Disabilities and Motor Vehicle Collisions Involving Pedestrians

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Background

Pedestrian versus motor vehicle collisions (MVC) are associated with substantial morbidity and mortality[1], and it has been shown that the risks of hospital admission and of death for pedestrians involved in a MVC are significantly higher than for car occupants or motorcyclists[2,3]. Although pedestrians were involved in only 2% of all traffic injuries in 1997, they account for 12 to 13% of all traffic-related deaths[4]. According to the National Highway Traffic and Safety Administration, on average a pedestrian is killed in a traffic crash in the United States every 11 minutes[4].

Safe pedestrian behaviors rely on cognitive skills which include the ability to focus attention on the traffic environment and ignore irrelevant stimuli, and studies have demonstrated that individuals with cognitive limitations can be more easily distracted than individuals without intellectual disabilities[5]. In situations involving traffic this can lead to increased risk of injury, since selective attention is vital to safe pedestrian to safely maneuver through situations involving motor vehicles[6].

It is also reasonable to hypothesize that other disabilities, such as sensory deficits including blindness and hearing loss may increase the risk of pedestrian injuries from motor vehicle traffic. It is possible that children with sensory deficits comprise a high-risk group for pedestrian injuries, although it is also possible that these children receive higher levels of adult supervision than their same age peers and consequently have lower injury rates[5]. In a study conducted in New Zealand, Roberts and Norton concluded that the risk of pedestrian injury for children whose parents reported abnormal vision was over four times that of children with reported normal vision. Additionally they determined that the risk of injury for children whose

parents reported abnormal hearing was close to twice that of children with reported normal hearing.

This report details auto-pedestrian injury cases for South Carolinians with a disability and those without a disability. The purpose is to compare the frequency of such injury cases between individuals with a disability and without a disability.

Methods

We conducted an analysis of Medicaid data in South Carolina to compare the risk of pedestrian motor vehicle injury in people with selected disabilities compared to those without. The categories of disability examined included sensory impairments (blindness/vision loss and hearing loss); developmental disabilities (intellectual disability or autism spectrum disorder/pervasive developmental disorder); and mobility impairments (hemiplegia and hemiparesis, quadriplegia and quadriparesis, paraplegia or unspecified paralysis, multiple sclerosis, other demyelinating diseases of the CNS, and spina bifida). Each specific disabling condition was analyzed separately; if an individual was diagnosed with one of these conditions at any time during the three year period being analyzed, he/she was placed in that disability category (e.g., blindness or multiple sclerosis).

We obtained data from the South Carolina Office of Research and Statistics (ORS) for individual enrolled in the South Carolina Medicaid program at some point between January 1, 2008 and December 31, 2010. ORS utilizes a unique identification system the permits identification of individuals without duplication. Individuals with the disabilities of interest were identified on the basis of having been diagnosed with a billing code (ICD-9) for that condition

during the study period; individuals could have more than one disability. For comparisons of the rates of pedestrian-automobile injury for people with and without specific disabilities, those with the specific disability were compared to people without any of the other disabilities being analyzed, in order to create a fair comparison group.

Pedestrian-automobile injuries were identified using "E-codes" in the South Carolina inpatient discharge and emergency department data. All episodes of pedestrian-automobile injury from 2008 through 2010 were identified. We dichotomized individuals according to whether they experienced at least one pedestrian-automobile injury during the study period. The analyses were limited to individuals at least 5 years of age or older during the study period. Chi-square tests were used to compare case rates between those with a disability and those without a disability. An alpha level of .05 was used to determine significance. Each frequency table was stratified by gender and age groups (5-18; 19-30; 31-45; 45-65 years old); however, due to small cell sizes, statistical comparison was only performed for the total number of people, not the age and sex specific strata. The comparison group for each disability type was the total group of Medicaid enrollees not diagnosed with ANY of the disabilities being examined. Table 1, below, describes the conditions being examined and the ICD-9 codes used to identify each one.

Table 1. Variable Descriptions

Variable	ICD-9 Codes
Auto-Pedestrian Collisions	E810.7; E811.7; E812.7; E813.7; E814.7; E814.9; E815.7; E816.7; E817.9; E818.7; E819.7
Disabilities	
Blindness/Vision Loss	369.00-369.25; 369.4
Hearing Loss	389.00-389.08; 389.10-18; 389.2; 389.7
Intellectual Disability	317; 318.1-.2; 319
Autism Spectrum Disorder/Pervasive Developmental Disorder	299
Multiple Sclerosis	340
Other Demyelinating Diseases of CNS	341.0-341.9
Hemiplegia/hemiparesis	342.0-342.9; 438.20-438.22
Cerebral Palsy	343.0-343.9
Quadriplegia/Quadriparesis	344.00-344.04
Paraplegia	344.1
Paralysis Unspecified	344.9
Spina Bifidia	741.000-744.03; 741.90-741.93

Results

The results of the analyses are shown in tables 2 through 12, below. Among the comparison group with none of the disabilities being examined, 1,673 (0.22%) experienced a pedestrian-automobile injury during the study period. For the groups with disability, the proportion ranged from 0.16% for people with cerebral palsy which had fewer than 5 people with pedestrian-automobile injury, so therefore ORS did not provide the exact count in accordance with their privacy policies) to 0.45% for people with hemiplegia or hemiparesis. For people with hemiplegia/hemiparesis, this was a statistically significant difference in the risk compared to people without a disability. The difference in risk of pedestrian-automobile injury was also significantly greater in people with intellectual disability (0.31%) compared to controls. No other differences were statistically significant, though people with

quadriplegia/quadriparesis and people with paraplegia/unspecified paralysis had increased risk that narrowly missed statistical significance.

Age and sex specific injury occurrence generally was not possible to examine because of cell sizes below the ORS privacy cut-off of 5. However, there was sufficient information available for people with intellectual disability. For this groupthe risk of pedestrian-automobile injury was highest in people 31 to 45 years of age, both males and females, and was generally higher in males than females. These trends were generally similar in the control group.

Table 2. Blindness/Vision Loss

	Age	Total Injury Cases	Blindness involved in MVC (%)*	Total # with Blindness	Without Disability involved in MVC (%)*	Total People without Disability
Total	**TOTAL**	**1,831**	**8(.34%)**	**2298**	**1,673(.22%)**	**740,167**
	5-18 yrs	656	*	462	622(.18%)	338,292
	19-30 yrs	473	*	224	438(.28%)	156,283
	31-45 yrs	331	*	341	287(.30%)	95,583
	46+ yrs	371	*	1271	326(.22%)	150,009
Male	TOTAL	834	*	996	734(.30%)	244,457
	5-18 yrs	344	*	240	319(.20%)	155,966
	19-30 yrs	124	*	98	105(.66%)	15,950
	31-45 yrs	149	*	165	120(.52%)	23,159
	46+ yrs	217	*	493	190(.38%)	49,382
Female	TOTAL	997	*	1302	939(.19%)	495,710
	5-18 yrs	312	*	222	303(.17%)	182,326
	19-30 yrs	349	*	126	333(.24%)	140,333
	31-45 yrs	182	*	176	167(.23%)	72,424
	46+ yrs	154	*	778	136(.14%)	100,627

***p = 0.219**

Table 3. Deafness/Hearing Loss

	Age	Total Injury Cases	Hearing Loss involved in MVC (%)*	Total #with Hearing Loss	Without Disability involved in MVC (%)*	Total People without Disability
Total	**TOTAL**	**1,831**	**28(.30%)**	**9,478**	**1,673(.22%)**	**740,167**
	5-18 yrs	656	10(.21%)	4,685	622(.18%)	338,292
	19-30 yrs	473	*	756	438(.28%)	156,283
	31-45 yrs	331	6(.55%)	1,090	287(.30%)	95,583
	46+ yrs	371	8(55%)	2,947	326(.22%)	150,009
Male	TOTAL	834	14(.35%)	4,007	734(.30%)	244,457
	5-18 yrs	344	5(.20%)	2,501	319(.20%)	155,966
	19-30 yrs	124	*	231	105(.66%)	15,950
	31-45 yrs	149	*	352	120(.52%)	23,159
	46+ yrs	217	*	923	190(.38%)	49,382
Female	TOTAL	997	14(.26%)	5,471	939(.19%)	495,710
	5-18 yrs	312	5(.23%)	2,184	303(.17%)	182,326
	19-30 yrs	349	*	525	333(.24%)	140,333
	31-45 yrs	182	*	738	167(.23%)	72,424
	46+ yrs	154	*	2,024	136(.14%)	100,627

***p = 0.1583**

Table 4. Autism Spectrum Disorders/Pervasive Developmental Disorders

	Age	Total Injury Cases	Autism involved in MVC (%)*	Total #with Autism	Without Disability involved in MVC (%)*	Total People without Disability
Total	**TOTAL**	**1,831**	**16(.25%)**	**6297**	**1,673(.22%)**	**740,167**
	5-18 yrs	656	10(.22%)	4508	622(.18%)	338,292
	19-30 yrs	473	*	962	438(.28%)	156,283
	31-45 yrs	331	*	507	287(.30%)	95,583
	46+ yrs	371	*	320	326(.22%)	150,009
Male	TOTAL	834	14(.29%)	4808	734(.30%)	244,457
	5-18 yrs	344	8(.22%)	3566	319(.20%)	155,966
	19-30 yrs	124	*	719	105(.66%)	15,950
	31-45 yrs	149	*	334	120(.52%)	23,159
	46+ yrs	217	*	189	190(.38%)	49,382
Female	TOTAL	997	*	1489	939(.19%)	495,710
	5-18 yrs	312	*	942	303(.17%)	182,326
	19-30 yrs	349	*	243	333(.24%)	140,333
	31-45 yrs	182	*	173	167(.23%)	72,424
	46+ yrs	154	*	131	136(.14%)	100,627

***p = 0.6408**

Table 5. Intellectual Disability

	Age	Total Injury Cases	ID involved in MVC (%)*	Total # with ID	Without Disability involved in MVC (%)*	Total People without Disability
Total	**TOTAL**	**1,831**	**64(.31%)**	**20,442**	**1,673(.22%)**	**740,167**
	5-18 yrs	656	12(.17%)	6,881	622(.18%)	338,292
	19-30 yrs	473	17(.40%)	4,212	438(.28%)	156,283
	31-45 yrs	331	22(.53%)	4,142	287(.30%)	95,583
	46+ yrs	371	13(.25%)	5,207	326(.22%)	150,009
Male	TOTAL	834	43(.36%)	12,089	734(.30%)	244,457
	5-18 yrs	344	10(.22%)	4,508	319(.20%)	155,966
	19-30 yrs	124	8(.32%)	2,501	105(.66%)	15,950
	31-45 yrs	149	15(.65%)	2,321	120(.52%)	23,159
	46+ yrs	217	10(.36%)	2,759	190(.38%)	49,382
Female	TOTAL	997	21(.25)	8,353	939(.19%)	495,710
	5-18 yrs	312	*	2,373	303(.17%)	182,326
	19-30 yrs	349	9(.53%)	1,711	333(.24%)	140,333
	31-45 yrs	182	7(.38%)	1,821	167(.23%)	72,424
	46+ yrs	154	*	2,448	136(.14%)	100,627

***p = 0.010**

Table 6. Multiple Sclerosis

	Age	Total Injury Cases	MS involved in MVC (%)*	Total # with MS	Without Disability involved in MVC (%)*	Total People without Disability
Total	**TOTAL**	**1,831**	**6(.28%)**	**2,127**	**1,673(.22%)**	**740,167**
	5-18 yrs	656	*	118	622(.18%)	338,292
	19-30 yrs	473	*	410	438(.28%)	156,283
	31-45 yrs	331	5(.62%)	808	287(.30%)	95,583
	46+ yrs	371	*	791	326(.22%)	150,009
Male	TOTAL	834	5(1.06%)	471	734(.30%)	244,457
	5-18 yrs	344	*	53	319(.20%)	155,966
	19-30 yrs	124	*	72	105(.66%)	15,950
	31-45 yrs	149	*	169	120(.52%)	23,159
	46+ yrs	217	*	177	190(.38%)	49,382
Female	TOTAL	997	*	1,656	939(.19%)	495,710
	5-18 yrs	312	*	65	303(.17%)	182,326
	19-30 yrs	349	*	338	333(.24%)	140,333
	31-45 yrs	182	*	639	167(.23%)	72,424
	46+ yrs	154	*	614	136(.14%)	100,627

***p = 0.49 (Fisher's exact test)**

Table 9. Other Demyelinating Diseases of the Central Nervous System

	Age	Total Injury Cases	Diseases of CNS involved in MVC (%)*	Total # with Diseases of CNS	Without Disability involved in MVC (%)*	Total People without Disability
Total	**TOTAL**	**1,831**	*	**380**	**1,673(.22%)**	**740,167**
	5-18 yrs	656	*	65	622(.18%)	338,292
	19-30 yrs	473	*	70	438(.28%)	156,283
	31-45 yrs	331	*	125	287(.30%)	95,583
	46+ yrs	371	*	120	326(.22%)	150,009
Male	TOTAL	834	*	119	734(.30%)	244,457
	5-18 yrs	344	*	34	319(.20%)	155,966
	19-30 yrs	124	*	19	105(.66%)	15,950
	31-45 yrs	149	*	29	120(.52%)	23,159
	46+ yrs	217	*	37	190(.38%)	49,382
Female	TOTAL	997	*	261	939(.19%)	495,710
	5-18 yrs	312	*	31	303(.17%)	182,326
	19-30 yrs	349	*	51	333(.24%)	140,333
	31-45 yrs	182	*	96	167(.23%)	72,424
	46+ yrs	154	*	83	136(.14%)	100,627

***p = 1.000**

Table 10. Hemiplegia/Hemiparesis

	Age	Total Injury Cases	Hemiplegia and Hemiparesis involved in MVC (%)*	Total # with Hemiplegia and Hemiparesis	Without Disability involved in MVC (%)*	Total People without Disability
Total	**TOTAL**	**1,831**	**36(.45%)**	**7,946**	**1,673(.22%)**	**740,167**
	5-18 yrs	656	*	428	622(.18%)	338,292
	19-30 yrs	473	7(1.91%)	366	438(.28%)	156,283
	31-45 yrs	331	10(.98%)	1,018	287(.30%)	95,583
	46+ yrs	371	17(.27%)	6,134	326(.22%)	150,009
Male	TOTAL	834	20(.58%)	3,477	734(.30%)	244,457
	5-18 yrs	344	*	239	319(.20%)	155,966
	19-30 yrs	124	*	155	105(.66%)	15,950
	31-45 yrs	149	6(1.28%)	467	120(.52%)	23,159
	46+ yrs	217	11(.42%)	2,616	190(.38%)	49,382
Female	TOTAL	997	16(.36%)	4,469	939(.19%)	495,710
	5-18 yrs	312	*	189	303(.17%)	182,326
	19-30 yrs	349	5(2.36%)	211	333(.24%)	140,333
	31-45 yrs	182	*	551	167(.23%)	72,424
	46+ yrs	154	6(.17%)	3,518	136(.14%)	100,627

***p < 0.0001**

Table 11. Quadriplegia/Quadriparesis

	Age	Total Injury Cases	Quadriplegia and Quadriparesis involved in MVC (%)*	Total # with Quadriplegia and Quadriparesis	Without Disability involved in MVC (%)*	Total People without Disability
Total	**TOTAL**	**1,831**	**9(.43%)**	**2,096**	**1,673(.22%)**	**740,167**
	5-18 yrs	656	*	344	622(.18%)	338,292
	19-30 yrs	473	*	399	438(.28%)	156,283
	31-45 yrs	331	*	590	287(.30%)	95,583
	46+ yrs	371	5(.66%)	763	326(.22%)	150,009
Male	TOTAL	834	6(.45%)	1,342	734(.30%)	244,457
	5-18 yrs	344	*	186	319(.20%)	155,966
	19-30 yrs	124	*	263	105(.66%)	15,950
	31-45 yrs	149	*	419	120(.52%)	23,159
	46+ yrs	217	*	474	190(.38%)	49,382
Female	TOTAL	997	*	754	939(.19%)	495,710
	5-18 yrs	312	*	158	303(.17%)	182,326
	19-30 yrs	349	*	136	333(.24%)	140,333
	31-45 yrs	182	*	171	167(.23%)	72,424
	46+ yrs	154	*	289	136(.14%)	100,627

***p = 0.061**

Table 12. Paraplegia/Unspecified Paralysis

	Age	Total Injury Cases	Paraplegia/Paralysis; Unspecified involved in MVC (%)*	Total # with Paraplegia/Paralysis; Unspecified	Without Disability involved in MVC (%)*	Total People without Disability
Total	**TOTAL**	**1,831**	**10(.39%)**	**2,537**	**1,673(.22%)**	**740,167**
	5-18 yrs	656	*	241	622(.18%)	338,292
	19-30 yrs	473	*	442	438(.28%)	156,283
	31-45 yrs	331	5(.68%)	732	287(.30%)	95,583
	46+ yrs	371	*	1,122	326(.22%)	150,009
Male	TOTAL	834	8(.51%)	1,578	734(.30%)	244,457
	5-18 yrs	344	*	144	319(.20%)	155,966
	19-30 yrs	124	*	311	105(.66%)	15,950
	31-45 yrs	149	*	492	120(.52%)	23,159
	46+ yrs	217	*	631	190(.38%)	49,382
Female	TOTAL	997	*	959	939(.19%)	495,710
	5-18 yrs	312	*	97	303(.17%)	182,326
	19-30 yrs	349	*	131	333(.24%)	140,333
	31-45 yrs	182	*	240	167(.23%)	72,424
	46+ yrs	154	*	491	136(.14%)	100,627

***p = 0.075**

Conclusions

Our analyses demonstrate that pedestrian-automobile injury was more common in individuals with intellectual disability. People with hemiplegia/hemiparesis were also significantly more likely to experience pedestrian-automobile injury. People with quadriplegia/quadriparesis and those with paraplegia or unspecified paralysis had higher rates of pedestrian-automobile injury, but in these cases the associations were not significant.

Risk of pedestrian-automobile injury did not differ for people with autism/pervasive developmental disorders, blindness, hearing loss, multiple sclerosis, other demyelinating diseases of the central nervous system, cerebral palsy, or spina bifida compared to people

without these conditions. One reason for the lack of significant findings for these disabilities may be the relatively small number of people with each of them, which leads to low power to detect significant differences. Another explanation is that people with these conditions may be less likely to attempt ambulating near, on, or across public streets and therefore have less exposure to risk of pedestrian-automobile injury overall despite an increased risk when/if they actually do attempt to do so. Finally, it may be that in fact risk of pedestrian-automobile injury is not increased for people with these disabilities.

Important limitations of these analyses must be recognized. First, we relied upon billing data to identify people with disabilities and to document the outcome of pedestrian-automobile injuries. It is likely that some people with disabilities and some people with injuries were missed or mis-identified in the billing data. Second, we did not go back in time to identify people who were diagnosed with one of the disabling conditions prior to the period during which we assessed the outcome of pediatric-automobile injury. Therefore, we cannot be certain that the disability preceded the injury rather than being caused by it. This should not be a problem for intellectual disability, which is a lifelong condition. However, hemiplegia/hemiparesis, quadriplegia/quadriparesis, and paraplegia/unspecified paralysis, could all be caused by traumatic brain injury or spinal cord injury. Of these, only hemiplegia/hemiparesis had a statistically significant association with risk of pedestrian-automobile injury. Additional analyses looking specifically at the timing of first diagnosis of hemiplegia/hemiparesis would be needed to ascertain whether the condition preceded or came after the initial diagnosis of pedestrian-automobile injury.

A final limitation of our analyses is that we did not look at the rates of occurrence of pedestrian-automobile injury, but instead identified people with at least one pedestrian-automobile injury during the time period of interest. This decision was made because a significant number of individuals had repeated diagnoses of pedestrian-automobile injury during the 3 year period of analyses. We believed this was unlikely to represent true recurrence of injury; rather, it is more likely that repeated diagnoses represent repeated episodes of care for injury occurring during a single episode of injury. Clinical details beyond those available in billing data would be needed to definitively determine whether repeat injuries have occurred.

In summary, it appears that pedestrian-automobile injuries are more common in people with intellectual disability. Though the absolute risk of pedestrian-automobile injury was quite low (approximately 3 per 1,000 over a 3 year period) even for people with intellectual disability, this finding may warrant additional effort to promote the safety of people who have intellectual disability. The risk of automobile-pedestrian injury also appeared to be increased in people with hemiplegia/hemiparesis, though as discussed above there is a need for additional investigation to clarify the direction of this association.

References

1. Peng RY, Bongard FS. Pedestrian versus motor vehicle accidents: an analysis of 5,000 patients. *J Am Coll Surg.* 1999;189(4):343–348.
2. Atkins RM, Turner WH, Duthie RB, Wilde BR. Injuries to Pedestrians in Road Traffic Accidents. BMJ. 1988 Dec 3;297(6661):1431–143.
3. Markogiannakis H, Sanidas E, Messaris E, et al. Motor vehicle trauma: Analysis of injury profiles by road-user category. *Emerg Med J.* 2006;23:27–31.
4. National Highway Traffic Safety Administration. Traffic Safety Facts 1997: Pedestrians. Publication HS-808 772. Washington, DC: US Department of Transportation; 1998.
5. Tabibi, Z. & Pfeffer, K. Choosing a safe place to cross the road: the relationship between attention and identification of safe and dangerous road-crossing sites*. Child: Care, Health and Development, (*2003*)* 29*,* 237–244*.*
6. Ampofo-Boatend, K., Thompson, J.A., et.al. Children's Perception of safety and danger on the Road. British Journal of Developmental Psychology. 1991, 82, 487-505.