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Trends in Lacrosse Injuries: A NEISS Study

Ryan Shams[1] and Stuart Alden[#]

[1]The Haverford School, USA
[#]Advisor

ABSTRACT

Lacrosse is a popular and growing sport in the United States. It is a moderate injury risk contact sport primarily played by youth. This study was conducted to identify general lacrosse injury trends in the United States and present specific injury information that was not included in previous studies. Lacrosse related injury data from 2012-2022 in the NEISS database, a database of emergency department injury reports from approximately 100 U.S. hospitals, was the probability sample for this study. After examining each injury narrative to filter out injuries not caused by playing lacrosse, there was a total of 4,498 sample cases representing 130,329 injuries nationwide. Using NEISS coding and extracted narrative data, tables and sub-tables were created. Tables were converted into graphs using the GraphPad Prism 10 software. There were significantly more male injuries, representing 71.41% of the national estimate. Most injuries occurred in the 10-18 age group, representing 84.07% of the national estimate. Sprain/strain was the most common diagnosis, and the upper extremity was the most injured body part region. “Hit by stick” was the most common injury mechanism. The most fractured upper extremity bone was the phalanx, and the most fractured lower extremity bone was the fibula. The identification of the most prevalent injury types can be used by sports medicine clinics and injury prevention programs to target certain common injuries and can guide lacrosse programs to create rules and regulations designed to minimize the risk of the most common injuries.

Introduction

In 2021, there were over 1.89 million lacrosse players in the United States (*Lacrosse Is Back on Solid Ground*, 2022). Lacrosse is a contact sport with a moderate injury risk (*Lacrosse Injuries - Sports Medicine Program - UR Medicine, University of Rochester Medical Center - Rochester, NY*, n.d.). This study is in the field of sports medicine, a specific branch of medicine focused on the prevention of sports injuries (*Understanding Sports Medicine: A Comprehensive Guide*, 2023). Several previous studies analyzed lacrosse injuries in the NEISS database; however, none have presented data on specific bone fractured, side of injury, and the digit injured. Bano et al. (2023), a study evaluating youth lacrosse injuries (ages 11-18), did not present that data. Diamond et al. (2001) focused specifically on head injuries in lacrosse. The current study aims to address the gaps in the literature by evaluating the general lacrosse injury trends and further includes injury narrative data for a more complete assessment of the scope of these injuries.

Given the injury risks that playing lacrosse poses for athletes, it is important to analyze U.S. lacrosse injuries and reach conclusions that can inform lacrosse athletes, clinicians, and policy makers in order to make the sport safer.

The scope of this study includes all U.S. emergency department lacrosse injuries from 2012-2022. Injuries seen at other sources of medical care and injuries outside the United States were excluded from this study. The main limitation with this study was that the NEISS database excludes injuries from other sources of care, such as primary care offices and urgent care. The lack of specificity in some narratives was another limitation, as some didn’t specify information such as the mechanism of injury.

The National Electronic Injury Surveillance System (NEISS) is a database of emergency department injury reports from approximately 100 U.S hospitals. It is a nationally representative probability sample, as each sample case has a statistical weight corresponding to how many injuries it represents nationally based on the size of the emergency

department in which the injury took place. A query was used to acquire NEISS lacrosse-related injury reports from 2012-2022. After downloading the reports into an excel file, the narratives were used to filter out injuries that weren't caused by playing lacrosse and extract information. Tables and sub-tables were made using the NEISS coding and the extracted information, and then the tables were converted into graphs using GraphPad Prism 10.

Methods

Overview

This observational study analyzed lacrosse injuries seen at emergency departments using the public National Electronic Injury Surveillance System (NEISS) database. The sample for this study was lacrosse injuries from 2012-2022. The NEISS database is a database of emergency department reports from a nationally representative probability sample of approximately 100 hospitals throughout the U.S (*National Electronic Injury Surveillance System (NEISS)*, 2018). The Consumer Product Safety Commission (CPSC) has operated the database for over 45 years.

Data Collection

A NEISS query was used to extract the data. The year range from 2012-2022 and the product code for lacrosse (1215) were selected. All demographics, diagnoses, body parts, and dispositions were included. Upon submitting the query, an excel file consisting of the sample emergency department injury reports was created. This excel file was then downloaded.

Filtering the Data and Extracting Narrative Information

Each case in the sample had a narrative, an injury summary with a length of up to 400 characters (*NEISS Coding Manual*, 2022). Each narrative was analyzed to filter out the injuries not caused by playing lacrosse. For example, injuries caused by playing catch with a lacrosse ball were one type of injury that was filtered out. After deleting all injury cases not caused by playing lacrosse, there were a total of 4,498 cases representing 130,329 injuries nationwide.

Three additional columns, injury mechanism, specific body part injured, and side of injury, were added to the excel spreadsheet. Using the narrative data, the additional information was added for each case.

Statistical Analysis

Using injury codes and the extracted narrative information, tables and sub tables were made. There were eight injury aspects used to create the tables and sub tables, the first five provided in the cases and the last three extracted from the narratives. These aspects were: sex, age, race, diagnosis, body part, injury mechanism, specific body part, and side of injury. Each aspect had a column in the spreadsheet. The filter feature in excel was used to select the specific subset of injury, and then the sum of the statistical weights, the national estimate, was recorded.

The individual ages were grouped into six age groups, and certain diagnoses with very low national estimates were grouped into the "other" category. Individual body part national estimates were recorded, and they were also grouped into five body part regions.

The tables and sub tables were then converted into graphs using the GraphPad Prism 10 software.

Ethical Considerations

There are no ethical concerns associated with this study, as the NEISS database is publicly available, and doesn't have information that would reveal anyone's identity.

Results

Overview

There were 4,498 injuries caused by playing lacrosse in the NEISS database from 2012 to 2022, representing 130,329 injuries nationwide.

Demographic Distribution

Most injuries occurred in males, representing 71.41% of the national estimate. Most injuries were from players in the 10-18 age group, representing 84.07% of the national estimate.

Table 1. Demographic distribution.

Sex	**National Estimate[1]**	**% of Total[2]**
Total	130,329	100%
Male	93,061	71.41%
Female	37,267	28.59%
Age	**National Estimate**	**% of Total**
Total	130,329	100%
0-9	2,459	1.89%
10-18	109,564	84.07%
19-25	14,406	11.05%
26-45	2,754	2.11%
46-65	944	0.72%
66+	203	0.16%
Race	**National Estimate**	**% of Total**
Total	130,329	100%
White	83,475	64.05%
Black	4,607	3.53%
Asian	1,321	1.01%
American Indian/Alaskan Native	491	0.38%
Native Hawaiian/Pacific Islander	28	0.02%
Other	2,622	2.01%
Not Stated	37,784	28.99%

[1]National estimates may not add up exactly to the total due to rounding.
[2]Percentages may not add up exactly to 100% due to rounding.

Diagnosis

The most common diagnosis was sprain/strain, with a national estimate of 28,241(21.67%) injuries.

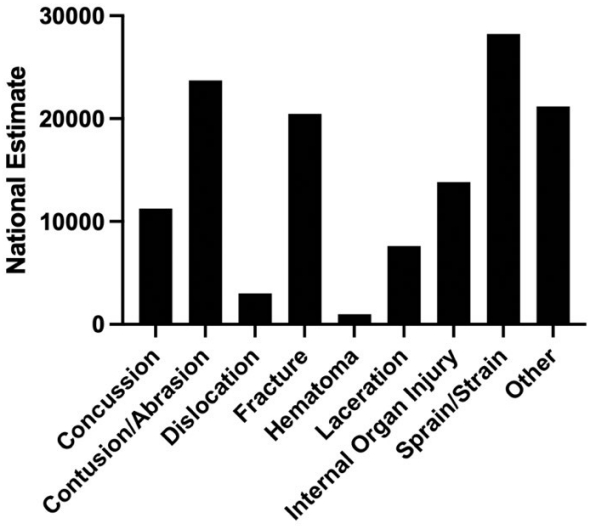

Figure 1. National estimate for each diagnosis. Sprain/strain was the most common diagnosis, followed by contusion/abrasion and fracture.

Body Part

The most injured body part region was the upper extremity, with a national estimate of 40,698(31.23%) injuries. In comparison, the lower extremity had a national estimate of 32,127(24.65%). There were 40,166(30.82%) head/face/neck injuries and 15,160(11.63%) trunk injuries.

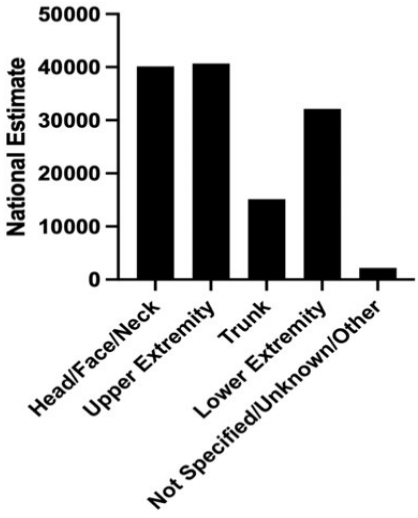

Figure 2. National estimate for each body part region. The upper extremity was the most injured body part region, followed closely by head/face/neck.

Diagnosis and Body Part

The most common diagnosis for each body part region was internal organ injury (head/face/neck), fracture (upper extremity), contusion/abrasion (trunk), and sprain/strain (lower extremity).

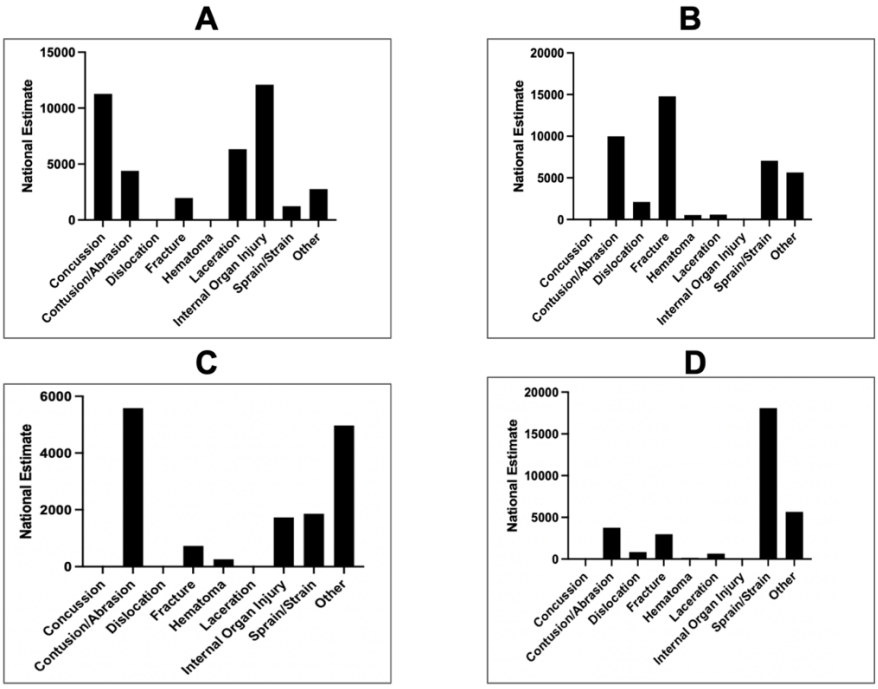

Figure 3. Diagnosis national estimate for each body part region. Figure 3A: head/face/neck. Figure 3B: upper extremity. Figure 3C: trunk. Figure 3D: lower extremity.

Injury Mechanism

The most common injury mechanism was hit by stick, with a national estimate of 24,413(18.73%).

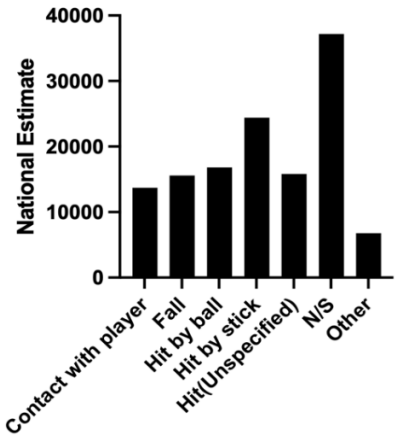

Figure 4. National estimate for each injury mechanism. The most common injury mechanism was hit by stick, followed by hit by ball and hit(unspecified).

Injury Mechanism and Diagnosis

33.94% of contusions/abrasions were caused by being hit by the lacrosse stick. 23.50% of fractures were caused by falls. 15.11% of sprains/strains were caused by falls.

Table 2. Diagnoses split by injury mechanism.

Injury Mechanism (Contusion/Abrasion)	**National Estimate (Contusion/Abrasion)[1]**	**% of Total (Contusion/Abrasion)[2]**
Total	23,718	100%
Contact With Player	1,919	8.09%
Fall	1,318	5.56%
Hit by Ball	4,475	18.87%
Hit by Stick	8,050	33.94%
Hit (Unspecified)	4,083	17.21%
N/S	3,523	14.85%
Other	349	1.47%
Injury Mechanism (Fracture)	**National Estimate (Fracture)**	**% of Total (Fracture)**
Total	20,461	100%
Contact With Player	2,104	10.28%
Fall	4,809	23.50%
Hit by Ball	1,995	9.75%
Hit by Stick	3,637	17.78%
Hit (Unspecified)	1,771	8.66%
N/S	5,311	25.96%
Other	833	4.07%
Injury Mechanism (Sprain/Strain)	**National Estimate (Sprain/Strain)**	**% of Total (Sprain/Strain)**
Total	28,241	100%
Contact With Player	2,145	7.60%
Fall	4,266	15.11%
Hit by Ball	676	2.39%
Hit by Stick	1,937	6.86%
Hit (Unspecified)	1,277	4.52%
N/S	16,366	57.95%
Other	1,573	5.57%

[1]National Estimates may not add up exactly to the total due to rounding.
[2]Percentages may not add up exactly to 100% due to rounding.

Injury Mechanism and Body Part

25.51% of head/face/neck injuries were caused by being hit by the lacrosse ball. 25.80% of upper extremity injuries were caused by being hit by the lacrosse stick. 22.89% of trunk injuries were caused by being hit by the lacrosse stick. 10.81% of lower extremity injuries were caused by falls.

Table 3. Body part regions split by injury mechanism.

Injury Mechanism (Head/Face/Neck)	**National Estimate (Head/Face/Neck)[1]**	**% of Total (Head/Face/Neck)[2]**
Total	40,166	100%
Contact With Player	6,638	16.53%
Fall	2,897	7.21%
Hit by Ball	10,247	25.51%
Hit by Stick	8,680	21.61%
Hit (Unspecified)	7,468	18.59%
N/S	2,960	7.37%
Other	1,274	3.17%
Injury Mechanism (Upper Extremity)	**National Estimate (Upper Extremity)**	**% of Total (Upper Extremity)**
Total	40,698	100%
Contact With Player	3,078	7.56%
Fall	8,375	20.58%
Hit by Ball	2,321	5.70%
Hit by Stick	10,499	25.80%
Hit (Unspecified)	4,887	12.01%
N/S	10,400	25.55%
Other	1,138	2.80%
Injury Mechanism (Trunk)	**National Estimate (Trunk)**	**% of Total (Trunk)**
Total	15,160	100%
Contact With Player	1,079	7.12%
Fall	819	5.40%
Hit by Ball	3,153	20.80%
Hit by Stick	3,470	22.89%
Hit (Unspecified)	2,122	14.00%
N/S	3,900	25.73%
Other	615	4.06%
Injury Mechanism (Lower Extremity)	**National Estimate (Lower Extremity)**	**% of Total (Lower Extremity)**
Total	32,127	100%
Contact With Player	2,931	9.12%
Fall	3,474	10.81%
Hit by Ball	1,074	3.34%
Hit by Stick	1,753	5.46%
Hit (Unspecified)	1,342	4.18%

N/S	19,205	59.78%
Other	2,347	7.31%

[1]National Estimates may not add up exactly to the total due to rounding.
[2]Percentages may not add up exactly to 100% due to rounding.

Side of Injury

There were significantly more upper extremity injuries on the right side than the left side. 36.72% percent of upper extremity injuries were on the right side, while 25.87% of upper extremity injuries were on the left side.

Table 4. Upper extremity and lower extremity split by side of injury.

Side of Injury (Upper Extremity)	**National Estimate (Upper Extremity)[1]**	**% of Total (Upper Extremity)[2]**
Total	40,698	100%
Left	10,528	25.87%
Right	14,946	36.72%
Both	88	0.22%
N/S	15,133	37.18%
Side of Injury (Lower Extremity)	**National Estimate (Lower Extremity)**	**% of Total (Lower Extremity)**
Total	32,127	100%
Left	8,756	27.25%
Right	10,549	32.84%
Both	188	0.59%
N/S	12,632	39.32%

[1]National estimates may not add up exactly to the total due to rounding.
[2]Percentages may not add up exactly to the total due to rounding.

Injured Digit

The first digit was the most injured digit for both the finger and the toe.

Table 5. Finger and toe injuries split by injured digit.

Injured Digit (Finger)	**National Estimate (Finger)[1]**	**% of Total (Finger)[2]**
Total	8,129	100%
First Digit	5,025	61.82%
Second Digit	465	5.72%
Third Digit	218	2.68%
Fourth Digit	84	1.03%
Fifth Digit	393	4.83%
N/S	1,943	23.90%

Injured Digit (Toe)	National Estimate (Toe)	% of Total (Toe)
Total	525	100%
First Digit	199	37.90%
Second Digit	0	0%
Third Digit	0	0%
Fourth Digit	0	0%
Fifth Digit	84	16.00%
N/S	242	46.10%

[1]National estimates may not add up exactly to the total due to rounding.
[2]Percentages may not add up exactly to 100% due to rounding.

Specific Bone Fractured

The most fractured bone in the upper extremity was the phalanx, with a national estimate of 2,887, representing 19.53% of upper extremity fractures.

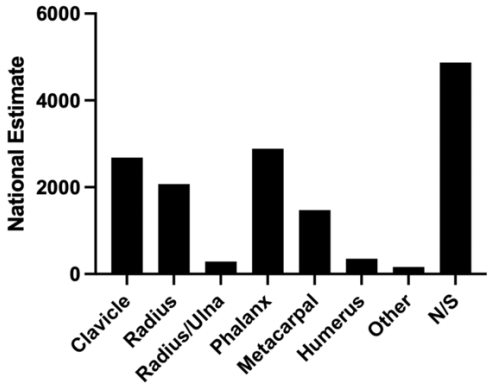

Figure 5. Upper extremity fractured bone national estimate. Phalanx fractures had the highest national estimate, followed by the clavicle and the radius.

The most fractured bone in the lower extremity was the fibula, with a national estimate of 647, representing 21.76% of lower extremity fractures.

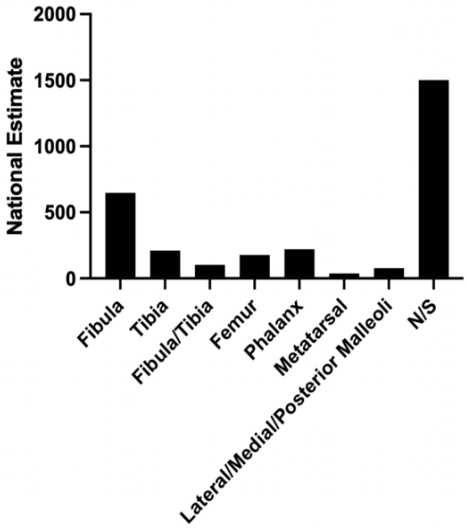

Figure 6. Lower extremity fractured bone national estimate. Fibula fractures had the highest national estimate, followed by phalanx and tibia.

Discussion

Results Summary

There was a national estimate of 130,329 lacrosse injuries seen at emergency departments from 2012 to 2022. The majority of the injuries were incurred in male lacrosse players, and most injuries were from players aged 10-18. Sprain/strain was the most common type of injury diagnosed, and the upper extremity was the most injured body part region. Internal organ injury and concussion were the most common diagnoses for the head/face/neck. The most common diagnosis for the upper extremity was fracture, while for the lower extremity it was sprain/strain. Contusion/abrasion was the predominant diagnosis for the trunk. Getting hit by the stick was the most common injury mechanism.

Results Justification/Explanation

The key findings of this study were similar to those of other studies. No prior studies had queried for the same data, but the results of this study were compared to those of similar studies. Bano et al. (2023) looked at lacrosse injuries from players aged 11-18, an age group that represented most of the national estimate of this study. Bano et al. (2023) had found sprain/strain to be the most common diagnosis, the upper extremity to be the most injured body part region, and hit by stick to be the most common injury mechanism, all results that match the findings of this study. With regards to demographic data, 73.7% of the national estimate in Bano et al. (2023) was male, a very similar percentage to the 71.41% for this study. The consistency in results both supports the validity of previous studies' findings and the validity of this study's findings.

According to 2018 lacrosse participation data, 60% of all United States lacrosse participants were male (*Lacrosse Participation in the U.S. By Level/Gender 2018*, n.d.). Injuries from male players represented 71.41% of the national estimate in this study, indicating that males are more prone to injury when considering the participation data. This conclusion matches a study finding that males had a risk of 2.42 injuries per 1000 athlete exposures while females had a risk of 2.22 injuries per 1000 athlete exposures (*Common Lacrosse Injuries & Trends | AOSSM Sports Medicine*

News, n.d.). One likely factor for this difference in injury risk is because men's lacrosse involves more contact than women's lacrosse.

The reason for the 10-18 age group representing most of the national estimate is because of more participation. Roughly 93% of lacrosse participants were in youth or high school levels (*Lacrosse Participation in the U.S. By Level/Gender 2018*, n.d.).

One possible factor in why sprain/strain was the most common diagnosis is that lacrosse is a sport with a high amount of directional changes and running. A possible factor for why the upper extremity was the most injured body part region is because the upper extremity is especially vulnerable to stick checking in lacrosse, as evident by hit by stick being the most common injury mechanism for the upper extremity. A likely explanation for why the head/face/neck region also had a high national estimate is because head trauma (concussions and internal organ injury) occurs frequently from colliding with a ball, stick, or another player, as evident by collision injuries being the most prevalent injury mechanisms in the head/face/neck region. Most lacrosse players wear helmets, but helmets only provide a limited level of protection against concussions (*Common Lacrosse Injuries & Trends | AOSSM Sports Medicine News*, n.d.). Contusion/abrasion was the most common diagnosis for the trunk, and this could be due to a lack of trunk protection because rib pads are optional in lacrosse (*Equipment*, n.d.).

Stick checking is both legal and common in lacrosse, which likely explains why hit by stick was the most common injury mechanism. Since lacrosse is a sport reliant on a dominant arm and most players are right-handed, it is possible there were significantly more upper extremity injuries on the right side because of this. A possible factor for why the phalanx was the most fractured upper extremity bone is because the fingers are vulnerable to stick checking, which can cause phalanx fractures.

Objectives

This study successfully achieved the objective of analyzing general injury trends and identifying the most common injury types for United States lacrosse injuries seen at emergency departments. Additionally, the study was able to present new findings for the area of research.

Implications

The findings of this study possess both academic and practical significance. The results of this study were consistent with prior studies, confirming the validity of the prior studies in the research area and supporting the findings of this study. This study also brought new findings to lacrosse injury research, as prior studies did not look at general injury trends nor include certain narrative data such as the side of injury, digit of injury, and fractured bone. The study supported existing evidence of male players being more prone to injury because of different rules and regulations, suggesting that equipment manufacturers and rule-makers should particularly focus on making men's lacrosse safer. Since stick checking was a cause for various injury types, equipment manufacturers should consider developing protective equipment designed to be more resistant to lacrosse stick strikes. The identification of the most common injury types can be used by sports medicine clinics to help protect their athletes from the injuries they are most at risk of.

Recommendations

Future studies could analyze lacrosse injuries seen at other sources of care, such as primary care and urgent care. The findings could then be compared to those of NEISS studies to test if emergency department injury data is similar to that of other sources of care. Studies on lacrosse injuries seen at other sources of care could create new findings and conclusions, alter existing findings and conclusions, or further support existing findings and conclusions. This research

could address the possible selection bias in NEISS studies, as certain injuries might be more commonly seen at one source of care than another.

Conclusion

This study successfully identified general lacrosse injury trends and common lacrosse injury types using the NEISS database, bringing new findings to lacrosse injury research and further supporting existing findings. The results can also guide the development of new equipment and rules for the sport and can provide essential injury information for lacrosse athletes and sports medicine clinics. Future studies should conduct research on lacrosse injuries seen at other sources of care and compare the results to NEISS lacrosse studies.

Limitations

The main limitation with this study was that it only analyzed injuries from the NEISS database, a database solely focused on U.S emergency departments. This limited the scope of the study, excluding injuries in other countries and injuries seen at other sources of care. Additionally, it is possible that certain types of injury were seen more frequently at one type of medical care than another, which could create a selection bias for the results of this study.

Another limitation was that some of the injury narratives lacked specificity and didn't mention the injury mechanism, specific body part injured, and/or side of injury. Thus, the N/S classification was used when certain information could not be extracted from the narrative. The narrative data results would have been more accurate and reliable if all narratives specified the information.

Despite the two limitations associated with the NEISS database, the study was able to successfully achieve the research objective. The NEISS database possesses many strengths, such as having national estimates and many injury aspects specified through the coding.

Acknowledgments

I would like to thank my advisor for the valuable insight provided to me on this topic.

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