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ORIGINAL PAPER

Epidemiology of Injury-Related Emergency Department Visits in the US Among Youth with Autism Spectrum Disorder

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Abstract Several reports suggest children with autism spectrum disorder (ASD) are more likely to be seen for injury-related ED visits; however, no nationally representative study has examined this question. Using data from the 2008 Nationwide Emergency Department Sample, over a quarter of all visits among those with ASD were related to injury. In the multivariate analyses, the odds of an injury-related visit was 54 % greater among those with ASD compared to youth with intellectual disability (ID), but 48 % less compared to youth without ID or ASD. Compared to all other pediatric injury-visits in the US, visits among children with ASD were more likely to be due to self-inflicted injury and poisoning and were more likely to result in hospitalization (all $p < 0.001$).

Keywords Autistic disorder · Injury · Epidemiology · Intellectual disability · Emergency medicine

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Introduction

Autism spectrum disorders (ASD) are a group of neurodevelopmental disorders characterized by impairments in social communication and interaction, as well as restricted, repetitive behaviors and interests (American Psychiatric Association 2013). Beyond these impairments, approximately 50 % of youth with ASD have an intellectual disability (ID; Volkmar et al. 1995; Matson and Shoemaker 2009; Charman et al. 2011; Baio 2012) and more than half suffer from a co-occurring psychiatric disorder (Simonoff et al. 2008). Other challenges faced by children with ASD include elopement, sensory processing and executive function difficulties, and lack of danger perception (Cavalari and Romanczyk 2012; Anderson et al. 2012; Lawson et al. 2015; Iannuzzi et al. 2014). These impairments can make it difficult for children with ASD to safely navigate their environments, possibly placing them at an increased risk for accidents and injuries. Given the global burden of morbidity and mortality associated with injury, a more detailed understanding of this problem is important for developing interventions that keep these individuals safe in their community.

Several studies using various methods and sampling procedures have examined both intentional and unintentional injury among children with ASD. Using data from the National Survey of Children's Health, Lee et al. (2008) reported that 3–5 year old children with ASD had double the rate of injuries compared to typically developing (TD) youth (24 vs. 12 %). McDermott et al. (2008), using Medicaid claims from South Carolina, found a 20 % increased odds of hospital/ED-related injury visits and a nearly eight fold increased odds of poisoning and self-inflicted injury in youth with ASD (n = 1610), compared to those without ASD. Findings from Schlenz et al. (2015)

mirrored those reported by McDermott et al. (2008), regarding an increased risk for self-inflicted injury, for adolescents (ages 13–18) with ASD enrolled in the South Carolina Autism and Developmental Disabilities Monitoring Network.

Taken together, it is unclear as to whether children with ASD are at increased risk for injuries or whether the findings are a product of methodological limitations including narrow age ranges and/or reliance primarily on parental retrospective report. Thus far, no study has employed a nationally representative sample to assess the proportion of ED visits that are related to injury involving youth with ASD using objective, claims-based data. Use of a large dataset also allows for examination of relatively rare events among and between minority groups such as those with ASD and youth with ID.

The current study aims to fill this gap in the literature through the use of nationally-representative ED data to characterize injury-related ED visits among youth with ASD. The first objective was to examine differences in the proportion of ED visits that are due to injury among three mutually exclusive groups: youth with ASD, youth with ID, and youth without ASD or ID. The second objective was to examine differences in the method and intent of injury-related ED visits across the ASD group, the ID group, and all other injury-related visits among youth without ASD or ID (hereafter referred to as the "Non ASD/Non ID group"). The final objective was to compare group differences in the probability of being hospitalized after an injury-related ED event.

Methods

Sample

Data for this study came from the 2008 Nationwide Emergency Department Sample (NEDS) database. NEDS is part of the Healthcare Cost and Utilization Project (HCUP), which is sponsored by the Agency for Healthcare Research and Quality (AHRQ). NEDS is the largest all-payer ED database publicly available in the US and allows for national estimates of hospital-based ED visits. NEDS contains more than 30 million ED visits each year, a stratified sample of approximately 20 % of all ED visits in US community, non-rehabilitation hospital EDs. In 2008, the NEDS included visits from 980 EDs in 28 states.

NEDS provides up to 15 International Classification of Disease, Ninth Revision, Clinical Modification (ICD-9-CM) codes and up to four External-Cause-of-Injury codes (E-codes) per ED discharge. Sampling weights are provided for calculating national estimates and confidence intervals of the estimates to make inferences to all ED visits from hospital-based emergency departments in community, non-rehabilitation hospitals in the US. Since these data were publicly available and thus de-identified, this study was considered exempt by the Institutional Review Board of the Johns Hopkins School of Medicine. De-identification of the data also precludes the ability to identify those patients with multiple visits. Thus, it is not possible to know if a single patient is responsible for multiple visits. Further description of the NEDS study and data is available on the NEDS website (http://www.hcup-us.ahrq.gov/nedsoverview.jsp).

ASD and ID Diagnosis

ASD and ID groups were identified using ICD-9-CM codes. ASD was identified using the Pervasive Developmental Disorders (PDD) ICD-9-CM classification of 299.XX, which includes autistic disorder (299.0), childhood disintegrative disorder (299.1), as well as specific (299.8) and nonspecific (299.9) pervasive developmental disorders. These diagnoses were collapsed into a single ASD category if a visit contained any of the four PDD diagnoses across one of the 15 potential diagnostic slots coded by the ED physician. ID was similarly coded and collapsed across ICD-9 codes 317 (mild ID), 318 (other, specified ID), and 319 (other, unspecified ID).

Visits with the presence of ICD code 315 "Specific delays in development" (including developmental speech or language disorder, mixed development disorder, other specified delays in development, etc.) were excluded from the analyses (unweighted, $n = 4628$) when the diagnosis of ID or ASD weren't present. Such visits were omitted since these children are at increased probability for misclassification with ID or ASD. Sensitivity analyses were conducted to examine if inclusion of these children changed the inferences across each study objective. Results showed that the inclusion of these visits did not affect any of the study findings. Secondly, children with both ASD and ID were excluded given the small sample size (unweighted, $n = 734$); thus, the ASD and ID groups are mutually exclusive representing those with ASD only and ID only. The remaining non-ASD, non-ID injury visits, termed "Non ASD/Non ID group", served as the reference group in the analyses. To increase the reliability of the child's diagnosis, the present analysis was restricted to children between the ages of 3–17 years. This resulted in removal of only eight children with an ASD diagnosis less than 3 years of age.

Measures

Demographic variables included age, gender, insurance type (collapsed into private, medical assistance, self-pay

and other), median household income by patient zip code, and whether the visit occurred on a weekend or a weekday. Hospital variables included the region of the country, rurality, and trauma level (collapsed into nontrauma and trauma I-III). Race is not publically available in the NEDS dataset.

Type of injury was identified using the suggested matrix from the CDC (2011) on presenting injury mortality and morbidity data, and included the following categories: poisoning, cut/pierce, suffocate, fall, burn, firearms, and struck by/against (referred to injury resulting from being hit or crushed by a human, animal, or inanimate object or force other than a vehicle or machinery). Types of injuries that were not listed in the CDC (2011) matrix were classified as "Other".

Injury intent was determined via E-code and Clinical Classification Software (CCS) for ICD-9-CM provided by HCUP (HCUP 2008; Elixhauser et al. 2014). Self-inflicted injury was defined by the CCS code 662, which includes E codes 950–959 and all other ICD-9-CM diagnoses related to self-injury and suicide. Other-inflicted injury was defined by E-codes 960–969 and undetermined intent was coded via E-codes 980–989. The remaining category, which included all other types of injuries, is referred to as unintentional injuries.

Psychiatric diagnoses were extracted using CCS categories, which directly relate to ICD diagnoses, to facilitate smaller and more clinically meaningful groups. These categories included mood disorders (CCS: 657, including bipolar and depressive disorders), anxiety disorders (CCS: 651), behavioral disorders (CCS: 652; including conduct, oppositional, and attention-deficit hyperactivity disorders), and psychotic disorders (CCS: 659). For the sake of parsimony, mood and anxiety were collapsed into one category termed internalizing problems and behavioral disorders are referred to as externalizing disorders. The psychotic disorders remained unaltered.

Lastly, disposition status was originally captured in NEDS as a 3-level variable, whereby the visits could result in: discharge to caregiver, transfer to a short-term hospital, and admitted to the hospital where the ED visit took place. In the regression analysis, discharge to another hospital and inpatient admission to the current hospital were collapsed due to small sample sizes and given the ultimate purpose was to examine the probability of inpatient admission, regardless of where hospitalization occurred. The NEDS does not include information about the type of inpatient admission (e.g., psychiatric vs. medical).

Data Analysis

To address the first objective, a survey weighted multivariate logistic regression model—adjusting for all eight demographic and hospital-related variables seen in Table 1—was performed to examine differences in the adjusted odds of an injury-related visit among three groups: the ASD group, ID group, and the Non ASD/Non ID group. Similar models, adjusting for demographic and hospital-related variables seen in Table 1, were used to examine differences—between the ASD group, ID group, and the Non ASD/Non ID group—across four additional outcomes: (1) the odds of an injury-related visit being self-inflicted or (2) other-inflicted; (3) the odds of a poison-related injury visit; and, (4) the odds of an injury-related visit resulting in a hospital admission.

While all variables in Table 1 were conceptualized as confounders, psychiatric diagnoses were not included in either model since these variables were considered potential mediator(s)/moderators(s), rather than confounders, of the association between developmental disability diagnosis and injury outcome. Medical problems were also not included in the analysis as confounders since they may be mediator(s), moderators(s), and/or direct sequela of the injury. All coefficients of the logistic models were exponentiated and reported as odds ratios, and all analyses were conducted using the svy commands of STATA/SE 12.1 (StataCorp. 2011).

Results

Group Differences in Demographics, Hospital Characteristics, and Psychopathology

As shown in Table 1, all comparisons of demographic and hospital variables were statistically significant between the three groups ($p < 0.001$). To minimize multiple comparisons, overall trends from Table 1 are discussed, rather than providing pair-wise contrasts across each variable.

The ASD group was more likely to be male, a known characteristic of ASD, and younger as compared to the other two groups. Visits among the ASD and ID groups were more likely to be covered by medical assistance and less likely to be self-pay compared to the Non ASD/Non ID group. Visits among the ASD and Non ASD/Non ID groups were more likely to involve private medical insurance compared to those with ID.

For household income by zip code, visits among the ASD group were associated with higher income zip codes as compared to visits among the other two groups. Visits by the ID group were more likely to come from zip codes with the lowest household income. Visits by the ID group were also less common on weekends compared to Non ASD/Non ID group visits.

When comparing hospital variables, visits among the ASD and the Non ASD/Non ID groups were less likely to

Table 1 Survey weighted patient demographic and hospital-related descriptive statistics for injury-related emergency department visits

	ASD group	ID group	Non ASD/non ID group	Weighted F or X^2 value	P
Sample size (n, %[a])	14,532 (26)	4118 (17)	6,398,195 (36)	701.6	<0.001
Age, mean (SD)	9.0 (4.1)	12.0 (4.0)	10.6 (4.5)	46.9	<0.001
Female (%)	15.6	38.5	40.2	384.5	<0.001
Insurance (%)				118.7	<0.002
Private	47.0	25.0	53.2		
Medical assistance	45.2	67.7	33.3		
Self-pay	3.8	3.5	9.0		
Other	4.0	3.8	4.5		
Household income by zip code (%)				16.2	<0.001
$1–$38,999	21.5	28.8	27.8		
$39,000–$48,999	27.0	28.5	28.5		
$49,000–63,999	26.2	25.7	22.3		
>$63,000	25.1	17.0	21.4		
Weekend (%)	29.4	24.0	30.7	10.6	<0.001
Region (%)				13.5	<0.001
Northeast	21.5	24.1	21.6		
Midwest	24.7	21.1	23.6		
South	31.1	29.8	36.2		
West	22.7	24.9	18.7		
Rurality (%)				19.5	<0.001
Large central metropolitan	26.5	32.1	22.1		
Large fringe metropolitan	27.0	22.1	24.4		
Medium metropolitan	22.7	19.2	21.7		
Small metropolitan	10.3	10.3	10.4		
Micropolitan	9.7	11.2	12.7		
Neither metropolitan nor micropolitan	3.7	5.2	8.7		
Trauma hospital (%)	46.7	59.4	34.3	228.6	<0.001

Note: Other injury visits refers to injury-related visits among youth without ASD, ID, or "Other delays in development" (ICD code 315). The ASD and ID groups are also mutually exclusive

[a] Percentages reflect the proportion of ED visits that are injury-related for each group

occur in trauma hospitals and larger metropolitan areas compared to the ID group. Visits among the ASD and ID groups were less likely to be in the Southern region of the US and more likely to be in the Western portion of the US compared to the Non ASD/Non ID group.

In terms of psychopathology, as seen in Table 2, the ASD and ID groups were also more likely to have internalizing, externalizing, and psychotic disorder diagnoses compared to the Non ASD/Non ID group. In the adjusted models, the ASD and ID groups were over 11 (OR 11.61, 95 % CI 9.94–13.60) and 5 (OR 5.79, 95 % CI 4.50–7.45) times more likely to have an internalizing disorder coded during an injury visit, compared to the Non ASD/Non ID group; the ASD group was 2 times more likely (OR 2.00, 95 % CI 1.42–2.69) to have an internalizing disorder compared to the ID group. For an externalizing diagnosis, the ASD and ID groups were over 10 (OR 10.13, 95 % CI 9.10–11.30) and 9 (OR 9.27, 95 % CI 7.60–11.35) times more likely to have an externalizing disorder coded during an injury visit, respectively, compared to the Non ASD/Non ID group, while no differences were found between the ASD and ID group (OR 1.09, 95 % CI 0.86–1.37). The ASD and ID groups were also over 14 (OR 14.05, 95 % CI 8.53–23.11) and 18 (OR 18.29, 95 % CI 10.45–32.04) times more likely to have a psychotic disorder coded during an injury visit, respectively, compared to the Non ASD/Non ID group, while no differences between the ID and ASD group emerged (OR 0.76, 95 % CI 0.37–1.61).

Prevalence of Injury-Related Visits

Thirty-six percent (n = 6,398,195), 26 % (n = 14,532) and 17 % (n = 4118) of all visits were related to injury among youth without ID or ASD, the ASD group, and the ID group, respectively. In the unadjusted survey weighted logistic regression model, the odds of an injury-related visit

Table 2 Mechanism of injury, intent, psychiatric diagnoses and disposition status of injury-related ED emergency department across groups (ages 3–17 years)

	ASD group	ID group	Non ASD/non ID group	Weighted F or X^2 value	P
Average number of injuries coded per visit (M, SD)	1.7 (.7)	1.6 (.6)	1.7 (.7)	0.01	0.92
Type of injury (%)				761.4	<0.001
Fall	28.9	20.9	27.2		
Struck by/against	14.9	9.3	23.2		
Cut/pierce	7.0	6.1	7.5		
Poisoning	5.7	4.9	2.1		
Motor vehicle accident	4.7	3.9	6.9		
Burn	1.1	1.3	0.9		
Suffocate	0.5	0.9	0.1		
Drown	0.2	0.1	<.1		
Firearm	<.1	<.1	.3		
Other	36.9	52.5	31.7		
Injury intent (%)				32.1	<0.001
Self-inflicted	2.4	4.1	1.0		
Other-inflicted	2.1	6.5	2.9		
Undetermined	0.8	1.1	0.4		
Unintentional	94.7	88.3	95.6		
Psychiatric diagnoses				664.8	<0.001
Externalizing	13.1	13.7	1.4		
Internalizing	7.3	9.5	1.1		
Psychosis	0.6	1.7	<0.01		
Disposition (%)				902.4	<0.001
Discharge to caregiver	85.4	59.6	95.0		
Transfer to other facility	2.8	4.2	1.8		
Inpatient hospitalization on-site	11.2	36.1	2.5		

Other injury visits refers to injury-related visits among youth without ASD, ID, or "Other delays in development" (ICD code 315). The ASD and ID groups are also mutually exclusive

was 65 % and 39 % less among the ID (OR 0.35, 95 % CI 0.32–0.38) and ASD (OR 0.61, 95 % CI 0.58–0.64) groups compared to those without ID or ASD (both $p < 0.001$). When comparing the ASD and ID groups, the unadjusted odds of an injury-related visit was 71 % greater among the ASD group compared to the ID group (OR 1.71, 95 % CI 1.57–1.86, $p < 0.001$). In the fully adjusted model, which included all demographic variables listed in Table 1, the odds of an injury-related visit was 64 % and 48 % less among the ID (OR 0.34, 95 % CI 0.31–0.36) and ASD (OR 0.52, 95 % CI 0.50–0.54) groups compared to the Non-ASD/Non-ID group, while the ASD group odds of an injury visit was over 50 % greater than the ID group (OR 1.54, 95 % CI 1.41–1.68) (all $p < 0.001$).

Injury Type and Intent

In general, the most common types of injuries for all visits, as seen in Table 2, were fall and being struck by or against. These two types of injuries were more likely to occur in the ASD and Non ASD/Non ID groups compared to the ID group, while the ASD group was less likely to be struck by or against than the Non ASD/Non ID group. Visits in both the ASD and ID groups were more likely to be associated with poisoning or suffocation, and less likely to be related to motor vehicle accidents or firearms when compared to the visits in the Non ASD/Non ID group. In the adjusted logistic model, visits in the ASD group were 2.5 times (OR 2.50, 95 % CI 1.67—3.75, $p < 0.001$) more likely to be related to poisoning compared to the Non ASD/Non ID group. However, there were no differences in the probability of poisoning among the ID group compared to the Non ASD/Non ID group (OR 1.61, 95 % CI 0.92–2.81, $p = 0.09$) or the ASD group (OR 0.64, 95 % CI 0.32–1.27, $p = 0.21$). No differences in the average number of injuries coded per visit were present across the three groups.

Overall group differences in injury intent were also observed. In the adjusted models, visits in the ASD and ID groups were over 5 times (OR 5.40, 95 % CI 4.18–6.92, $p < 0.001$) and 3 times (OR 3.24, 95 % CI 2.27–4.63,

$p < 0.001$) more likely to be associated with a self-inflicted injury compared to the Non ASD/Non ID group. Visits among the ASD group were 66 % more likely to be related to self-inflicted injury compared to visits among the ID group (OR 1.66, 95 % CI 1.07–2.56, $p = 0.02$). On the other hand, visits among the ID group were 46 % more likely to be due to other-inflicted injury compared to the Non ASD/Non ID group (OR 1.46, 95 % CI 1.05–2.01, $p = 0.02$), although the difference between other-inflicted injury visits in the ID and ASD groups did not reach statistical significance (OR 1.40, 95 % CI 0.93–2.10, $p = 0.11$). There were no differences in the proportion of other-inflicted injury between the ASD and Non ASD/Non ID group (OR 1.04, 95 % CI 0.81–1.32, $p = 0.75$). In addition to self- and other inflicted, a small proportion of visits were considered undetermined, while the remaining and preponderance of visits were unintentional.

For the self-inflicted injury analysis, it is important to highlight the substantial anticonservative (away from the null, or overestimation of the effect) and conservative (towards the null, or underestimation of the effect) confounding by age and gender that was present for the ASD and ID groups, respectively. This can be seen in the unadjusted odds, which implicates the ID group as having the greatest proportion of self-injurious visits. However, when the covariate of age alone was added to the model, the relative odds of self-injury (compared to all Non ASD/Non ID group) moved from 2 to 4 among the ASD group and decreased from 4 to 3 among the ID group. When gender was added alongside age, the estimates continued to separate, as the OR moved to 6 for ASD and remained at 3 for ID. The final estimates, after all variables were included in the model, are reported above.

Disposition

Visits among the ID group had the highest odds of hospitalization from the ED. They were over 12 times (OR 12.1, 95 % CI 10.50–14.0, $p < 0.001$) and three times (OR 3.41, 95 % CI 2.85–4.07, $p < 0.001$) more likely to have the visit result in hospitalization compared to the Non ASD/Non ID and ASD groups, respectively. The likelihood of hospitalization was also significantly higher among the ASD group compared to the Non ASD/Non ID group (OR 3.55, 95 % CI 3.20–3.90, $p < 0.001$).

Discussion

This is the first national study to assess the epidemiology of specific injury types, which resulted in an ED visit, among children with ASD or ID. Results from the analyses indicate that the ASD and ID groups had proportionately less injury-related ED visits compared to the Non-ASD/Non-ID group. The results do, however, show that the proportion of injury-related ED visits among youth with ASD was greater than the proportion of visits related to injury among those with ID. Furthermore, specific differences in types and intent of injury clearly emerged for both the ID and ASD groups, when compared to visits among the Non ASD/Non ID group, which provides targets for injury prevention and intervention among these populations.

While many similarities across groups were present with respect to the type of injury-related visit, the most notable difference among the ASD and ID groups was an increased probability of poisoning; a finding that is consistent with McDermott et al. (2008). However, poisoning does not seem to be specific to ASD given there were no differences in the probability of such compared to those with ID. Further research is warranted to better understand which substances were ingested (e.g., household products, prescription medications) as well as the endogenous and exogenous risk factors for poisoning that are shared by these populations, such as the presence of psychiatric symptoms (Brereton et al. 2006) and use of multiple psychopharmacologic agents (Spencer et al. 2013; Kreider et al. 2014), respectively. The findings, however, do indicate that poison prevention strategies should be made readily available to caregivers of children with ASD or ID, and medical providers should regularly monitor application of child-proofing efforts in the home for both groups.

An important result from this study was the higher probability of psychiatric symptoms and self-inflicted injury among those with ASD or ID compared to those without ASD or ID. While the presence of psychiatric symptoms and self-injurious behaviors are known risk factors for suicide in the typically-developing population, future research is required to better understand if psychiatric symptoms and self-injurious behaviors increase the probability for suicide among those with developmental disabilities. Unfortunately, the ICD E-codes 950–959 include both self-inflicted injury with and without suicidal intent so we are unable to precisely sort out suicidal intent for specific visits. Nevertheless, this is the third study to report these findings for self-inflicted injury (Schelnz et al. 2015; McDermott et al. 2008), which converges with increasing concern in the literature and media about suicidal behavior in youth with ASD (Segers and Rawana 2014; Hannon and Taylor 2013). Many pediatric emergency department physicians, however, are unfamiliar with the best course of action for individuals with ASD or ID who are deemed to be at high risk. Hospitals in the United States (US) are being strongly encouraged by the Joint Commission to identify safety risks inherent in its patient population including using screen tools to identify those at risk for suicide in response to National Patient Safety Goal

15.01.01. Best-practices for suicide risk screening in subpopulations with ASD and/or ID are needed to fill a critically important patient safety and clinical gap (Ludi et al. 2012).

Another important finding was that visits among youth with ID were disproportionately inflicted by someone else, most likely an assault-related event, as suggested by Ecodes 960–969 ("Homicide and injury purposely inflicted by other persons"). It is unclear if the perpetrator of injury was an adult or a peer as NEDS does not collect these data. Nevertheless, previous reports show that this population is vulnerable to perpetration from both groups via bullying (Sterzing et al. 2012) and maltreatment (Sullivan and Knutson 2002). This is the first study to report an increased rate of injury due to others in the ED among those with ID in the US, and provide an important call to protect these children as well as replicate these findings.

When looking at disposition among the groups, the ASD and ID groups were more likely to be hospitalized, particularly the ID group. This finding could suggest that the medical-psychiatric profile of the child, acuity of the injury, and severity of the outcome is greater than that which is seen in typical pediatric injury in the US. On the other hand, emergency medicine healthcare providers may be less confident in establishing the disposition plan when caring for patients with ASD or ID and tend to keep this population under observation for longer periods to time to err on the side of caution. Second, this finding is consistent with the high costs of care, including probabilities of hospitalization, among youth with these types of neurodevelopmental disorders (Croen et al. 2006). Thus, from both a public health and economic perspective, injury prevention programs are needed for children with DD as well as training and triage protocols for ED providers on managing injuries in children with ASD and ID.

Several limitations of this study deserve mention. This includes the use of a cross-sectional dataset from a single calendar year (2008) that occurred several years prior to this publication. Second, because the NEDS databases are de-identified, it is not possible to link ED visits to a particular patient and therefore it is not known if one patient contributes multiple visits. Third, there were limitations regarding what data was included in the NEDS (e.g., race, perpetrator) and, as mentioned above, there were limited data about the reason for hospitalization (psychiatric vs. medical) and self-inflicted injury. Fourth, it is likely that misclassification of injuries could be present, especially for more stigmatized causes of injury (self-injury, assault), which is particularly concerning considering the large proportion of visits with non-specific coding (i.e., the "Other" type of injury classification) across the ASD and ID groups (see Table 1 for details). Lastly, assessment of injuries and psychiatric diagnoses, including ASD and ID, were not systematically gathered and assessed with gold standard measures across EDs, which is an inherent limitation when using nationally sampled medical record data. This can be seen in the low co-occurrence of ID and ASD (4 %) in the present sample compared to the 50 % co-occurrence reported in the literature (Baio 2012; Charman et al. 2011; Matson and Shoemaker 2009; Volkmar et al. 1995). Future prospective designs, with detailed assessment of injury and diagnosis as well as the inclusion of children with both ASD and ID, is indicated. These limitations should be counterbalanced by the use of a large epidemiologic dataset that allows for assessment of more rare injury types (i.e., poisoning, firearm) and making inferences about the US as a whole.

In summary, data from this study do not indicate that a greater proportion of ED visits, among youth with ASD or youth with ID, are injury-related compared to youth without these disorders. However, patterns of ED use were specific to these populations, notably the increased probability of: (1) poisoning in the ASD and ID groups; (2) self-injury in the ASD group; (3) harm by others in the ID group; and, (4) admission to an inpatient unit after the injury-related ED visit among the ID and ASD groups. Taken together, these data highlight the need for developing prevention and monitoring programs to keep youth with ASD or ID safe in the community.

Author Contributions LK, RV, and HW conceived of the study and participated in the design; LK, RV, HW, EB, RW, and MG participated in interpretation of the data and coordination of the study; LK performed the statistical analysis; All authors read and approved the final manuscript.

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