 41% black, and 59% white/other. Twenty-eight adolescents (47%) sustained blunt injuries and 32 (53%) penetrating injuries compared to 188 (28.4%) adult blunt injuries and 475 (72%) penetrating injuries. Adolescent median injury severity score (ISS) was 16 (interquartile range [IQR]: 4.5-25), adult median ISS was 10 (IQR: 4-25). Mortality estimates for adolescents and adults were 35% and 24%, respectively ($p=0.09$). Most adolescent deaths occurred within 3 days after admission while adult deaths occurred further into hospitalization ($p<0.01$). Psychiatric care was administered in 64% of adolescents (n=39) and 84% of adults ($p< 0.01$). Both groups A and B had a cumulative mortality of 25% ($p=0.4$). Spatial analysis identified overlapping clusters of high SITI standardized incidence ratios and high DCI scores.

Conclusions: Psychiatric resources for adolescent patients who present after self-inflicted injury to an adult trauma center were found to be deficient. As a result, this population received significantly less inpatient psychiatric care compared to adults with similar rates of mortality. The high incidence of suicide attempts and subsequent mortality in adolescents requires immediate attention and more resources to addess this public health crisis.

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Introduction

According to the Centers for Disease Control and Prevention (CDC), 10.6 million Americans considered suicide, 3.2 million created a plan, and 1.4 million attempted suicide in 2017 alone, resulting in 47,000 deaths [1]. Among adolescents, the problem is even more striking with suicide ranked as the second leading cause of death [1]. Adolescents also have a greater suicide attempt rate when compared to adults [2] with attempts outnumbering deaths 50:1 [3], compared to 25:1 in adults [1]. Finally, younger age at initial suicide attempt was found to be a risk factor for subsequent suicide attempts [4].

Many adolescents suffer from undiagnosed psychiatric disorders with a reported 90% of adolescent suicide victims meeting the diagnostic criteria prior to their death [3]. This finding illustrates the importance of immediate intervention by mental health professionals prior to and following attempted suicide in adolescents. The likelihood of repeat suicide attempts ranges from 6% at one month of follow-up to 10% at three months of follow-up [5]. However, when compared to adults, adolescents had lower rates of suicide completion after receiving psychiatric treatment [2]. An additional benefit of timely psychiatric treatment following an episode of self-harm is the overall improvement in self-reported quality of life [6]. The importance of swift psychiatric care, especially in the adolescent population, is clearly of paramount importance.

Adolescents have unique mental health needs compared to adults. Yet, many adult trauma centers that are tasked with treating these patients do not have specialized psychiatric resources in-house to care for this patient population. This deficiency leads to delays in psychiatric treatment or referral for outpatient treatment following discharge rather than timely care delivered in the inpatient setting. While previous research has focused on the survival of children and adolescents when treated at adult versus pediatric trauma centers [7-10], little is known about how mental health resources are utilized in adult urban centers with high volumes of self-inflicted injuries.

Furthermore, the association of community-level economic distress and self-inflicted injuries has also not been explored in depth. The Economic Innovation Group has created the distressed communities index (DCI), which is an aggregate score determined by rates of low education levels, housing vacancy, adult unemployment, poverty, median income ratio, change in employment, and turnover in establishments and businesses, based on zip-code level data from 2012 to 2016. This metric has five levels: distressed, at-risk, mid-tier, comfortable, and prosperous [11]. DCI, a surrogate for community economic distress, significantly predicts pediatric firearm violence, yet its association to self-inflicted injuries is currently unknown [11].

With these knowledge gaps in mind, this study aimed to examine the differences in psychiatric resource utilization and survival differences between adolescents and adults treated at an adult urban Level-1 trauma center. Additionally, we sought to determine whether injury characteristics or clinical outcomes are related to community-level economic distress, using the DCI and geospatial analyses. In conducting this research we hypothesized that: (1) there would be no differences in mortality between the two age groups, but that adolescent psychiatric care would be delayed due to resource limitations and; (2) self-inflicted injuries would occur in communities with high levels of economic distress.

Methods

Patient Population and Clinical Data:

Patients with self-inflicted injuries presenting from January 1, 2009 to October 31, 2018 to an ACS-verified, urban, level one trauma center were identified in a database maintained by the institution. Data collection and analysis protocols were approved by the Institutional Review Board. Patients at least 14 years of age and treated for self-inflicted injuries were included in the study. Patients were excluded if the intentionality of their injuries was unclear based on review of the medical record. Specific reasons for exclusion were injuries sustained while evading police or in police custody, injuries inflicted by others, or injuries deemed unintentional by the treating physician. The institution's trauma registry was used to collect information regarding patient demographic and clinical characteristics, survival, and receipt of psychiatric consultation. Review of medical records was used to verify accuracy of the registry-derived information and to determine the timing of psychiatric consultation. The variables of interest include: age at time of injury, gender, race, zip code of residence, insurance type, type of injury, Glasgow coma scale (GCS), toxicology findings, injury severity score (ISS), pre-existing diagnosis of psychiatric disorder, total time in ICU, total time in hospital, discharge status, psychiatric consultation placed, date of psychiatric consultation order, and date of performed psychiatric consultation. Zip code of residence was used to determine DCI. Date of psychiatric consult order and date of consult were used to determine the wait time for consult.

The final cohort was categorized in two ways. For the primary analysis, participants were grouped according to age: adolescents aged 14 to 19 years old versus adults aged 20 years or older. For the secondary analysis the cohort was divided into two levels of community economic distress: group A, consisting of persons residing in distressed and at-risk communities, and group B, consisting of persons from non-distressed (mid-tier, comfortable, and prosperous) communities. The analytic variables were then compared between the age groups and between two economic distress categories.

Statistical Analyses:

All data analyses were conducted using SAS, version 9.4 (SAS Institute, Cary, NC). Means (standard deviations [SD]) and medians (interquartile ranges [IQR]) were calculated for normally distributed and skewed continuous variables, respectively. Frequencies and percentages were used to describe distributions of categorical variables. Chi-square tests, Fisher's exact tests, and Wilcoxon tests were used to compare variables between adolescents and adults and across economic distress-based groups, as appropriate. Kaplan-Meier plots and Cox regression models were used for survival analysis. The results of Cox models were expressed as adjusted hazard ratios (HR) and the corresponding 95% confidence intervals (CI). A two-sided p-value of ≤0.05 was used as the cutoff for statistical significance.

Spatial Analyses:

ZIP code DCI data was assigned to corresponding ZIP Code Tabulation Areas (ZCTA). Shapefiles for ZCTAs were extracted from Census.gov and a total of 237 ZCTAs were identified in the Atlanta Metropolitan Area. The DCI study did not cover all ZCTAs in the Atlanta Metropolitan Area, so values were assigned from other ZIP codes if they were redirected by the interactive maps available on the EIG website. DCI scores for ZIP codes which were not redirected by the interactive maps were imputed using the mean of its spatial neighbors. Redirected values were used on 9 occasions and imputations in 2.

Standardized Incidence Ratios (SIR) were calculated for the overall incidence and for each age group. Bayesian smoothing using Poisson-Gamma models was used to obtain smooth SIRs. Local Indicators of Spatial Autocorrelation (LISA) maps based on the local Moran's I were used for cluster detection. Significance was determined using a randomization method with 999 iterations and a pseudo p-value threshold of 0.05.

The R package spatialreg was used to fit spatial Durbin linear models for the SIR and a single covariate of DCI score. All models used a first-order queen contiguity weight matrix. Total impacts were calculated using the contrast estimation incorporated into the spatialreg package.

Results

Demographics and Clinical Characteristics:

Of the 754 patients initially identified, 31 patients were excluded for unintentional injuries. There were 723 patients subsequently included in the analysis and of these, 60 (8.3%) were adolescents and 663 (91.7%) were adults. In the adolescent group, the median age was 17 (IQR 16-19), 55 (91.7%) were male, 33 (55%) were black, and 27 (45%) were white/other race. In adults, the median age was 37 (IQR 29-51) years, 503 (75.9%) were male, 272 (41%) were black, and 391 (59%) were white/other race. There were 27 (48.2%) adolescents who lived in distressed communities while 297 (46.4%) adults did. In terms of insurance status, 18 (30%) adolescents had government insurance, 13 (21.7%) had commercial insurance, and 21 (35%) were self-pay; in the adult group, 141 (21.3%) government insurance, 134 (20.2%)

commercial, and 289 (43.6%) self-pay. There were 8 (13.3%) adolescents positive for alcohol and 11 (18.3%) positive for substances; in adults, 142 (21.4%) were positive for alcohol and 197 (29.7%) for substances. The mechanism of injury was penetrating in 32 (53.3%) adolescents and 475 (71.6%) adults. The median (IQR) values for GCS and ISS were 13.5 (IQR 3-15) and 16 (IQR 4.5-25), respectively in adolescents, and 15 (IQR 3-15) and 10 (IQR 4-25), respectively in adults [Table 1].

Clinical Outcomes and Psychiatric Care Utilization:

The overall mortality was 35% (21 deaths) in adolescents and 24% (161 deaths) in adults, but the difference was not statistically significant (p=0.09). The median hospital length of stay was 2 (IQR: 1-7) days and 6 (IQR: 2-14) days in adolescents and adults, respectively (p<0.001) [Table 1]. Deaths among adolescents tended to occur earlier after admission compared to deaths among adults (p=0.003) [Figure 1]. The Cox regression analysis demonstrated that greater mortality, was associated with self-pay for care compared to private insurance (HR 2.6; 95% CI 1.6-4.4; p<0.001), having a penetrating vs. blunt or other injury (HR 2.4; 95% CI 1.4-3.9; p<0.001), and having ISS greater than 15 vs. ≤15 (HR 25.9; 95% CI 12.6-53.3; p<0.001). After controlling for other factors, the difference in mortality between the adolescent and the adult age groups was attenuated and was no longer statistically significant (HR=1.7; 95% CI 1.0-2.8; p=0.051). Race, gender and living in a community that was not considered to be economically distressed were not associated with mortality [Table 2].

Prior to their self-inflicted injury, 10 (16.7%) adolescents and 242 (36.5%) adults had a previous diagnosis of a psychiatric illness. In adolescents, of the 39 alive at discharge, 25

(64.1%) received inpatient psychiatric consultations, while 420 (83.7%, p = 0.002) of the 502 adults alive at discharge did. Once the psychiatric consult order was placed, the mean number of days to actual consultation was 0.92 (SD 0.97) in adolescents and 0.57 (SD 1.08) in adults (p=0.02) [Table 1].

Community-Level Economic Distress:

Of the 723 patients identified with self-inflicted injuries, 696 patients could be assigned DCI scores. Of these, 324 (46.6%) were in group A (economically distressed) and 372 (53.5%) were in group B (not economically distressed). In group A, the median age was 35 (IQR 26.5-49), 263 (81.2%) were male, 183 (56.5%) were black, and 141 (43.5%) were white/other race. In group B, the median age was 37 (IQR 27-51), 273 (73.4%) were male, 107 (28.8%) were black, and 265 (71.2%) were white/other race. In group A, 82 (25.3%) and 49 (15.1%) study participants had government and commercial insurance, respectively, 141 (43.5%) used self-pay, and 52 (16.1%) had other types of coverage. Group B included 73 individuals (19.6%) with government insurance, 95 (25.5%) with commercial insurance, 157 (42.2%) with self-pay, and 47 (12.6%) with other sources. In terms of clinical characteristics, group A had 230 (71%) patients with penetrating injuries and 94 (29%) had blunt trauma, median GCS was 15 (IQR 3-15), and median ISS was 10 (IQR 4-25); group B had 263 (70.7%) and 109 (29.3%) cohort members had penetrating blunt mechanisms, respectively, median GCS was 14 (IQR 3-15), and median ISS was 10 (IQR 4-25). In group A, 59 (18.2%) patients tested positive for EtOH, 87 (26.9%) tested positive for illicit substances, and 116 (35.8%) had a prior diagnosis of a major psychiatric illness; whereas, in group B, 88 (23.7%) patients tested positive for EtOH, 117

(31.5%) tested positive for other substances, and 132 (35.5%) had a prior psychiatric illness. Among 243 patients in group A, 199 (81.9%) received an inpatient psychiatric consult and the mean time to consult was 0.55 days (SD 0.78). Among 278 patients in group B, 230 (82.7%) received a consult with the mean time of 0.62 days (SD 1.3). For group A, the median hospital length of stay was 5 days (IQR 2-13) and the cumulative mortality was 25.0% (81 deaths); in group B, the median length of stay was 6 days (IQR 2-14) and mortality was 25.3% (94 deaths) [Table 1]. Kaplan-Meier analysis showed no difference in survival between the two economic deprivation-based groups with a log-rank p-value of 0.4.

LISA maps for DCI scores [Figure 2A] showed a large cluster of low scores (more prosperous) located towards the north of the metropolitan area. This cluster coincided with a cluser of low SIRs with similar characteristics [Figure 2B]. In contrast, clusters of high DCI scores sorround the centroid for the Atlanta Metropolitan Area and are also located in peripheral ZCTAs in the south and west. For the overall SIR, the cluster of high values also surrounds the centroid of the Atlanta Metropolitan Area.

Cluster analysis considering only adolescent cases showed no evidence of a significant cluster of high values of SIRs [Supplementary Figure 1A]. Scattered clusters of low SIRs appear in the south, with two large clusters towards the northeast and northwest. Adult SIR clusters show a pattern largely consistent with that of the overall SIRs, with clusters of high values surrounding the center of the Metropolitan Area and a large cluster of low values in the north (Supplementary Figure 1B).

Spatial Durbin Models showed a significant effect of the DCI score on the overall (0.017; 95% CI 0.0051-0.0291; p=0.005) and adult (0.013; 95% CI 0.1162-0.9016; p=0.004) SIRs, but not on the adolescent SIR (0.042; 95% CI -3.1872; p=0.366) [Supplementary Table 1]. The total impact contrasts the direct effects and the indirect effects (lagged DCI scores) and it differed little in magnitude from the direct effect in the overall and adult models, but was nearly half of the direct effect in the adolescent SIR model.

Discussion

Suicide remains a significant public health problem across all age groups, but especially in adolescents [3]. Adolescents have higher rates of attempt than adults [2], tend to use firearms in their attempts, and have higher rates of completion [12]. It has been suggested that many suicidal adolescents have undiagnosed depression or may not be cognizant that a suicide attempt is an irreversible act [12]. If prompt psychiatric care is provided following a suicide attempt, adolescents had more favorable outcomes in terms of quality of life and a decrease in completion rates [2, 6]. The need for early and specialized psychiatric care to treat adolescent patients at high-risk for suicide is crucial in improving their outcomes.

The present study found that the most common mechanism of injury was penetrating. The difference in the overall mortality between adolescents and adults was not statistically significant after controlling for sociodemographic and trauma-related characteristics; however, adolescents tended to die earlier in the hospitalization than adults according to the Kaplan-Meier survival analysis. This may be due to the higher ISS in adolescents as compared to adults (16 vs 10) or other factors related to the injury itself. On Cox regression analysis for mortality, unsurprisingly, we found that higher ISS and the use of a penetrating mechanism led to significantly higher mortality. In addition, self-pay for care significantly increased risk of mortality, which may be due to other factors that contribute to a lack of insurance.

This study also found fewer adolescents with diagnosed psychiatric conditions prior to attempt, which may be due to less exposure to healthcare professionals or recent development of the condition. There was a lower proportion of adolescents who received inpatient psychiatric consults as compared to adults and a delay in time to consultation for the adolescent group. This may be due to limited child and adolescent psychiatric resources at this adult trauma center and lack of in-house availability at all times. In Georgia, it is estimated that there are 8 child and adolescent psychiatrists per 100,000 children below age 18, which is considered a severe shortage [13]. Some patients and their families may have also chosen to follow-up outpatient rather than remain in the hospital. This study is consistent with prior research reporting that adolescents under 18 years of age most frequently used firearms in their suicide attempts [12], often had evidence of a psychiatric disorder, but without a formal diagnosis [3], and had no difference in survival outcomes when treated at adult centers [7-10].

For the secondary aim, this study found no association between DCI and injury characteristics or survival in individuals with self-inflicted injuries. In both groups, most patients were male and the most frequent injury mechanism was penetrating. However, there was a higher proportion of black patients in group A, the economically distressed group, than in group B.

Cluster analyses of the overall and adult SIRs and DCI scores showed overlapping clusters of high DCI scores and high SIRs (Figure 2). Although it is indirect, this suggests a pattern that coincides with previous observations of trauma incidence in disadvantaged communities. This was further verified with spatial models which showed a significant effect of the DCI score on the SIRs, independent of spatial autocorrelation. Although the magnitude of the effects is small, it linearly interacts with the SIRs to produce significant effects. For example, changes of 10 units in the DCI score, which were frequent between the two DCI studies, could represent an increase in the overall SIR of 17.1%. More extreme changes could be observed since only 35% of the ZIP codes considered “Mid-Tier” in 2007-2011 remained in that tier in 2012-2016 [14].

The lagged DCI scores were not significant in any of the analyses, suggesting that DCI scores of neighboring ZCTAs have little effect on the SIR in a given ZCTA. Alternatively, this may represent a limitation of the DCI index itself, since it is calculated from the ranks of each feature included. Information regarding the magnitude of each feature is lost in the calculation, and not all of the features can be guaranteed to exhibit the same degree of spatial autocorrelation.

Total impacts in the models can be interpreted as the impact on the SIR of a given ZCTA if the DCI score changes in both it and all other ZCTAs. Although the total impacts differed little from the direct effects, it is worth noting that they were greater in magnitude in both the overall and adult models.

Both the LISA cluster analysis and the spatial models failed to identify a significant effect of DCI score on the adolescent SIR. However, the clusters of low SIR values were consistent with those found in the overall and adult models. The SIR for adolescents showed a mark heterogeneity which persisted after smoothing. Although such variations are typical of data in which some regions have much smaller populations than others, it is likely that this was compounded by the relatively few adolescent cases (60 vs 663).

A review of current literature shows that adolescents are frequently defined as 15-19 years old, with some definitions expanding the range to 21 years of age [3, 7-11]. We classified adolescents as those aged 14 to 19 years to account for our local-regional practice that prehospital emergency medical technicians transport anyone 14 years or older to the adult trauma center in our area. The overall number of adolescent patients in this study was much smaller than the adult group, which limited statistical power and precluded meaningful sub-group analyses. In addition, some of the older patients in the adolescent group would have been seen by in-house adult psychiatric services. It was not possible to determine if patients who did not receive an inpatient psychiatric consult, underwent psychiatric care at another center after being transferred or received outpatient psychiatric services soon after discharge. Thus, at least some of the younger patients may have been misclassified as having received no psychiatric consultation when in fact they were seen elsewhere. In terms of the analysis, we may not have accounted for all relevant injury characteristics relating to the patient's ability to receive a psychiatric consultation. This may have led to residual confounding by injury type and severity.

Finally, in the absence of individual measures of socioeconomic status, we used zip-code level data to measure community-level economic distress. It is important to keep in mind that zip codes, especially in a densely populated urban setting, represent heterogeneous geographic areas that include people from a wide range of income levels. A more accurate measure of area-based socioeconomic status would have been obtained using census track or block-level data. Future research should build in this study by including all adolescents presenting with suicide attempts and by comparing timing and receipt of psychiatric care received at the adult versus pediatric trauma centers.

Conclusion

Suicide is a leading cause of death in both adolescents and adults, but adolescents are at particularly increased risk. In this study, overall mortality was similar between adolescents and adults and, after controlling for other factors, age group was not a statistically significant risk factor for mortality, but deaths in the adolescent group tended to occur earlier in hospitalization. However, the adolescent group had a significantly lower proportion of inpatient psychiatric consultations compared to the adult group. There was also no association found between community-level economic distress and self-inflicted injuries. A significant need exists for greater psychiatric resources for adolescent patients treated at adult trauma centers to ensure that they receive prompt and necessary psychiatric care to improve their outcomes and reduce their future risk of suicide.

References

1. Centers for Disease Control and Prevention. (2019, September 5). *Preventing Suicide*. https://www.cdc.gov/violenceprevention/suicide /fastfact.html. Reviewed 2019, Sept 5.
2. Safer, D.J., *Adolescent/Adult Differences in Suicidal Behavior and Outcome.* Annals of Clinical Psychiatry, 1997. **9**(1): p. 61-66.
3. Shain, B., *Suicide and Suicide Attempts in Adolescents.* Pediatrics, 2016. **138**(1): p. e20161420.
4. van Aalst JA, S.S., Vitsky JL, Bass SM, Miller RS, Meador KG, Morris JA Jr, *Long-term follow-up of unsuccessful violent suicide attempts: risk factors for subsequent attempts.* J Trauma, 1992. **33**(3): p. 457-64.
5. Spirito, A., et al., *Adolescent suicide attempts: Outcomes at follow-up.* American Journal of Orthopsychiatry, 1992. **62**(3): p. 464-468.
6. Pajonk, F.-G., et al., *Long-term follow-up after severe suicide attempt by multiple blunt trauma.* European Psychiatry, 2005. **20**(2): p. 115-120.
7. Walther, A.E., et al., *Teen trauma without the drama: outcomes of adolescents treated at Ohio adult versus pediatric trauma centers.* J Trauma Acute Care Surg, 2014. **77**(1): p. 109-16; discussion 116.
8. Matsushima, K., et al., *Injured adolescents, not just large children: difference in care and outcome between adult and pediatric trauma centers.* Am Surg, 2013. **79**(3): p. 267-73.
9. Walther, A.E., et al., *Pediatric and adult trauma centers differ in evaluation, treatment, and outcomes for severely injured adolescents.* J Pediatr Surg, 2016. **51**(8): p. 1346-50.
10. Miyata, S., et al., *Trauma experts versus pediatric experts: comparison of outcomes in pediatric penetrating injuries.* J Surg Res, 2017. **208**: p. 173-179.
11. Tracy B.M., et al., *Community distress predicts youth gun violence*. J Pediatr Surg, 2019. **54**(11): 2375-2381.
12. Hadjizacharia, P., et al., *Traumatic suicide attempts at a level I trauma center.* J Emerg Med, 2010. **39**(4): p. 411-8.
13. American Academy of Child & Adolescent Psychiatry. Workforce maps by state. https://www.aacap.org/aacap/Advocacy/Federal_and_State_Initiatives/Workforce_Maps/Home. Published 2015.
14. Economic Innovation Group., *From Great Recession to Great Reshuffling: Charting a Decade of Change Across American Communities*. https://eig.org/wp-content/uploads/2018/ 10/2018-DCI.pdf. Published 2018, October.

Tables and Figures:

Table 1: Demographics and Clinical Outcomes

N (total)	Adolescents (60)	Adults (663)	P-value	Group A (324)	Group B (372)
Age (median, IQR)	17 (16-19)	37 (29-51)		35 (26.5-49)	37 (27-51)
Male (n, %)	55 (91.7%)	503 (75.9%)		263 (81.2%)	273 (73.4%)
Race (n, %)					
Black	33 (55%)	272 (41%)		183 (56.5%)	107 (28.8%)
White/Other	27 (45%)	391 (59%)		141 (43.5%)	265 (71.2%)
Distressed Communities Index (n, %)					
Distressed	27 (48.2%)	297 (46.4%)		--	--
Not Distressed	29 (51.8%)	343 (53.6%)		--	--
Insurance Status (n, %)					
Government	18 (30%)	141 (21.3%)		82 (25.3%)	73 (19.6%)
Commercial	13 (21.7%)	134 (20.2%)		49 (15.1%)	95 (25.5%)
Self-Pay	21 (35%)	289 (43.6%)		141 (43.5%)	157 (42.2%)
Other	8 (13.3%)	99 (14.9%)		52 (16.1%)	47 (12.6%)
EtOH positive (n, %)	8 (13.3%)	142 (21.4%)		59 (18.2%)	88 (23.7%)
Positive substance use (n, %)	11 (18.3%)	197 (29.7%)		87 (26.9%)	117 (31.5%)
Injury Type (n, %)					
Penetrating	32 (53.3%)	475 (71.6%)		230 (71%)	263 (70.7%)
Blunt	28 (46.7%)	188 (28.4%)		94 (29%)	109 (29.3%)
GCS (median, IQR)	13.5 (3-15)	15 (3-15)		15 (3-15)	14 (3-15)
Injury severity score (median, IQR)	16 (4.5-25)	10 (4-25)		10 (4-25)	10 (4-25)
Prior Diagnosis of Major Psych Illness (n, %)	10 (16.7%)	242 (36.5%)		116 (35.8%)	132 (35.5%)
Inpatient Psych Consult (n, %)	25 (64.1%)	420 (83.7%)	0.002	199 (61.4%)	230 (61.8%)
Days to Psych Consult (mean, SD) days	0.92 (0.97)	0.57 (1.08)	0.02	0.55 (0.78)	0.62 (1.3)
Hospital length of stay (median, IQR) days	2 (1-7)	6 (2-14)	<0.001	5 (2-13)	6 (2-14)
Cumulative mortality (n, %)	21 (35%)	161 (24.3%)	0.09	81 (25%)	94 (25.3%)

Table 2: Multivariable Cox Regression Analysis for Mortality

Variable	**Hazard Ratio**	**95% Confidence Interval**		**P-value**
Age group				
Adult	1.0	(reference)		
Adolescent	1.7	1.0	2.8	0.051
Gender				
Male	1.0	(reference)		
Female	1.1	0.7	1.7	0.69
Race				
Whites/other	1.0	(reference)		
Black	0.93	0.6	1.4	0.73
Distressed communities index				
Distressed	1.0	(reference)		
Not Distressed	1.2	0.8	1.7	0.38
Insurance				
Private	1.0	(reference)		
Government-issued	1.4	0.7	2.7	0.32
Self-Pay	**2.6**	**1.6**	**4.4**	**<0.001**
Other	1.7	0.8	3.3	0.15
Injury type				
Blunt or other	1.0	(reference)		
Penetrating	**2.4**	**1.4**	**3.9**	**<0.001**
Injury severity score				
0-15	1.0	(reference)		
>15	**25.9**	**12.6**	**53.3**	**<0.001**

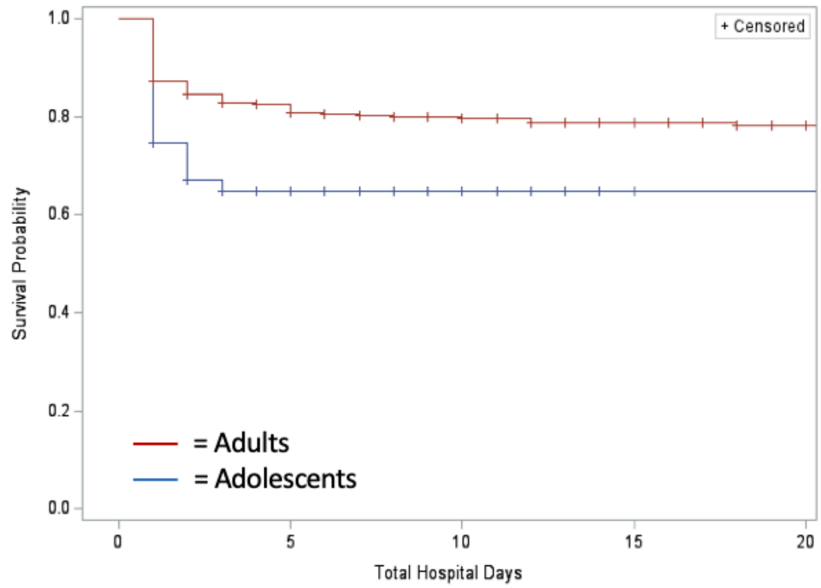


Figure 1: Overall survival by age group. Kaplan-Meier survival curve showing the overall survival for adolescent (age 14-19) and adult (age 20 and over) patients treated for self-inflicted injuries at Grady Memorial Hospital, an adult level-1 trauma center, between 2009 and 2018. Log rank p-value = 0.003.

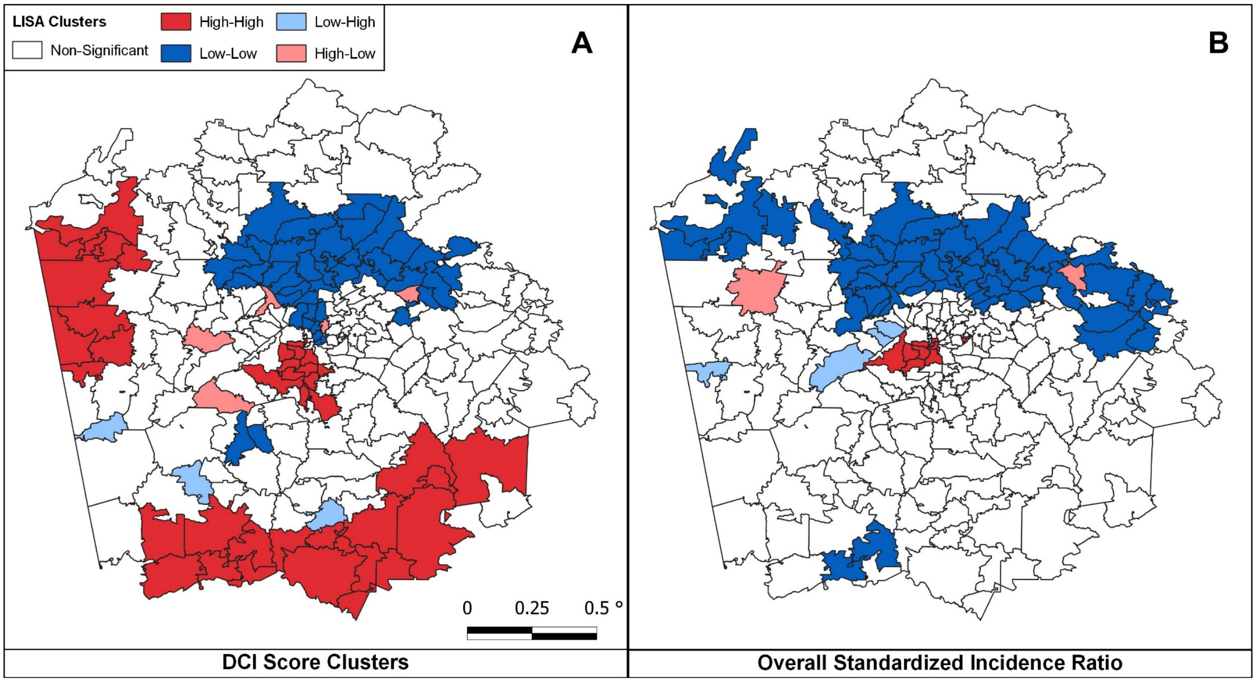
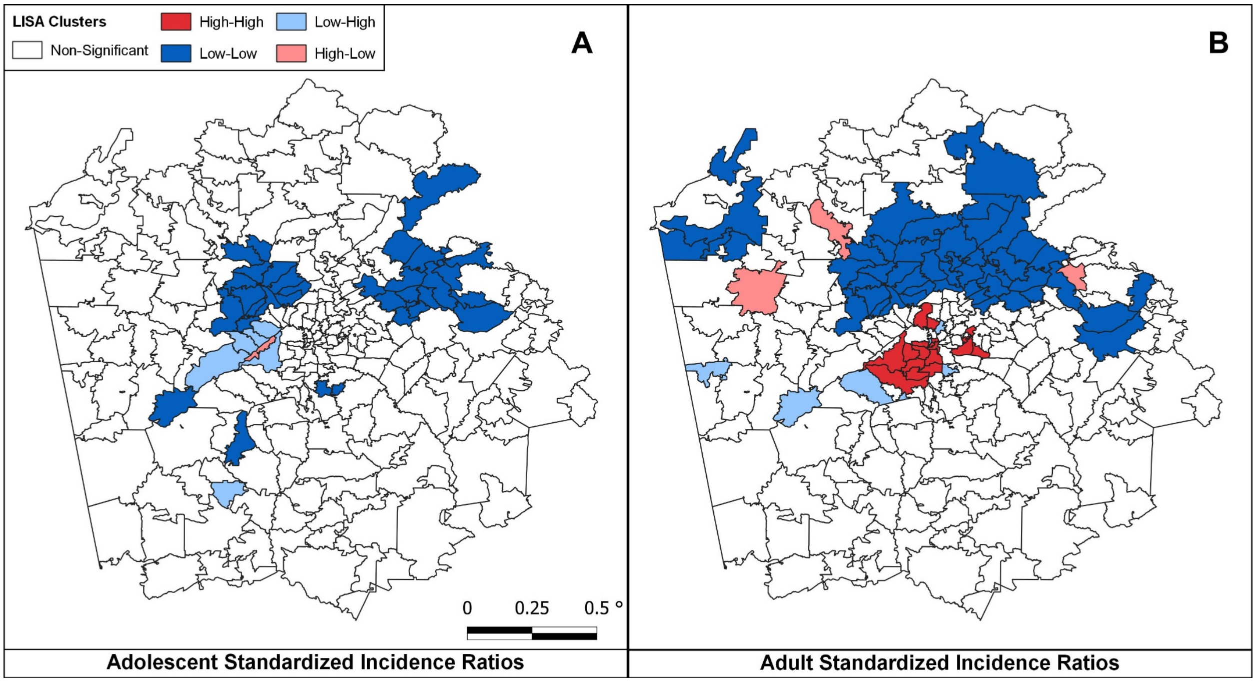


Figure 2: Comparison of clusters of DCI Scores and Overall Standardized Incidence Ratios of Self-Inflicted Injuries. Areas with high values with spatial neighbors with equally high values shown in bright red. (hotspots). Areas with low values with spatial neighbors with equally low values shown in dark blue (cold spots). Spatial outliers are represented by light colors. All values compared to mean.

Supplementary Table 1: Spatial Linear Durbin Models for Standardized Incidence Ratios

Variable	**Coefficient**	**95% Confidence Interval**		**p value**
Overall				
DCI Score	**0.0171**	**0.0051**	**0.0291**	**0.0055**
Lagged DCI Score	-0.0027	-0.0192	0.0137	0.7432
Intercept	0.5479	-0.0057	1.1014	0.0524
Total Impact	**0.0143**	**0.0035**	**0.0251**	**0.0094**
Adults				
DCI Score	**0.0127**	**0.1162**	**0.9016**	**0.0036**
Lagged DCI Score	0.0005	0.0042	0.0212	0.9374
Intercept	0.5089	-0.0112	0.0122	0.0113
Total Impact	**0.0132**	**0.0055**	**0.0024**	**0.0008**
Adolescents				
DCI Score	0.0419	-3.1872	5.2252	0.3660
Lagged DCI Score	-0.0204	-0.0492	0.1331	0.7489
Intercept	1.019	-0.1457	0.1049	0.6336
Total Impact	0.0215	-0.0607	0.1404	0.6079



Supplementary Figure 1: Clusters of Standardized Incidence Ratios of Self-Inflicted Injuries in adolescents and adults. Areas with high values with spatial neighbors with equally high values shown in bright red. (hotspots). Areas with low values with spatial neighbors with equally low values shown in dark blue (cold spots). Spatial outliers are represented by light colors. All values compared to mean.