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Adult Burn Inpatients Have Increased Burn Severity and Mortality Compared to Children in Retrospective Analysis of National Inpatient Sample 2017

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ABSTRACT

Introduction: Socioeconomic status and comorbidities are associated with increased mortality in patients with external surface burn patients, however differences between pediatric and adult burn populations have not been adequately studied.

Objectives: Our objectives were to explore the presentation, management, and outcomes of external surface burns across age groups.

Methods: The 2017 National Inpatient Sample (NIS) was queried for patients with any diagnosis of external body surface burns. Demographics, comorbidities, complications, total charges, length of stay (LOS), number of procedures undergone (NPU), and time from admission to first procedure (TFP) were identified. Univariate and multivariable analyses were used to identify statistical associations with age.

Results: 52,335 inpatients were identified with burns, with the majority male (63.6%) and adults (81.8%). Mean age was 50.5 (standard error [SE] 0.1) and 5.5 (SE 0.1) years for adults and children, respectively. Adults had higher prevalence of hypertensive disease (43.5% versus. 1.4%), diabetes mellitus (24.1% versus 0.3%), and obesity (11.7% versus 1.6%) than children ($P < 0.001$). Adults versus children had higher odds for mortality (odds ratio [OR] 4.26, 95% confidence interval [CI] 3.08–5.89), sepsis (OR 5.16, 95% CI 4.10–6.48), and pneumonia (OR 4.26, 95% CI 3.30–5.50).

Conclusions: In this national cohort of inpatients with external surface burns, comorbidities, and odds for mortality and complications varied by age. Pediatric patients more often had lower household incomes; however, adults had significantly higher odds for mortality suggesting that age and comorbidity status are more impactful on burn outcomes than socioeconomic status.

Introduction

Burn injury is a significant public health concern, with the World Health Organization estimating 180,000 burn related deaths globally [1]. Socioeconomic status and comorbidities are associated with increased mortality in external surface burn patients of all ages [2,3]; however, differences in the impact of demographics, including comorbidity burden, between pediatric and adult burn populations has not been adequately studied. We performed a retrospective analysis of inpatients with external surface burns comparing presentation, management, and outcomes between children and adults.

Methods

The 2017 National Inpatient Sample (NIS), a nationally representative database of all non-Federal hospital stays, was queried for patients with any diagnosis of external body surface burns by ICD-10 code (T20.0-3, T21.0-3, T22.0-3, T23.0-3, T24.0-3, and T25.0-3) [4]. NIS uses the All Patient Refined DRGs (APR-DRG) classification system to categorize severity of illness as minor, moderate, major, or extreme loss of function (LOF). Age identified children (younger than 18 years) and adults (18 years or older). Demographics (sex, race, median income, primary payer status, hospital region), comorbidities, complications, total charges, length of stay (LOS), number of procedures undergone (NPU), and time from admission to first procedure (TFP) were identified. Univariate and multivariable analyses were used to identify statistical associations with age with $P < 0.05$ considered statistically significant.

Results

There were 52,335 inpatients identified with burns, with the majority being males (63.6%), white (58.7%), and adults (81.8%) (Table 1). Mean patient age was 50.5 (SE: 0.1) and 5.5 (standard error [SE] 0.1) years for adults and children, respectively (Table 1). A greater proportion of children versus adults were in the lowest income quartile and a greater proportion of adults vs. children were in the highest income quartile ($P < 0.001$) (Table 1). The majority of pediatric patients were Medicaid insured (59.2% versus 24.6%) ($P < 0.001$). Adults versus children were more likely to have major LOF (33.5% versus 13.6%) ($P < 0.001$) (Table 1). Adults had higher incidence of hypertension (43.5% versus 1.4%), diabetes mellitus (24.1% versus 0.3%), anemia (21.5% versus 3.9%), hyperlipidemia (18.7% versus 0.1%), chronic pulmonary disease (18.0% versus 6.3%), obesity (11.7 versus1.6%), and heart failure (9.5% versus 0.3%) than children ($P < 0.001$) (Table 1). Adult versus pediatric burn patients with obesity and diabetes had greater odds of mortality ($P < 0.001$) (Table 1).

On multivariable analyses, adjusting for demographics, hospital data, and comorbidities, adults had greater total charges ($125,444 versus $91,244), LOS (8.7 versus 6.6 days), and TFP (2.6 versus 1.8 days) but underwent slightly fewer procedures (3.4 versus 3.6 procedures) than children ($P < 0.015$) (Table 2). Adults had higher odds of mortality (odds ratio [OR] 4.26, 95% confidence interval [CI] 3.08–5.89), sepsis (OR 5.16, 95% CI 4.10–6.48), pneumonia (OR 4.26, 95% CI 3.30–5.50) than children ($P < 0.001$) (Table 3).

Conclusions

In this retrospective study of 52,335 inpatients with burns, we found that the majority were male, burns were four times more common in adults, and adults more often had comorbidities, complications, greater odds of mortality, and experienced more severe burns and LOF than children. Children versus adults were more likely to be in the lowest income quartile and Medicaid insured.

Our findings that most burn patients were adult men was consistent with a cross-sectional retrospective analysis of 97,986 cases of burn injuries in the National Electronic Injury Surveillance System (NEISS) 2000-2018 reporting that 51.6% of patients were adults and 54% were men [5]. Similarly, another cross-sectional NEISS retrospective study 2000-2018 reported that adult versus pediatric patients (80.16% versus 19.81%) comprised the vast majority of patients with fire and flame burns [6].

We found that adult versus pediatric burn patients with obesity and diabetes had greater odds of mortality. Similarly, diabetic and obese burn patients had 2.38 higher odds of mortality than non-diabetic and non-obese patients in a systematic review and meta-analysis [7]. In a retrospective case-control study of 5332 adult burn patients admitted to

Table 1. Demographic data of patients with burns by age group (%).

		Pediatric (< 18 years)	Adult (≥ 18 years)	Total	P value
		N = 9535 (18.2%)	N = 42800 (81.8%)	N = 52335	
Age	Age, years (mean [SE])	5.49 [0.06]	50.50 [0.09]	42.30 [0.11]	< 0.001
Sex	Male	59.7	64.4	63.6	< 0.001
	Female	40.3	35.6	36.4	
Race	White	41.5	62.5	58.7	< 0.001
	Black	26.3	17.6	19.2	
	Hispanic	20.4	12.2	13.7	
	Other	11.9	7.7	8.5	
Median Income Quartile - Patient Zip Code	0 – 25	39.5	37.6	37.9	< 0.001
	26 – 50	27.8	27.3	27.4	
	51 – 75	19.7	20.4	20.3	
	76 – 100	13.0	14.7	14.4	
Primary Payer Status	Medicare	0.2	33.5	27.4	< 0.001
	Medicaid	59.2	24.6	30.9	
	Private Insurance	29.1	23.1	24.2	
	Other	11.5	18.8	17.5	
Hospital Region	Northeast	18.6	15.6	16.2	< 0.001
	Midwest	19.6	21.2	20.9	
	South	41.7	41.3	41.4	
	West	20.1	21.8	21.5	
Severity of Illness Subclass (Loss of Function)	Minor LOF	51.0	17.9	23.9	< 0.001
	Moderate LOF	29.9	35.5	34.5	
	Major LOF	13.6	33.5	29.9	
	Extreme LOF	5.5	13.0	11.7	
Comorbidity	Anemia	3.9	21.5	18.3	< 0.001
	Heart Failure	0.3	9.5	7.8	< 0.001
	Chronic Pulmonary Disease	6.3	18.0	15.9	< 0.001
	Coagulation Defect	1.0	5.5	4.7	< 0.001
	Diabetes Mellitus	0.3	24.1	19.8	< 0.001
	Hypertensive Disease	1.4	43.5	35.8	< 0.001
	Fluid and Electrolyte Disorders	6.0	26.2	22.5	< 0.001
	Obesity	1.6	11.7	9.9	< 0.001
	Renal Failure	0.0	9.5	7.8	< 0.001
	Lipidemia	0.1	18.7	15.3	< 0.001
	Mood (affective) Disorders	2.7	39.1	32.5	< 0.001
	Dermatitis and Eczema	3.2	1.5	1.8	< 0.001

LOF = loss of function.

a regional burn center 2002-2012, preexisting cardiovascular disease was associated with a 33% increase in intensive care unit admission (incidence rate ratio [IRR] =1.33, 95% CI=1.22–1.47) and 42% increased mortality (IRR=1.42, 95% CI=1.10–1.84) [8]. Adults versus children in our study more often had heart failure and coagulation defects, which may explain increased odds of mortality in adults. Similarly, in another retrospective case-control study of 5480 burn patient admissions 2016-2018, those with neurological disorders, diabetes, hypertension, and psychoses, had increased risk of complications and death [9]. In our multivariable analyses, adults versus children had higher rates

Table 2. Management, charges, and outcomes of patients with burns by age group.

		Pediatric(< 18 years)	Adult(≥ 18 years)	Total	P value
Total Charges	Charges ($) (mean [SE])	91,243.77 [3,554.80]	125,444.41 [1,603.87]	119,261.90 [1,463.79]	< 0.001
Length of Stay	Number of Days (mean [SE])	6.64 [0.15]	8.69 [0.07]	8.32 [0.06]	< 0.001
Number of Procedures	Number of Procedures (mean [SE])	3.64 [0.05]	3.43 [0.02]	3.47 [0.02]	< 0.001
Time Until 1st Procedure	Number of Days (mean [SE])	1.79 [0.05]	2.59 [0.03]	2.44 [0.03]	< 0.001
Mortality	Mortality Rate (%)	0.6	2.9	2.5	< 0.001
Sepsis	Complication Rate (%)	1.0	7.5	6.3	< 0.001
Pneumonia	Complication Rate (%)	0.9	5.7	4.8	< 0.001
Respiratory Failure	Complication Rate (%)	3.5	12.5	10.9	< 0.001
Skin Subcutaneous Infection	Complication Rate (%)	4.1	20.0	17.1	< 0.001
Osteomyelitis	Complication Rate (%)	0.2	2.2	1.9	< 0.001
Acute Kidney Failure	Complication Rate (%)	0.4	12.9	10.7	< 0.001
Urinary Tract Infection	Complication Rate (%)	0.9	6.0	5.1	< 0.001
Hypoxemia	Procedure Rate (%)	0.3	1.7	1.5	< 0.001
Tracheotomy	Procedure Rate (%)	0.5	1.9	1.7	< 0.001
Tracheostomy	Procedure Rate (%)	2.1	3.9	3.6	< 0.001
Tracheoscopy	Procedure Rate (%)	0.9	2.0	1.8	< 0.001
Transfusion	Procedure Rate (%)	1.6	3.8	3.4	< 0.001
Ventilation	Procedure Rate (%)	0.6	1.2	1.1	< 0.001
Imaging	Procedure Rate (%)	1.5	6.0	5.2	< 0.001

of complications and mortality, which may be due to adults having more comorbidities.

We found a statistically significant difference in income distribution for pediatric versus adult patients by zip code. Primary payer status can be used as a proxy for income and the primary payer for most pediatric patients was Medicaid. Since Medicaid qualifications require household incomes below the federal poverty level, most pediatric burn patients lived in low-income households, regardless of zip code. In a retrospective case-control study of 135,680 patient records from the National Burn Repository 2002-2011, uninsured status was used as a proxy for lower socioeconomic status and was correlated with higher mortality rate (OR 1.3, P = .007) and longer LOS (OR 1.3, P < .001) for burn patients [2]. However, despite pediatric burn patients being more likely to live in low-income households, we found that adult burn patients suffered higher rates of morbidity and mortality. Our findings suggest that the higher burden of comorbidities and complications in adult versus pediatric burn patients play a more significant role than socioeconomic status in predicting patient outcomes.

The NIS database only reports inpatient cases, therefore burn patients who presented to urgent care, primary care, burn clinics, or those who did not seek medical care were excluded. It does not specify burn location (ie face) and treatment data. Cases were retrospectively reported without dermatologist confirmation, limiting our analysis.

We found that most burn inpatients were adults and have higher rates of complications and mortality than children, which may be explained by adults higher incidence of severe burns, represented by increased incidence of major or extreme LOF, and comorbidities. Although pediatric patients more often had lower household incomes, they had better outcomes than adults, suggesting that age and comorbidity status are more impactful on burn outcomes. Therefore, we recommend that dermatologists consider patient age and comorbidity status when managing burns and need for burn unit referral.

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Table 3. Adjusted multivariable analysis (with marginal values and odds ratios) of management, charges, and outcomes in patients with Burns by age group.

		Adjusted (Adult versus. reference Child)	95% CI	P value
Total Charges	Charges (marginal $)	23,150.95	14,797.32 to 31,504.57	< 0.001
Length of Stay	Length of Stay (marginal days)	1.56	1.22 to 1.90	< 0.001
Number of Procedures	Procedures (marginal number)	-0.15	-0.27 to -0.03	0.012
Time Until 1st Procedure	Time (marginal days)	0.23	0.08 to 0.38	0.002
Mortality	Complication (OR)	4.26	3.08 to 5.89	< 0.001
Sepsis	Complication (OR)	5.16	4.10 to 6.48	< 0.001
Pneumonia	Complication (OR)	4.26	3.30 to 5.50	< 0.001
Respiratory Failure	Complication (OR)	2.53	2.22 to 2.89	< 0.001
Skin Subcutaneous Infection	Complication (OR)	4.69	4.20 to 5.24	< 0.001
Osteomyelitis	Complication (OR)	7.45	4.43 to 12.53	< 0.001
Acute Kidney Failure	Complication (OR)	14.18	9.86 to 20.39	< 0.001
Urinary Tract Infection	Complication (OR)	3.84	3.04 to 4.84	< 0.001
Hypoxemia	Complication (OR)	2.84	1.94 to 4.15	< 0.001
Tracheotomy	Procedure (OR)	3.01	2.07 to 4.40	< 0.001
Tracheostomy	Procedure (OR)	1.25	1.05 to 1.48	0.011
Tracheoscopy	Procedure (OR)	2.09	1.59 to 2.76	< 0.001
Dressing	Procedure (OR)	0.46	0.41 to 0.51	< 0.001
Transfusion	Procedure (OR)	1.57	1.29 to 1.91	< 0.001
Ventilation	Procedure (OR)	0.80	0.58 to 1.10	0.162
Imaging	Procedure (OR)	2.05	1.70 to 2.48	< 0.001
Covariables: sex, race, income quartile, primary payer status, hospital region, fluid and electrolyte disorders, hypertensive disease				

CI = confidence interval; OR = odds ratio.

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