TITLE PAGE

"Pediatric restraint use and injury across race, ethnicity, and class in Illinois"

by

Mickey Edwards, MPA, PhD

Visiting Research Specialist, University of Illinois at Springfield

edwardhj@mail.uc.edu; 260-418-3475

&

Manuel Gutierrez

Visiting Research Specialist, University of Illinois at Springfield

Mguti3@uis.edu

Pediatric restraint use and injury across race, ethnicity, and class in Illinois

Mickey Edwards, Ph.D. & Manual Gutierrez

Abstract

The top killer of children in America is motor vehicle crashes. For children 12 years and younger the proper use of a child restraint could make the difference between moderate and severe injury, and even death. Through uncommon access to both crash and hospital records, this manuscript investigates the circumstantial and socioeconomic characteristics associated with a child being properly restrained at the time of a motor vehicle crash. Zip code level data of the childhood crash victims are also aggregated and studied to learn of the community factors related to restraint use. Results suggest that 10.5% of children during the study period were either not restrained at all or improperly restrained at the time of the crash. Properly restrained children were between 10 and 20 times less likely to die compared to unrestrained or improperly restrained children. Black children were some nine percentage points, and Hispanic children were almost six percentage points, less likely to be properly restrained compared to White children. Children of all races covered by Medicaid were also nearly seven percentage points less likely to be properly restrained compared to others. Unrestrained children suffered worse injuries that resulted in higher hospital charges and Medicaid bills compared to restrained children. Children residing in zip codes with relatively high rates of poverty and carlessness are especially overrepresented as not being properly restrained. A binary logistic model estimates that children aged four through eight are also significantly less likely to be properly restrained. Recommendations are made for targeted interventions and for regulatory changes to ensure greater pediatric restraint compliance.

Introduction

Motor vehicle crashes are the number one killer of American children – those under age 18 (Cunningham et al., 2018). Many of those childhood deaths occur after reaching driving age, when they may operate motor vehicles either alone or while accompanied by peers, while also exercising a degree of autonomy in safety restraint use. Children aged 12 and under commonly require a modified seating arrangement, like a booster seat, since their bodies are too small for the standard seat belt to be effective in crash events. Children aged four to eight are especially at risk, since by then many have physically outgrown their car seat, yet still require a booster in order for seat belts to properly function. However, Arbogast, et al. (2009) and Lee et al. (2008) find that four to eight year olds are often prematurely buckled in vehicles without adequate boosters – and the available data support this. According to a CDC analysis of 2018 data, 636 children aged 12 years and younger died in motor vehicle traffic crashes, and an additional 97,000 were injured. In crashes where restraint use was known, 33% were not restrained. The report also found that proper use of car seats saved 325 children aged four years and younger. Finally, the study reports that car seats can reduce the risk of injury by 71–82% for younger children, and booster seat use reduces the risk of serious injury by 45% for children aged four to eight (CDC, 2020).

Safety seats and boosters provide better protection for children during crashes than standard seat belts alone. At least one study from some 20 years ago noticed a pivot of the public's attention toward the risk car crashes pose to children placed in front seats – especially if the vehicle was equipped with airbags (Berns and Vaca 2001). Yet the issue of unrestrained or improperly restrained children is especially troubling in the Black and Hispanic communities. According to Gunn et al. (2005) 24% percent of Black children were completely unrestrained, compared to 13% of White child passengers (aged 4–10 years). Additionally, some 64% of Black children were restrained in some fashion but inappropriately, and all child passengers aged four to eight years were found to be at an increased risk of being inappropriately restrained (Gunn et al. 2005). Berns and Voca (2001) report that some parents shared with the researchers that one of the reasons why children travel unrestrained or improperly restrained is because booster seats were just too difficult to use or because they thought their child was large enough to use the standard seat and seat belt. Similarly, Gunn et al. (2005) assert that a lack of knowledge about booster seats, age, and weight requirements drive adults to ineffectively restrain children. This may be especially problematic in Black communities where researchers note that almost twice as many Blacks as Whites lack both the general knowledge of, and resources to purchase, booster seats (Gunn et al. 2005).

Prince et al. (2019) highlight an important issue with safety regulations across motor vehicle types. In places like New York City, taxis and other ridehail transportation services are exempt from the restraint laws that apply to private motor vehicles. In their study they analyze rear-seat infant, child, adolescent, and teen restraint injuries in taxis compared to other private motor vehicles. Findings reveal that child restraint use for those aged eight years or younger was one-tenth that of other motor vehicles. They conclude that taxi and ridehail passengers are less likely to properly use restraints and are therefore more likely to suffer an injury, compared to those who travel in private motor vehicles (Prince et al. 2019).

Research statement

This paper seeks to answer the question of whether Black and Hispanic children, and those of low socioeconomic status, are disproportionately injured and killed in motor vehicle crashes. It uses uncommon access to Illinois Department of Public Health hospital data and Illinois Department of Transportation crash data to trace pediatric victims from the crash through their medical treatment and eventual discharge. Combined, these data help us learn which children are most likely to not be properly restrained during a motor vehicle crash and the medical consequences thereof.

Sources and methods

Data linkage

Funded by a grant from the Illinois Department of Transportation in collaboration with the Illinois Department of Public Health, the University of Illinois at Springfield successfully linked Illinois crash and hospital records for the years 2016 through 2018. The linkage was accomplished using an advanced method developed in the National Highway Traffic Safety Administration's Crash Outcome Data Evaluation System program (McGlincy, 2021). Using LinkSolv software to complete the linkage, a combination of data fields were identified for optimal matching of the crash and hospital data sets: county, victim age, crash date, victim date of birth, and victim sex.

Cook County, home to Chicago, is where some 40% of the Illinois population resides, effectively making county a relatively indiscriminate match field – which is a factor controlled for in the LinkSolv software.

The data set analyzed here was limited to crash victims aged 12 years and younger whose crash files also had the "restraint use" field completed. It was also limited to complete data files – those crash and hospital files that were successfully linked. Access to data of this type and their successful linkage is critical in our understanding of the effects of motor vehicle crashes on the lives of the children and families of Illinois. Such an investigation as presented here would not be possible without the successful linkage of the disparate crash and hospital files. Findings enable policymakers to target at-risk communities with interventions intended to prevent injury and death.

Child restraint use field

One of three responses were possible for the completed child restraint field: used, not used, and used improperly. Used and not used responses are fairly clear in their interpretation and analysis. The response of used improperly is less clear. This response was determined by the police officer completing the crash report and left open to interpretation – and many scenarios could solicit such a response. For example: a child prematurely placed in a booster seat according to the manufacturer's recommended use, a child facing the wrong direction according to statute, and a child properly restrained but placed in the front passenger seat may all be determined to be improperly restrained. However, since improper use of a restraint (however it was determined to occur) likely increases the risk of injury, not used and used improperly are sometimes considered in the aggregate throughout the analysis.

Strength of association, independence of data

For each cross-tabulation analysis and table formulation a Pearson Chi-squared test of independence was performed and level of significance (p value) is reported. Additionally, to quantify the strength of association between variables analyzed, a Cramer's-V test was conducted and reported in presented tables. Still, given the nature of data linkage, the files may be incomplete or include mismatched records despite the use of advanced methodology and software.

Logistic regression model

A logistic regression model was fitted and performed to estimate the effects of crash characteristics and victim characteristics on the likelihood of a child being properly restrained at the time of a motor vehicle crash. Complete analysis results are presented just below in the Findings section of this manuscript. The logistic regression model was statistically significant with a Chi-square value of 292, 12 degrees of freedom, and a p value of less than 0.000. The model correctly classified about 90% of cases and explains almost 14% (Nagelkerke R^2) of the variance in whether or not a child was properly restrained during a motor vehicle crash event. The findings section begins with a summary of the data and then progresses from there with incremental depth culminating in a discussion of the logit model results.

Findings

Summary statistics

Greater than one-in-ten (10.5%, 442 cases) pediatric (12 and under) crash victims in Illinois between the years 2016 and 2018 for which the data exists, was either not properly restrained (3.2%) or not restrained at all (7.3%). This of course implies that only 89.5% of Illinois childhood crash victims were properly restrained at the time of the crash. And those children not properly restrained suffered more severe injuries as a result, as assessed by responding police officers and medical professionals upon hospital arrival.

Table 1 presents injury severities associated with pediatric restraint use. In cases where a child restraint was used properly, 54.5% of children escaped with no indication of injury. The proportion of uninjured children was cut in half to 27.1% among children not properly restrained, and 31.4% among completely unrestrained children. The proportion of non-incapacitating injuries (injury severity of B) more than doubled among unrestrained and improperly restrained children relative to those properly restrained. The same trend holds true for incapacitating injuries (injury severity of A) as the proportion of children un, or improperly, restrained more than doubled compared to restrained children. Finally and tragically, improperly restrained children were 23 times, and unrestrained children were 10 times, more likely die in a motor vehicle crash in Illinois relative to restrained children. Though mercifully, we are working with a relatively small yet tragic number of fatal childhood crashes (10) in which the crash file reported the use or disuse of a restraint.

*Table 1: restraint use and injury severity among pediatric motor vehicle crash victims**

	*Injury Severity***				
Child Restraint Used?	*O*	*C*	*B*	*A*	*K*
Yes	54.5%	22%	19.4%	3.9%	0.1%
No	31.4%	21%	38.2%	8.4%	1.0%
Improperly	27.1%	18.8%	42.1%	9.8%	2.3%

** Pearson chi-square = 175, $p < .000$; Cramer's V = .144, $p < .000$ **KABCO injury scale: K = fatality; A = incapacitating injury; B = non-incapacitating injury; C = reported/not evident; O = no indication of injury*

Age stratification

Akin to previously published research on pediatric restraint use the majority, some 64.3% ($p < .000$), of unrestrained children were between the ages of four and eight – probably because these children were prematurely placed in seatbelts (Lee et al., 2008). Some of these children may have outgrown their car seat which was then not replaced with an appropriate belt-positioning booster seat (Arbogast, et al., 2009). Four to eight year olds represent the majority (nearly 2/3) of the unrestrained in this data set even though they represent just about 38% of childhood crash victims. Children aged zero and one were the most consistently properly restrained at 96% and 93.8% of the time, respectively. Still, this implies that 4% of children under one, and 6.2% of children aged one, were not properly restrained at the time of a motor vehicle crash. Further, only about 82% of seven year olds were properly restrained during a crash – the lowest proportion age group among children.

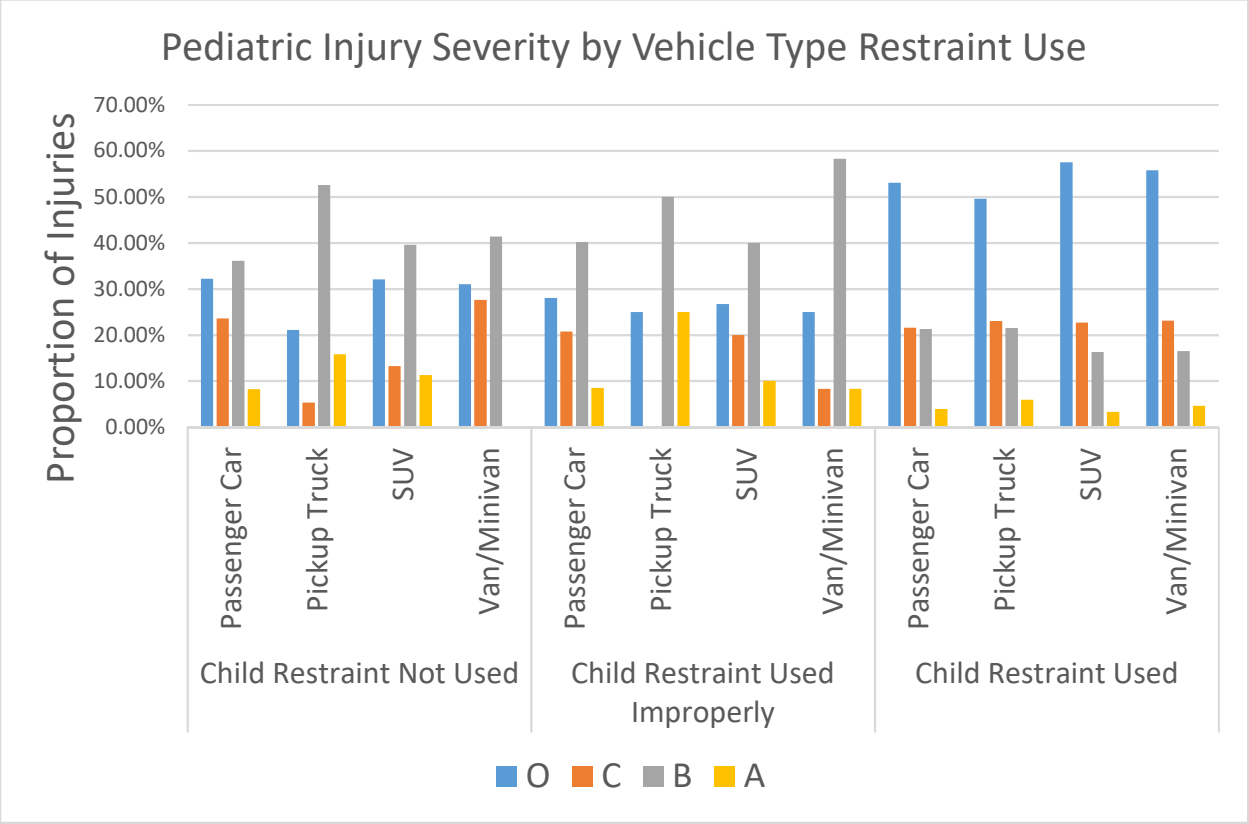
Vehicle type, restraint use, and injury severity

Some parents may opt for a larger, heavier vehicle in which to transport their children under the assumption that heft and height would be more protective in the event of a crash. Figure 1 shows that among properly restrained children, vehicle type is not strongly associated with injury severity. Injury severity is relatively evenly distributed across vehicle types among the properly restrained. The same is not true for those not properly restrained. Among the unrestrained and improperly restrained, children in SUVs, pickup trucks, and vans may actually experience worse medical outcomes than those in passenger cars. Though these findings are not definitive and require further research. [1]

Across restraint uses, pickup trucks disproportionately represent incapacitating injuries (KABCO scale of A) among childhood crash victims relative to other vehicle types. Of interest in Figure 1 is the increased proportion of children who escape uninjured among those properly restrained regardless of vehicle type. Also of note is the decreased proportion non-incapacitating injuries (KABCO scale of B) among properly restrained children, and the relatively elevated proportion of such injuries among improperly restrained children. Finally, among properly restrained children, injury severity distribution across vehicle type was relatively more predictable and uniform – suggestive of the effectiveness of child restraints.

[1] A brief note about the absence of fatal crashes (K) in Figure 1: when the data are disaggregated and analyzed at the level as presented in Figure 1, cell counts get relatively small. So to protect patient privacy fatalities are not reported here.

*Figure 1: Pediatric injury severity in motor vehicle crash by vehicle type and child restraint use**

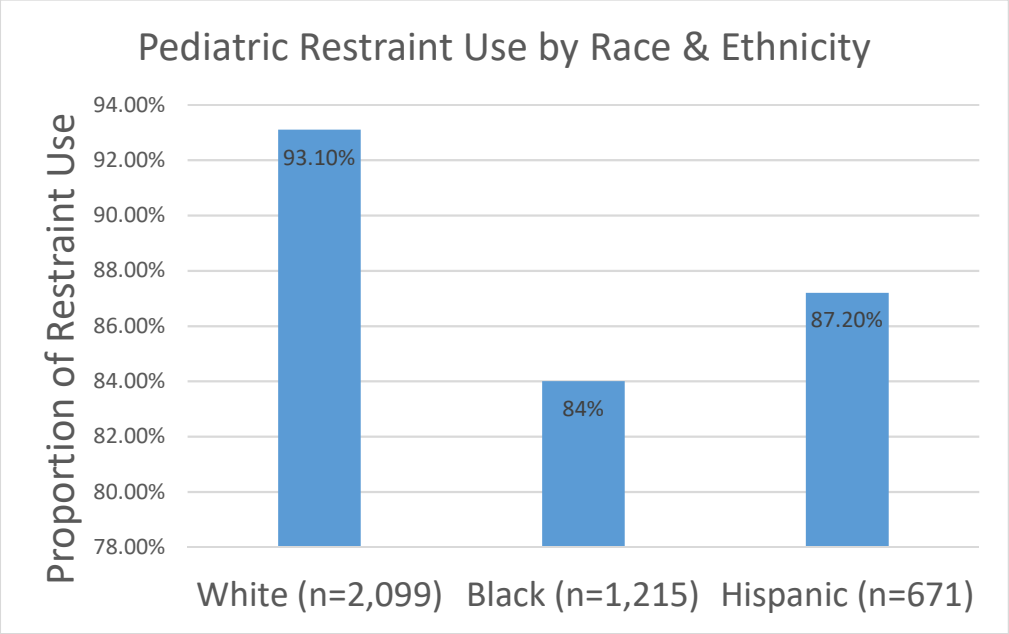


** Total Pearson chi-square = 47.5, p < .100; Total Cramer's V = .106, p < .100 **KABCO injury scale: A = incapacitating injury; B = non-incapacitating injury; C = reported/not evident; O = no indication of injury*

The children less likely to be properly restrained

Figure 2 illustrates that pediatric restraint use, or disuse, is not evenly distributed across race and ethnicity in Illinois. Black childhood crash victims were greater than nine percentage points more likely to not be properly restrained compared to their White peers. And Hispanic childhood crash victims were nearly six percentage points more likely to not be properly restrained compared to Whites, but greater than three percentage points more likely relative to Black children.

*Figure 2: Pediatric restraint use by race and ethnicity in Illinois**

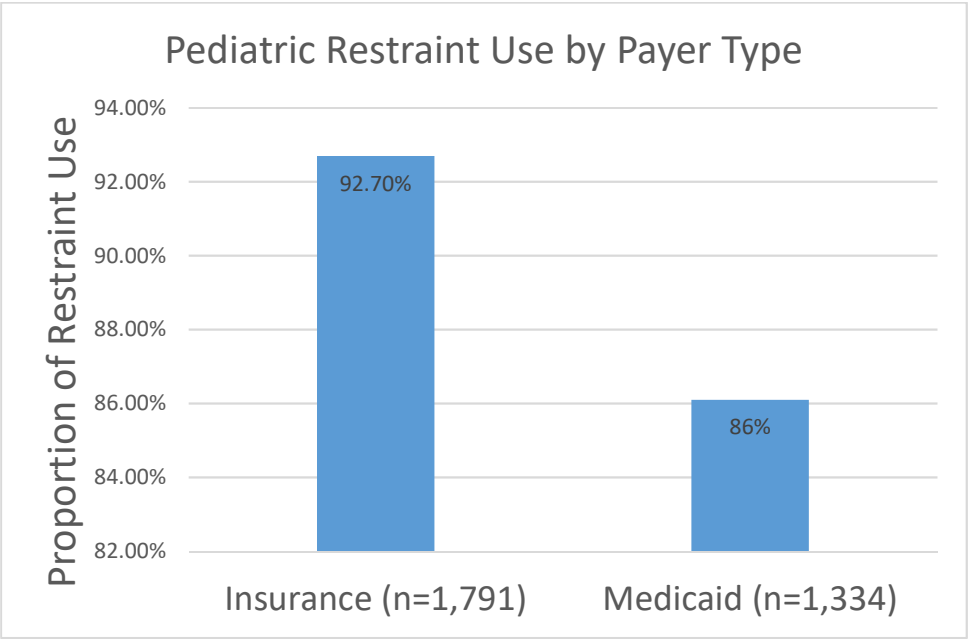


** Pearson chi-square = 102, p < .000; Cramer's V = .110, p < .000*

The data comparing pediatric restraint use across race and ethnicity are stark, though the social class into which the child was born likely plays a more influential role in whether or not that child will be properly restrained during a motor vehicle crash. This is especially true in the U.S. where race and ethnicity are pretty good proxies for social class. Another good proxy in the U.S. for social class is between those who qualify for Medicaid and those who do not. Eligibility for this medical assistance program is limited to, among other requirements, those households characterized as either very low income, or low income. For example, in Illinois, Medicaid eligibility for a household of two (the minimum household size to have an eligible dependent child: caregiver + child) is limited to those with an annual income of no more than $24,040 (Benefits.Gov). Given this low income threshold for eligibility, cases billed to Medicaid are assumed to be made by the socioeconomically disadvantaged.

A cross-tabulation analysis of restraint use and payer type reveals a similar relationship to that of race/ethnicity and restraint use. Figure 3 shows that children covered by Medicaid are significantly less likely to be properly restrained relative to those covered by insurance. These results imply that nearly 14% of children covered by Medicaid were not properly restrained at the moment in which they became crash victims. Both Figure 2 and Figure 3 are presented as zoomed in on the top of the bars, rather than starting at zero, in order to highlight the differences between restraint use, race, and payer type.

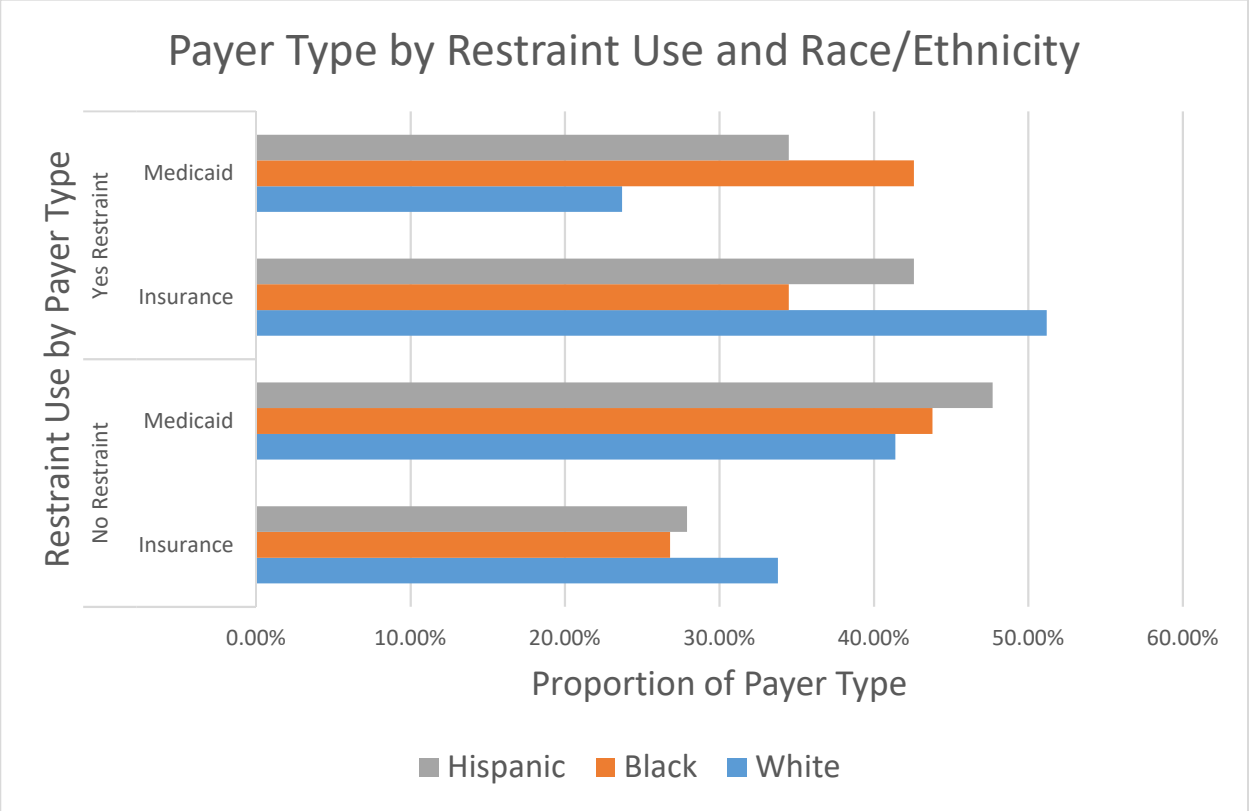
*Figure 3: Payer type by pediatric restraint use**



** Pearson chi-square = 45.3, p < .000; Cramer's V = .104, p < .000*

But that is not the whole story, looking more closely at the nuances of payer type, race/ethnicity, and restraint use the relationship with social class becomes a little clearer. Figure 4 presents the proportion of payer type, Medicaid or insurance, for childhood crash victims by restraint use and race/ethnicity. For example, among children who were not properly restrained, payer type may be a better predictor of restraint use than race or ethnicity. Figure 4 shows the relatively tight clustering across race and ethnicity around payer type among unrestrained children. That is, those cases billed to Medicaid in which a restraint was either not used or used improperly ranged from 41.4% to 47.7% - a spread of about six percentage points between race/ethnicity. Those cases billed to insurance in which a restraint was either not used or used improperly ranged from 26.8% to 33.8% - a spread of about seven percentage points between race/ethnicity. The gap between race/ethnicity and payer type widens to nearly 19 percentage points among properly restrained children billed to Medicaid. Of properly restrained children whose cases were billed to insurance, a gap of almost 17 percentage points emerges between race/ethnicity. So while race and ethnicity are related to whether a child was properly restrained during a motor vehicle crash, eligibility for at least one social assistance program – Medicaid – appears to be more so.

*Figure 4: Proportion of payer type by restraint use and race/ethnicity**



** Total Pearson chi-square = 137, p < .01; Total Cramer's V = .088, p < .01*

Pediatric injuries and hospital charges

So what does the appropriate use, or disuse, of restraints mean for pediatric injury and subsequent hospital charges? A reasonable assumption would be that unrestrained children end up with increased injury severities. It follows that since children covered by Medicaid are less likely to be properly restrained it would be those children who suffer the most severe injuries and Medicaid that pays the greatest share of hospital charges. It further follows that payer type would be a strong predictor of pediatric medical outcomes of Illinois childhood crash victims. It turns out the data generally follow these reasonable assumptions.

Table 2 shows that 93.1% of the children who escaped a motor vehicle crash uninjured (MAIS of 0; see Table 2 for a description of MAIS) were properly restrained, and just 6.9% of uninjured children were not properly restrained. Of properly restrained children, 64.6% were uninjured. And of children not properly restrained, just 40.7% were uninjured. Table 2 also demonstrates that all injury severities, especially the most severe, were significantly more common among improperly restrained children relative to the properly restrained. Finally, children not properly restrained were nearly four times more likely (p <.000) to suffer a moderate or more severe injury (MAIS of 2+) compared to restrained children.

*Table 2: Pediatric restraint use and injury severity using MAIS**

		MAIS						
Child Restraint Used?		*0*	*1*	*2*	*3*	*4*	*5*	Total
Yes n=3,772	Within Yes	64.6%	33%	1.9%	0.5%	-	0.1%	100%
	Within MAIS	93.1%	84.9%	78%	48.6%	-	50%	100%
No n=442	Within No	40.7%	50%	4.5%	4.1%	-	0.7%	100%
	Within MAIS	6.9%	15.1%	22%	51.4%	-	50%	100%
	Total	100%	100%	100%	100%	-	100%	100%

** Pearson chi-square = 155, p < .000; Cramer's V = .192, p < .000*; *MAIS, the maximum abbreviated injury scale, is a score of the most severe injury of a patient with multiple possible injuries; 0: no injury, 1: minor, 2: moderate, 3: serious, 4: severe, 5: critical, 6: maximal (untreatable); there were no MAIS 4 ratings*

For the three years 2016-18 hospital charges of pediatric motor vehicle crash victims in Illinois totaled $13,909,657. Medicaid was billed $5,778,000 of that, and $3,367,961 of that Medicaid bill was to care for improperly restrained or unrestrained children. Irrespective of payer type, hospital charges totaled $4,696,098 for children not properly restrained.

Average and median hospital charges among children not properly restrained was much higher, as might be expected to accompany a greater likelihood of severe injury. In fact, average charges were nearly four and half times that of properly restrained children: $10,624 (median = $1,579) compared to $2,442 (median = $993). Illustrative of the effect of more severe injuries and subsequent hospital charges among those covered by Medicaid is their average and median hospital charges. The average hospital charge for a childhood crash victim to Medicaid was $4,331, compared to $3,005 for those billed to insurance. But their median charges are practically statistically identical: $1,035 for Medicaid and $1,039 for insurance. So a few very high charges among severely injured un-or improperly restrained children pulls the average Medicaid charge up. This is also evident in the standard deviation of Medicaid charges, which is nearly three times that of insurance charges: $61k compared to $20.3k.

Children in low socioeconomic status zip codes have worse outcomes

Just as payer type is a decent predictor of whether or not a child in Illinois will be properly restrained in a motor vehicle crash, so too is the zip code in which the child resides. Within Illinois, 791 zip codes in which a childhood crash victim resided were identified, and 233 in which the child was un-or improperly restrained.

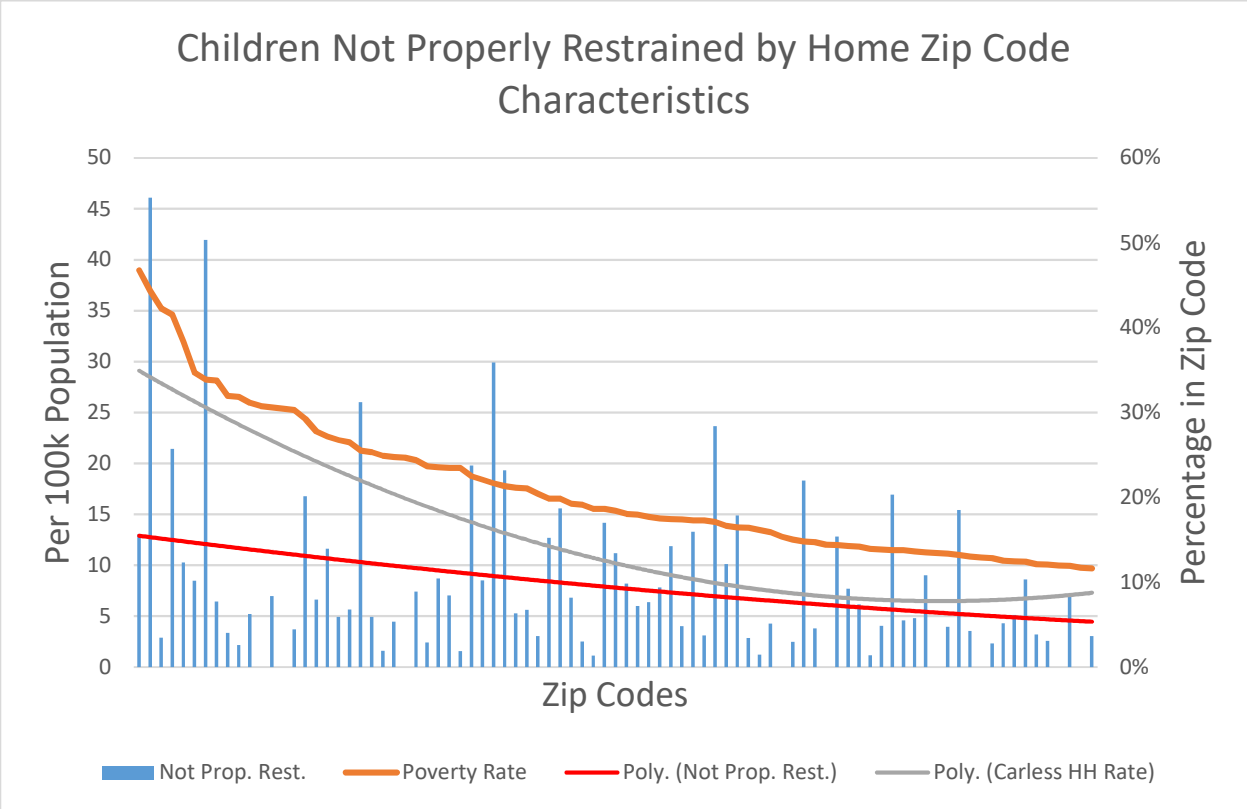
Pediatric restraint use, and disuse, are not evenly distributed across class in Illinois. Those in zip codes with high poverty and high carlessness are generally less likely to properly restrain their young when motoring. Figure 5 graphically portrays the distribution of children not properly restrained across the child's home zip code by poverty and carless household rates. The occurrences are normalized to per 100k population for ease of communicating outcomes, as is common practice with the public dissemination of medical data. Figure 5 focuses on those zip codes in which a childhood motor vehicle crash victim lived and had a poverty rate at or below the

Illinois average of 11.5% (2019 ACS 5-Year Estimates). This yielded 87 zip codes and 1,676 crashes with which to further investigate the relationship between where children live, the socioeconomic circumstances thereof, and their likelihood of being properly restrained in a motor vehicle crash. Findings at the zip code scale also enable targeted interventions within the communities most in need, such is the intent with this analysis.

Zip codes with poverty rates at or below the Illinois average were fit into a combined clustered column chart, ordered with respect to poverty rate, with carless household rate displayed as an order-two polynomial trend line of the data. This means that Figure 5 displays from left to right zip codes with the highest poverty rate to zip codes with the lowest poverty rate. And because poverty and carlessness are often correlated, the household carless rate is also generally ordered from highest to lowest, left to right.

What Figure 5 makes apparent is that children who live in zip codes with relatively high rates of poverty and carlessness are disproportionately not properly restrained when involved in a motor vehicle crash. This is made clear through the clustered columns representative of occurrences of children not properly restrained and adjusted to 100k population for the 87 zip codes at or below the average Illinois poverty rate. The red-colored order-two polynomial trend line of children not properly restrained also helps to clarify the disproportionate representation of the impoverished and the carless.

Figure 5: Proportion of children not properly restrained involved in motor vehicle crashes in Illinois from 2016-2018 by their home zip code poverty and carless household rates



However, it is also true that not all zip codes with a high poverty and carless rate experienced disproportionate occurrences of children not properly restrained. For example, the 60612 zip code, which constitutes an area of West-Central Chicago centered on Interstate 290 and Western Avenue, experienced 12 children involved in crashes – all were properly restrained. This is true even though this zip code has a carless household rate more than four times greater than the state average; and a poverty rate nearly three times the state average. Still, as demonstrated near the left side of Figure 5, those zip codes with the highest proportions of children not properly restrained are among the most disadvantaged. Peoria, Illinois is an example of this disadvantage. The 61605 and 61603 zip codes of Peoria rank among the most impoverished, most carless, and most occurrences per 100k population of children not properly restrained across all of Illinois.

Binary logistic model results

For a more robust understanding of the relationship between crash characteristics and the propensity of children to be properly restrained in Illinois, a binary logistic model was fitted to the data. The logit model is a statistical method used to estimate the effect select variables have on the likelihood of an event occurring, in this case the event is a child being properly restrained. A binary logistic model is the most appropriate application in this circumstance because the (binary) dependent variable has a response of either yes or no (1 or 0, respectively). An estimated odds ratio of one implies that particular variable has no effect on the likelihood of an event occurring. This is evident in Table 3 where the variables close to one are predicted to not significantly add to the model. Significant variables with an estimated odds ratios of less than one are implied to reduce the likelihood of the event occurring. And conversely, significant variables with an odds ratio greater than one are assumed to increase the likelihood of an event occurring. This corresponds with the positive and negative sign of the estimated coefficient factor and is simply the exponentiated version of the coefficient – which is done for convenience of interpreting the results since the coefficients are in log-odds units.

Eight of the selected variables are estimated to add significantly to the model: poverty, Medicaid payer, Hispanic, non-White, Black, being aged four to eight, increased injury severity as measured by the MAIS, and propensity for head injury. In other words, each of these variables is estimated to have a statistically significant effect on whether or not a child was properly restrained during a motor vehicle crash, when controlling for other variables. The model estimates that being covered by Medicaid is associated with a reduction in the likelihood of a child being properly restrained. In fact, the model implies that being covered by Medicaid is associated with a reduction in a child's chances of being restrained by a factor of about 0.72. It also estimates that each percentage point increase in the poverty rate at the zip code level correlates with a reduction in the likelihood of being appropriately restrained by a factor of 0.083.

A child who is either Hispanic, Black, or just non-White was less likely to be properly restrained in a crash, according to the logit model. The estimated effect is roughly similar across race/ethnicity, which is associated with a reduction in these children's chances of being restrained by a factor of about 0.6. Also important to highlight is a phenomenon mentioned above, which is that children aged four through eight are significantly less likely to be properly restrained. Lee et al., 2008 suggest that some of these children may be prematurely put in a standard seatbelt. The

model results in Table 3 imply that being aged four through eight correlates with a decrease in a child's likelihood of being properly restrained by half, similar to findings by Arbogast, et al. (2009).

*Table 3: Logistic regression modeling the likelihood of a child being properly restrained during a motor vehicle crash event**

Variable	*Coefficient*	*Odds Ratio*	*Significance*
Carless Households	1.23	3.41	.164
Poverty Rate	**-2.49**	**.083**	**.003**
Medicaid Payer	**-.331**	**.718**	**.002**
Hispanic	**-.487**	**.614**	**.002**
Non White	**-.473**	**.623**	**.002**
Black	**-.623**	**.563**	**.000**
Male	.042	1.04	.688
Rural	-.069	.933	.569
Weekend	-.159	.853	.154
Aged 4 to 8	**-.694**	**.500**	**.000**
Injury Severity (MAIS)	**-.650**	**.522**	**.000**
Head Injury	**-.326**	**.722**	**.006**

Variables that add significantly to the model at the 1% level or better appear in **bold; dependent variable is restraint use*

More severe injury and injury to the head are both estimated to correlate with a reduced likelihood of being restrained. Injury severity in this context is interpreted a little differently compared to the other variables in the model. Injury severity here is treated more as a correlate, rather than a factor influencing an event outcome – the logit model is not chronologically dependent after all. For example, a child sustaining a head injury is correlated with a 0.72 factor reduction in restraint use. And each iteration in MAIS escalation correlates with a 0.52 factor reduction in restraint use. In other words, the model implies that children not properly restrained are significantly more likely to suffer a head injury and/or a more severe injury.

Discussion

Where an analysis of this manner falls short is we are limited to identifying correlating characteristics with children not properly restrained during a motor vehicle crash. For a more nuanced understanding of the causes of such outcomes, research must be conducted within the zip codes and neighborhoods most affected. Community and faith leaders must be engaged to facilitate an understanding by researchers of the unique challenges faced by residents there. Surveys, interviews, and even casual conversations with caregivers of children within targeted communities will help policymakers address the inequity of poor, minority, and carless children going unrestrained and suffering the consequences thereof.

Buckle Up for Life, which is a child safety initiative of Cincinnati's Children's Hospital and funded through a grant from Toyota, has a partnership with Chicago's Ann and Robert H. Lurie Children's Hospital to distribute car seats. In addition, many hospitals have programs in place that provide new mothers an appropriate child restraint before leaving the hospital with baby. Further, many hospitals will not release mothers and/or children until staff verifies the newborn(s) are placed in an appropriately installed child seat. Organizations such as 211.org are available across Illinois to

assist caregivers in acquiring safety seats and other resources, including in the aforementioned zip codes in Peoria. Free child safety seats are also commonly available through Medicaid but typically require the recipient to complete some predetermined quantity of training.

With multiple resources and organizations in place giving away free equipment and training to the disadvantaged, why are so many disadvantaged children disproportionately unbuckled? We do not know for certain. But perhaps the required training of some programs, which is certainly useful and important for caregivers to understand how to properly restrain their children, may also erect a barrier for some would-be recipients. Being unaware that programs exist to provide child safety seats, or the importance of their use, also likely plays a role. Still, some researchers have found that difficulties with use, an uncomfortable child, or making many daily trips leads to children going improperly restrained (Kendi et al., 2021). Also, as ridehail (Lyft and Uber) use proliferates many parents, especially those without reliable access to a household car, are opting to take their children along for the ride, often without proper restraint (Edwards, 2021). This may disproportionately affect children aged four through eight who have outgrown a standard car seat, according to one study (Savage et al., 2021), and supported by findings reported in this manuscript.

Conclusion

The analysis presented in this manuscript demonstrates that, once more, the most vulnerable children among us are those most likely be hurt – and hurt the most. We know the zip codes in which children are most likely to go unbuckled across Illinois. We also know the logit model provides a decent idea of the socioeconomic characteristics correlated with unbuckled children. Resources must be physically provided for those caregivers in need where they are in their communities: at their places of worship, at their homes, and where they work. Such proactive outreach and initiatives would improve access to, and awareness of, child restraints and other resources available to caregivers.

Additionally, some insurance companies reimburse customers for a replacement car seat involved in a crash. And others may (*may* being heavily emphasized) preemptively provide a car seat at no cost. The codification that insurance companies must provide services and devices widely known to benefit child development is not without precedence. For example, the Patient Protection and Affordable Care Act of 2010 requires health insurance providers to supply breastfeeding support, counseling, and pump equipment to new mothers for the duration of breastfeeding (HealthCare.gov). A quite reasonable corollary would be the required provision of appropriate safety seats for dependent children. The reduction and ultimate elimination of childhood crash injuries and fatalities – especially among those not properly restrained – is an achievable goal that can be accomplished through thoughtful and targeted outreach and soft-touch regulation.

References

Arbogast, K.B., J.S. Jermakian, M.J. Kallan, and D.R. Durbin. 2009. "Effectiveness of Belt Positioning Booster Seats: An Updated Assessment." *Pediatrics*. 124 (5): 1281–1286. 10.1542/peds.2009-0908.

Benefits.gov. 2021. "Illinois Medicaid." https://www.benefits.gov/benefit/1628.

Berns, S. D., and F. Vaca. 2001. "Commentary: We need to give children a boost before we buckle them." *Annals of emergency medicine*, *37*(4), 407–410.

Centers for Disease Control and Prevention. 2020. *Child Passenger Safety*. https://www.cdc.gov/injury/features/child-passenger-safety/index.html (June 23, 2021).

Cunningham, R.M., M.A. Walton, and P.M. Carter. 2018. "The Major Causes of Death in Children and Adolescents in the United States." *The New England Journal of Medicine* 379:2468-2475.

Edwards, M. 2021. "Twelfth ride: a Saturday morning driving for Uber in Cincinnati." *Planning Forum.* Volume 18.

Gunn, V L. 2005. "Racial Differences in Child Safety Restraint Use in Tennessee." *Injury Prevention* 11(6): 340–42.

HealthCare.gov. 2021. "Breastfeeding benefits." https://www.healthcare.gov/coverage/breast-feeding-benefits/.

Kendi, S., J.L. Winkels, J.M. Chamberlain, and M.L. Macy. 2021. "An Adapted Child Safety Seat Hassles Score Is Associated With Suboptimal Child Passenger Safety Behaviors Among Parents." *Academic Pediatrics*. Volume 21, Issue 5, 892 – 899.

Lee, K.C., R.A. Shults, A.I. Greenspan, T. Haileyesus, A.M. Dellinger. 2008. "Child passenger restraint use and emergency department–reported injuries: A special study using the National Electronic Injury Surveillance System–All Injury Program, 2004." *Journal of Safety Research*. Volume 39, Issue 1.

McGlincy, M.H. 2021. LinkSolv. Strategic Matching. Morrisonville, NY.

Savage, M.F., S. Kendi, M.L. Macy. 2021. "Ride-Share Use and Child Passenger Safety Behaviors: An Online Survey of Parents." *Academic Pediatrics.* Volume 21, Issue 8, 1363 – 1371.

Prince, P., Hines, L.M., Bauer, M.J. 2019. "Pediatric Restraint Use and Injury in New York City Taxis Compared with Other Passenger Vehicles." *Transportation Research Record: Journal of the Transportation Research Board* 2673(7): 541–49. doi: 10.1177/0361198119843091.

U.S. Census Bureau. 2019. 2015-2019 5-year American Community Survey.

Acknowledgments

The authors wish to express a debt of gratitude for the team at the Institute for Legal, Legislative, and Policy Studies at the University of Illinois at Springfield. Especially for the technical assistance of Daniel Leonard, M.S., guidance by A.J. Simmons, Ph.D., and manuscript review by Amy Watson. Thank you.

Disclaimer

Funding for this research was made possible (in part) by the Illinois Department of Public Health (DPH) through funds from the Illinois Department of Transportation (IDOT), 22-0343-03, and/or U.S. Centers for Disease Control and Prevention, CDC-RFA-CE21-2101. The views expressed in written conference materials or publications and by speakers and moderators do not necessarily reflect the official policies of DPH, IDOT, or the U.S. Department of Health and Human Services, nor does the mention of trade names, commercial practices, or organizations imply endorsement by the U.S. Government.