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Child Passenger Safety Perceptions and Practices In Ride-Sharing Vehicles

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16. Abstract

Given the increased use of ride-share vehicles and the demographic of the most frequent users of these services, concerns regarding how children are being transported in ride-share vehicles (including personal vehicles used to provide ride-share services as well as taxis) are emerging. The purpose of this study was to provide insight into how children are restrained when traveling in ride-share vehicles. An observational survey was conducted from July to August 2022 in two urban areas; the target population were children from birth to 12 years old transported in ride-share vehicles. The percentages of restrained children observed in ride-share vehicles was substantially lower than the national estimate of 89.8% for children traveling in private vehicles (Boyle, 2023). About half of the children observed were traveling unrestrained and the remainder were either using the vehicle seat belts or a child restraint system (CRS). Substantial percentages of infants (46%), toddlers (49%), and children (51%) were traveling unrestrained. The observed CRS use rate was 8.1%, with 41% of restrained children using seat belts.

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Executive Summary

Motor vehicle crashes are the primary cause of unintentional injury among children in the United States. An appropriate child restraint system (CRS) gives a child the best protection in a crash. One of the most effective ways to save a child's life and prevent injuries in the event of a crash is through the proper use of a CRS until the vehicle seat belt fits the child properly. The National Highway Traffic Safety Administration (NHTSA) recommends that all children 12 and younger traveling in a vehicle sit in the rear seats and use restraint systems appropriate to their height and weight. Research shows that restraining children in rear seats reduces fatal injury risk by approximately 75% for children up to age 3, and almost 50% for children ages 4 to 8 (Durbin et al., 2015). Of the 796 child passenger vehicle occupants killed in traffic crashes in the United States in 2021 whose restraint use was known, 40% were unrestrained (National Center for Statistics and Analysis, 2023). Despite the research demonstrating the safety benefits of sitting in the rear seat and using appropriate CRSs, children continue to travel unrestrained in vehicles or are prematurely transitioned from one type of CRS to another before the children have reached the recommended height and weight for those CRSs.

The use of ride-sharing services has increased dramatically over the past few years (Jiang, 2019), and children are increasingly riding in ride-share vehicles (e.g., Uber or Lyft). Complicating matters is that researchers and other safety advocates do not have a clear understanding of how caregivers and drivers are navigating CRS use in these vehicles. Gaps in legislation and issues related to accessibility may result in lower use of CRS in ride-share vehicles. Given the increased use of ride-share vehicles and the demographic of the most frequent users of these services, concerns regarding how children are being transported in ride-share vehicles are emerging.

The purpose of the study was to provide insight into how children are restrained when traveling in ride-share vehicles. This study includes personal vehicles used to provide ride-share services as well as taxis. Previous research has largely relied on self-report of CRS use in ride-share vehicles with very few studies collecting direct observations of this behavior. Obtaining reliable data on CRS use in ride-share vehicles is necessary for researchers to gain a better understanding of caregiver behavior and inform the development and evaluations of safety countermeasures.

The observational survey was conducted from July to August 2022 in two urban areas. The target population was children from birth to 12 years old transported in ride-share vehicles. The data collection methodology was based upon the National Occupant Protection Use Survey (NOPUS) and the National Survey of the Use of Booster Seats (NSUBS). The study employed a custom data collection application to record observed restraint use of vehicle occupants at a sample of sites that have a relatively high incidence of children visitors, were more likely to attract children in ride-share vehicles and were likely to reasonably represent the target population. Both descriptive and statistical analyses were conducted to identify key characteristics and any significant differences in restraint use between groups of interest. The analysis was adjusted for the complex survey design and all analyses used survey weights and weighted percentages.

Across both metropolitan statistical areas (MSAs) a total of 13,294 vehicle occupants in 2,989 vehicles were observed, of which 4,379 occupants were children from birth to 12 years old. Overall, half of children observed were traveling unrestrained and the remainder were either using vehicle seat belts or CRSs. A substantial percentage of children in each age group (infant: 46%, toddler: 49%, and child: 51%) were traveling unrestrained. The percentage of restrained children observed in ride-share vehicles in the selected MSAs was substantially lower than the national estimate of 89.8% for children traveling in private vehicles in 2021 (Boyle, 2023).

Furthermore, the observed CRS use rate was 8.1%; with a higher percentage (41%) of restrained children using seat belts, suggesting that while some of the children were restrained, many were not using the proper restraint for their height and weight.

A higher rate of restraint use in infants, toddlers, and children was observed at airports than at other points of interest (POI). Like findings from other observational studies, restraint use of the driver and other adult vehicle occupants was positively related to child restraint use.

Introduction

Motor vehicle crashes are the primary cause of accidental death and injury among children 5 to 14 years old in the United States, and the lack of restraint use has been identified as a key risk factor in fatal crashes involving children (West et al., 2021; Wolf et al., 2017). An appropriate CRS provides the best protection in a crash until a vehicle seat belt fits the child properly. NHTSA recommends that all children 12 and younger be properly restrained in the rear seats of passenger vehicles using restraint systems appropriate for their height and weight. Research shows that using CRSs reduces the risk of fatal injury for infants under 1 year old by 71% for passenger cars and by 58% for pickups, SUVs, and minivans. For toddlers 1 to 4 years old, the corresponding reductions are 54% and 59% (Kahane, 2015). Despite the research demonstrating the safety benefits of using appropriate CRSs in rear seats, children continue to travel unrestrained in vehicles. In 2020 there were 181 passenger vehicle occupant fatalities involving children under 4 years old, with 31% unrestrained (based on known restraint use). In the 4-to-7 age group there were 207 fatalities; of which 43% were unrestrained (based on known restraint use) (NCSA, 2022). In addition to children riding unrestrained in privately-owned vehicles, CRSs are frequently used incorrectly, and children are often prematurely transitioned to inappropriate restraint types for their height and weight. Studies have found misuse rates to be as high as 60 to 80% (Decina, et al., 2005; Greenwell, 2015; Hoffman, et al., 2016).

Complicating matters, the use of ridesharing services has increased dramatically over the past few years. In 2018 some 36% of U.S. adults used ridesharing services such as Uber and Lyft. This is more than twice the share of the population who used ridesharing apps in 2015 (Jiang, 2019). Several self-report surveys point to higher use of ride-share vehicles among adults 18 to 44 years old (Ehsani et al., 2021; Giese et al., 2020), and people between 18 and 29 were seven times as likely to use these services as those 65 and older (28% and 4%, respectively) (Smith, 2016). These high-use age groups are also more likely to be parents of young children (Martin et al., 2022).

Ride-share companies initially targeted adults as their main consumers; however, more recently services tailored for child passengers (alone or with parents) have increased. Companies tailored to children include BubbiKids (Texas, Connecticut, Florida, Virgina); HopSkipDrive (San Francisco, Los Angeles, Orange County); GoKart (North Carolina); Kango (San Francisco); Sheprd (Newton, Massachusetts); UberFamily (various locations); ZemCar (Boston); and Zum (San Francisco, Orange County) (Atiyeh, 2018; Safe Ride News, 2019). Although ride-share companies promote increased personal safety, driver background checks, and easy scheduling, the system does not necessarily lend itself to a high usage of child restraints.

State and local regulatory inconsistencies, such as types of vehicles covered under restraint laws, the severity of fines for violations of the law, and ages covered by child restraint laws contribute to the confusion on the part of caregivers and ride-share drivers. Some parents reported never using ride-share vehicles with their children because they did not know it was an option or did not understand the logistics associated with that kind of travel (Owens et al., 2019). Other parents believed that ride-share drivers were not permitted to provide rides to children. As of 2019 there were 34 States with CRS legislation that exempted for-hire vehicles from requiring child restraint systems (Owens et al., 2019). Ride-share services are covered under these for-hire vehicles. As of 2020 New York revised its seat belt law to require backseat passengers in ride-share vehicles 16 or older be restrained by seat belts. New York also requires all children under 8 years old use properly fitted CRSs, and the law applies to taxis and other ride-share services as well as privately owned vehicles. Prior to strengthening the law in New York, studies point to lower rates of CRS use in New York City taxis compared to private vehicles (Keshavarz et al., 2006; Prince et al., 2019). Given the increased use of ride-share vehicles and the demographic of the most frequent users of these services, concerns regarding how children are being transported in ride-share vehicles are emerging.

Limited research has been conducted on CRS use in ride-share vehicles. Keshavarz et al. (2006) used interview data with parents of children from birth to 19 years old who arrived for care in a pediatric emergency department in a New York City hospital to assess the level of knowledge and compliance of caregivers with the NHTSA CRS use guidelines in both privately owned vehicles and taxis. Respondents reported lower rates of CRS use in taxis compared to private vehicles for children up to 1 year old (22% and 48%). Similarly, 85% of children older than 8 used seat belts often or always in private vehicles as compared to 42% of children traveling in taxis. Among parents and caregivers of children under 8, some 44% said CRSs were too difficult to carry around, making it the most cited reason for CRS nonuse in taxis (Keshavarz et al., 2006).

In an online national survey of parents with children under 8, some 59% reported that they transported their children differently when traveling in ride-share vehicles compared with private-owned vehicles (Owens et al., 2019). Of those, 37% reported holding the children on their laps and 25% allowed the children to ride without CRSs. Several online and in-person surveys with parents and caregivers point to specific circumstances in which non-use of CRS is perceived as more acceptable, including traveling in ride-share vehicles or taxis; traveling while on vacation, carpooling, when traveling short distances; and when there is no CRS available (Levi et al., 2020; McDonald et al., 2018; Niu et al., 2019). Lower rates of child restraint use in taxis compared to personal vehicles was also reported by caregivers of children in China and New Zealand (Niu et al., 2019; Wilson et al., 2013).

There is a lack of research on best practice approaches for promoting child safety in ride-share vehicles. A better understanding of caregiver and ride-share driver behaviors and attitudes related to restraint use in ride-share vehicles could inform the development of public policy, regulations, enforcement measures, and educational campaigns.

In 2020 the Transportation Research Board initiated a new Behavioral Traffic Safety Cooperative Research Program project titled “Ensuring Child Safety in For-Hire Ride-Share Vehicles” with the objective of identifying and prioritizing the types of behavioral interventions needed to improve child passenger safety in the ride-share environment, including taxis.[1] The research considered tools, policy alternatives, educational strategies and messages, corporate best practices, and other relevant approaches to promote child passenger safety through increased CRS use.

This study builds on the Transportation Research Board research by directly observing CRS use in ride-share vehicles. Previous research has largely relied on self-report of CRS use in ride-share vehicles with very few studies collecting direct observations of this behavior. Obtaining reliable data on CRS use in ride-share vehicles is necessary for researchers to gain a better understanding of caregiver behavior and inform the development and evaluations of safety

[1] For more information, see www.nap.edu/login.php?action=guest&record_id=27067.

countermeasures. The following report details the methodology and findings of an observational study of ride-share vehicles conducted from July through August 2022.

Methodology

The purpose of the study was to provide insight into how children are restrained when traveling in ride-share vehicles. The observational survey was conducted in two urban areas and the target population was children from birth to 12 years old transported in ride-share vehicles. The sampling and data collection methodology was based on current data collection protocols used in other observational surveys, such as NOPUS and NSUBS (Boyle, 2022, 2023). The study employed a custom data collection application to record observed restraint use of vehicle occupants at a sample of sites that have a relatively high incidence of children visitors and were likely to reasonably represent the target population.

Sample Design

Statistically speaking, observing a child in a ride-share vehicle is a rare event. Several self-report surveys point to higher use of ride-share vehicles among young adults concentrated in urban settings as compared to older adults and people living in rural areas (Das, 2020; Dias et al., 2017; Ehsani et al., 2021; Giese et al., 2020; Smith, 2016). As such, the sampling plan required the inclusion of two MSAs, with the exception of New York City,[2] to increase the likelihood of observing ride-share traffic.

Selecting MSAs

Researchers considered several population and location characteristics when selecting the two MSAs. They accessed population size and travel summary statistics data from the U.S. Census Bureau 2019 American Community Survey (ACS), identified from SafeGraph (a platform that curates a database of global POI) the number of businesses within each MSA that were likely to attract children, identified the top 15 metro areas for Uber ridership (Bloomberg Second Measure Data Analytics (2021) as cited by Dean (2022)), and identified which MSAs had ride-share services that catered to children (e.g., HopSkipDrive, GoKart, Kango) at the time of data collection.

Researchers identified the total population size, population size of children 12 and younger, and vehicle ownership statistics from the ACS. They also used the ACS to identify the following population characteristics and travel behaviors.

- Number of households
- Average number of vehicles per household
- Average family income
- Number of households that have children 12 and younger
- Number of households that do not own vehicles and have children 12 and younger
- Number of people that taxi to work
- Number of people that take public transportation to work
- Number of people that walk or bike to work

[2] NHTSA specifically requested that New York City not be considered when selecting locations for the survey. New York City made changes to its child restraint laws while the survey was being designed and conducted.

The SafeGraph POI file was used to determine the number of businesses with the potential to attract large numbers of children within or near the MSA. Types of businesses:

- Amusement parks
- Tourist attractions
- Museums
- Cinemas
- Zoos and aquariums
- Performing arts centers
- Parks and recreation areas
- Civic centers
- Libraries
- Sports complexes

A classification scheme and ranking system was developed to select the MSAs with the greatest potential for observing children in ride-share vehicles. Each of the population characteristics and travel behaviors and MSA attributes outlined above was sorted into one of five categories.

- Population category:
  - Population of children 12 or younger
  - Number of households with children 12 or younger
  - Average family income
  - Density
- Transportation category:
  - Number of people taking taxis to work
  - Number of people taking public transportation to work
  - Average vehicles per household
- Kids and no vehicles category:
  - Number of households that do not own vehicles and have children 12 or younger
- Ride-share category:
  - Total number of child-centric ride-share companies
  - Ranking for Uber ridership
- SafeGraph category:
  - Number of amusement parks
  - Number of tourist attractions
  - Number of museums
  - Number of cinemas
  - Number of zoos and aquariums
  - Number of performing arts centers
  - Number of parks and recreation areas
  - Number of civic community centers
  - Number of libraries
  - Number of sports complexes
  - Number of taxi stands

For each category, researchers ranked the MSAs using the available data, with a lower numbered rank being equivalent to an MSA possessing characteristics that are more suited for the purposes of the study (e.g., more children, fewer vehicles per household, greater number of child-centric businesses, and greater penetration of ride-share services). The score for each category was calculated as the average of the ranks within that category, resulting in five category sub-scores. A weighted average of these five sub-scores was then used to calculate the final score or ranking for each MSA.

Using this method, researchers narrowed down the total list of MSAs from 152 to the top five ranking MSAs for consideration for inclusion in the survey. The top five MSAs included New York-Newark (ranked number one), two MSAs located in the Northeast, one MSA located in the Mid-Atlantic region, and one located in the Midwest (see Table 1). Based on the rankings researchers selected one Northeastern MSA (ranked number two), and to avoid conducting the survey in two MSAs located in the same region, selected the second MSA from the Mid-Atlantic region (ranked number four). Both MSAs have urban and tourist characteristics, and each includes several neighboring counties.

Table 1. Top five MSAs

MSA	Uber Rank	Average Population Rank	Average Transportation Rank	Average Children and No Vehicle Rank	Average Ride-Share Rank	Average SafeGraph Sites Rank	Final Score	Rank Order
New York-Newark (NY-NJ-CT-PA)	4	1.50	1.67	1	9.75	3.94	2.80	1
Northeast MSA	6	6.75	16.67	6	10.75	6.88	9.24	2
Northeast MSA	8	9.25	16.00	2	11.75	13.00	10.23	3
Mid-Atlantic MSA	2	3.75	31.67	3	2.25	7.11	10.47	4
Midwest MSA	5	5.75	12.33	5	47.25	4.77	10.99	5

Sampling Site Types

For operational efficiency and to maximize the potential to observe children in ride-share vehicles, researchers enumerated and selected a sample of businesses (i.e., sites) within each MSA, based on their likelihood of attracting children in ride-share vehicles. The team used data from SafeGraph to identify the various businesses in each MSA and the best times to schedule data collection at each business. Researchers reviewed the SafeGraph's POI file to identify the following types of businesses and their addresses: amusement parks, tourist attractions, museums, cinemas, zoos, aquariums, performing arts centers, park and recreation centers, civic centers, libraries, sports complexes, airports, and taxi stands located near railroad stations and airports. Researchers augmented the SafeGraph data by searching independent online websites highlighting child-centric activities in each MSA. Overlap analysis of the SafeGraph data and businesses identified by the child-centric websites enabled researchers to develop a comprehensive list of popular businesses for children in each MSA. Foot traffic patterns, included in SafeGraph's POI file, were also reviewed so that data collection times could be scheduled for the busiest times of day at a given business; and therefore, increase the likelihood of observing children in ride-share vehicles.

Businesses were categorized based on their ability to attract large numbers of children in ride-share vehicles. Several site types were given priority and all the sites identified for that site type were included in the sample. These primary sites included sports parks or arenas, zoos, aquariums, historical sites, and certain types of museums. Additionally, airports were included as primary sites in both MSAs because of the high volumes of ride-share vehicles that work these locations. Researchers specifically selected airports within 45-minute drives of the Mid-Atlantic and Northeastern MSAs. Secondary sites were also sampled because of their appeal for children. These site types included cinemas, train stations, and other outdoor venues. Finally, "Other" businesses such as parks and play spaces were randomly assigned to the main sample until 40 sites were selected or assigned to the reserve sample.

Overall, 80 sites were selected for each MSA, 40 sites in the main sample and an additional 40 reserve sites. If sampled sites were closed for business during the scheduled data collection session or inaccessible because the roadways surrounding them were closed during the field period, replacement sites were selected from the reserve sample. When the data collector needed to select a replacement site from the reserve sample, they selected a site that was geographically close to the sampled site. Table 2 shows the distribution of the sites among the site types that were included in the frame (N), main sample (n), and reserve sample (n reserve), and the sampling rates for the main sample of each of three categories of sites.

Table 2. Frame size, sample size, and sampling rate for selected MSAs

		Primary Sites	**Secondary Sites**	**Other Sites**
Mid-Atlantic MSA	N	30	16	66
	n	30	7	3
	n reserve	0	5	35
	Rate	100%	44%	5%
Northeastern MSA	N	23	11	71
	n	23	8	9
	n reserve	0	0	40
	Rate	100%	73%	13%

Securing Site Cooperation

All sites other than airports used curbside data collection that did not require advance permission from the business manager/owner. Cooperation was obtained from five airports in advance to ensure that all their security needs were met prior to the field period. An initial point of contact, typically the airport security director or manager, received a recruitment email that provided a brief explanation of the study and included a letter of authorization from NHTSA. The email was followed by a meeting between researchers and airport staff and provided an opportunity for researchers to explain the study in more detail and respond to any questions the airport representatives might have regarding the study protocol and scheduling. Usually the airport required a list of data collectors who were assigned to the airport, a picture of the safety vest and the identification badge the data collectors would be wearing, an authorization letter from NHTSA, a certificate of insurance, and an indemnification agreement. Once researchers secured the cooperation from the airport, they gave airport representatives specific dates and times for data collection. Additionally, most airport representatives requested that data collection staff notify airport representatives each time they began collecting data and before they left the airports.

Hire and Train Observers

Six data collectors and one backup data collector administered the survey. All data collectors had extensive experience identifying CRSs and determining if a child was properly restrained in one. All have worked on a variety of occupant protection surveys, including NOPUS and NSUBS. The data collectors were paired into teams of two and assigned to collect data at a set of sites within each MSA.

All data collectors had to complete a 2-day training. Customized training material was developed to meet the specific objectives of the study. The training was multimodal and included Federal and State mandated trainings, PowerPoint slides, and hands-on field practice. Classroom training was conducted in the Washington, D. C., area, followed by field practice. Training topics included: an overview of the study; identifying different CRS types and other data collection variables; using a smartphone application to collect and transmit the data; addressing emergency situations; and administrative procedures. Observations made by data collectors during field practice were reviewed for accuracy by researchers.

When estimating age, data collectors were instructed to observe each vehicle occupant's physical characteristics. For a child, data collectors were instructed to consider the height and weight of the child as well as gross motor skills, including the ability to walk steadily on their own, balance, ability to jump or run, and navigate getting into/out of the vehicle without adult assistance**.** When observing race data, collectors based their assessment on each vehicle occupant's physical characteristics.

Study Protocol

The survey tool and material were approved by the researcher's Institutional Review Board. Office of Management and Budget clearance was not required for this study as it collected observational data and did not involve any interaction with the public.

The survey was conducted from July 14 to August 3, 2022, in the Mid-Atlantic MSA and from August 5 to August 31, 2022, in the Northeastern MSA. Each of the three teams collected data at three sites a day, totaling nine sites visited each day. Data were collected during daylight (7 a.m. to 8 p.m.) 7 days a week. Each selected site was assigned a 2-hour data collection period, and every effort was made to schedule data collection at a site when larger numbers of children were expected to be present. For example, data collection at sport parks and arenas was scheduled for the 2 hours just before the start of a game. Primary sites were visited an average of 4.15 times over the field period to increase the likelihood of observing children in ride-share vehicles. Sites that were not designated as primary sites were visited two times on average. A total of 111 data collection periods observed at least one ride-share vehicle with child occupants in the Northeastern MSA, and 108 data collection periods observed at least one ride-share vehicle with child occupants in the Mid-Atlantic MSA.

Each data collector worked independently of the partner while at a site, collecting observations from different vehicles. Having two data collectors at each site increased the number of observations obtained during the 2-hour data collection period and minimized the number of missed vehicles because one data collector was busy. The teams were provided schedules and custom maps identifying the locations of the sampled and reserve sites in each MSA.

When collecting data at airports, data collectors were instructed to position themselves near the drop-off or pickup locations for ride-share/taxi services, whichever location was busiest at the assigned time. At all other sites, data collectors were advised to stand at the drop-off or pickup locations when available or to position themselves curbside near locations where the ride-share vehicles were stopping to pick up passengers or drop them off.

Data collectors were instructed to look for the ride-share company logo sticker, taxi roof cap, or illuminated light to help differentiate ride-shares and taxis from private passenger vehicles. In addition to stickers and logos, they were instructed to look for cues that may provide insight that each vehicle was a ride-share, such as all passengers sitting in the rear row of seats or drivers wearing protective masks.[3]

When collecting data, potential observation opportunities were identified via different strategies, for example:

1. Ride-share vehicles were observed approaching a drop-off zone, with an emphasis on spotting vehicles that appeared to have at least one occupant from birth to 12 years old. As the vehicle slowed to a stop, the data collector approached the vehicle and recorded observations. The data collectors were instructed to stand close enough to the vehicles so that they could complete their observations, but far enough away so they did not intrude or violate the personal space of the vehicle occupants.
2. Data collectors positioned themselves to observe passenger groups awaiting pick-up who appeared to include children from birth to 12 years old. The vehicles were observed from afar and the data were recorded when the ride-share vehicles stopped for pick-up and occupants were getting into the vehicles before they left the locations.

Data collection used a customized smartphone application. At each site data collectors documented site identifying information including the site identification number. The application recorded a date and time stamp for each observation as well as the duration of data collection session. As the ride-share vehicle approached, the data collector captured vehicle information (including whether it was a taxi or a personal vehicle used as a ride-share vehicle), seating position for each occupant, occupant estimated age, and occupant restraint use by stepping through a series of screens (Figure 1).

[3] During the field period Uber and Lyft drivers were required to wear protective surgical or cloth masks when transporting passengers.

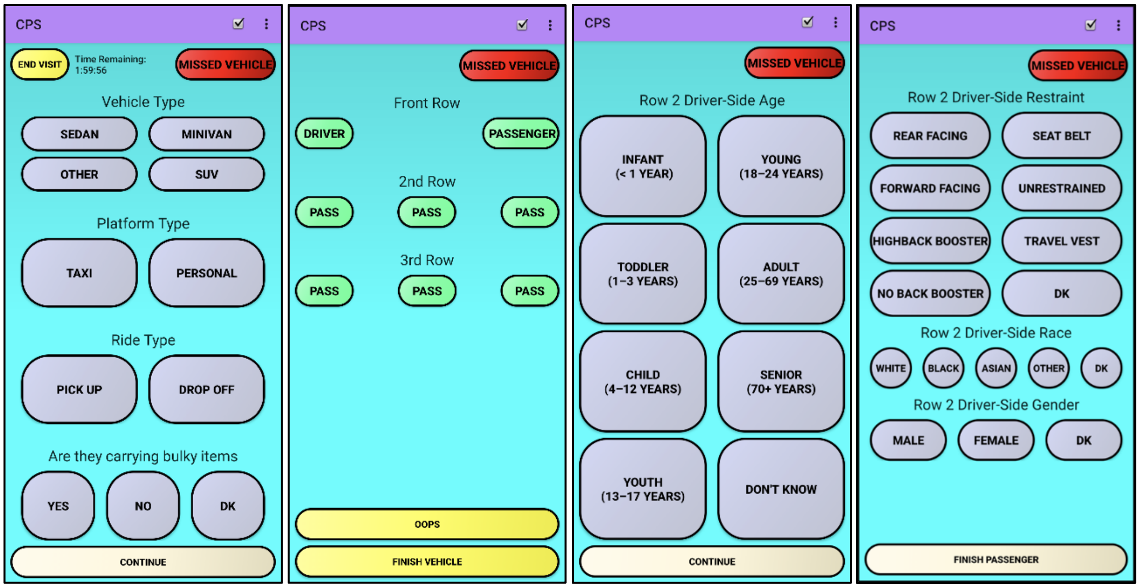

Figure 1. Example data collection application screens

Data collectors recorded specific details at the vehicle and occupant level (see Table 3). Data entry options available on the application were dynamic; they adapted based on the data collector's previous entries. For example, the options for rear-facing, forward-facing, high-back booster, no back booster, and travel vest were not available if the driver seating position was selected or if the occupant's age was recorded as Youth, Young, Adult, or Senior.

Adults or children who were sitting in the vehicle seats or on booster seats were coded as unrestrained if the vehicle shoulder belts were not visible or the belts were positioned under the children's arms or behind their backs. Children observed in forward-facing or rear-facing CRSs were coded as unrestrained if **both** harness straps did not come over their shoulders or the harness retainers, i.e., "chest clips," and the buckle at the hips were not secured.

Table 3. Data collection variables, vehicle, and occupant level

	Vehicle Level Information
Vehicle Type	Sedan, Minivan, SUV, Other
Platform Type	Taxi, Ride-share
Ride Type	Drop-off, Pick-up
Presence of Bulky Items	Yes, No, Don't Know
	Occupant Level Information
Seating Position	Front Row: Driver; Outboard Passenger Second Row: Driver Side Passenger; Center Passenger; Outboard Passenger Third Row: Driver Side Passenger; Center Passenger; Outboard Passenger
Restraint Use	Rear-facing, Forward-Facing, High-Back Booster, No-Back Booster, Travel Vest, Seat Belt, Unrestrained, Don't Know
Adult Occupant Age	Youth (13-17 years), Young (18-24 years), Adult (25-69 years), Senior (70+ years), Don't Know

Child Occupant Age	Infant (<1 year), Toddler (1-3 years), Child (4-12 years), Don't Know
Sex	Male, Female, Don't Know
Race	White, Black, Asian, Other, Don't Know

Data Transmission

Data were transmitted to Westat headquarters after data collection was completed at each site using cellular and Wi-Fi technologies. The data were transmitted as text files and were imported to a PostgreSQL database. The database was used to accumulate the raw data and conduct quality control checks. Customized views and queries were created to facilitate daily reviews for completeness, adherence to the schedule, and to confirm data collection was conducted at the assigned sites. Data were reviewed and cleaned within 24 hours of receipt. Safeguards and redundancies were built in at each step of the process to prevent data loss. Near real-time processing of the data allowed for a tally of completed observations broken out by site type and other key variables daily.

Weighting

The base weights for all visits at each site follow from the sample design described above. Based on the population and sample sizes from Table 2, the base weights for each MSA and site type are shown in Table 4.

Table 4. Site-level base weights by MSA and category

	Primary Sites	Secondary Sites	Other
Mid-Atlantic MSA	30/30 = 1	16/7 ≈ 2.29	66/3 = 22
Northeast MSA	23/23 = 1	11/8 ≈ 1.38	71/9 ≈ 7.89

Researchers did not take ineligibility from the sampling phase into account in the weighting. Replacements for ineligible sampled sites took on the probabilities of the corresponding sampled site. Ineligible sites were those initially identified as businesses that would attract large numbers of children, but upon further exploration were not. These sites might include community centers that only provided activities for seniors or cinemas that catered to adults. Additionally, several visits to a sampled site were not adjusted for in the weighting process.

Researchers accounted for nonresponse at the visit level and adjusted for abandoned sites, shorter window of observation time, and missed vehicle observations. If a site was permanently closed when the data collectors arrived, the visit was multiplied by a factor of 0. There were two cases of permanently closed sites, one in each of the MSAs. There were four visits where the total observation time was less than 120 minutes, ranging from 34 to 107 minutes. Two of these sites were in the Northeast MSA and two in the Mid-Atlantic MSA. For these sites, the weights were adjusted by a factor of 120 divided by the total observed time at the site.

Finally, for sites where ride-share vehicles with child passengers that were not observed because the data collector was busy recording information from another vehicle or could not get a clear view of the vehicle occupants, the weights were adjusted by a factor of the total number of missed vehicles divided by number of observed vehicles. When collecting data from a vehicle, data collectors were instructed to monitor the surrounding area for ride-share vehicles with child occupants. Each screen of the data collection app had a button that could be selected to indicate that a ride-share vehicle with a child occupant was observed, but they were unable to capture the data. One hundred eleven site visits had vehicles missed, ranging from 1 to 13 vehicles missed.

Final weights were calculated as

$$base\ weight * abandonment\ factor * minutes\ factor * missed\ vehicle\ factor$$

Summary statistics of the final weights are shown in Table 5.

Table 5. Summary statistics of final weights by MSA and category

MSA	Category	Minimum	Mean	Maximum
Northeast MSA	Primary	0	1.064	2
	Secondary	2.286	2.336	2.824
	Other	22	22	22
Mid-Atlantic MSA	Primary	1	1.113	3
	Secondary	1.375	1.606	4.125
	Other	0	8.348	27.843

Statistical Analysis

The analysis plan focused on descriptive analyses including total counts of children in ride-sharing vehicles and proportion of such children using restraints, reported by site type, day of week, time of day, and child's estimated age group. All analyses used survey weights and weighted percentages.

Additional analyses included chi-square tests, for reasonable sample sizes (at least 10 cases per table cell, and at least 50 total cases in the table). The analysis was adjusted for the complex survey design, to assess whether there are any significant differences in restraint use between groups of interest, for example, if children of a certain age were more likely to be restrained when traveling in ride-share vehicles.

Findings

Observed Sites

Forty sites were included in a main sample for each MSA, and 40 sites were selected as part of a reserve sample in each MSA if data collectors were unable to collect data at a sampled site. Data collectors observed at least one target vehicle at 60 sites, across the two MSAs. Twenty-eight sites were visited in the Northeastern MSA, and 32 sites were visited in the Mid-Atlantic MSA. Forty-one of the 60 sites were visited more than once. Data collectors completed 111 site visits in the Northeastern MSA and 108 site visits in the Mid-Atlantic MSA where at least one ride-share vehicle with a child occupant was observed.

Observed Occupants

Across both MSAs a total of 13,294 vehicle occupants in 2,989 vehicles were observed, of which 4,379 occupants were children from birth to 12 years old (see Table 6). Note some demographic characteristics including age group, sex, and race are missing for a small number of the observed occupants.

Table 6. Observed vehicles, all occupants, and child occupants

Total Vehicles Observed by MSA	
MSA	**Unweighted *N***
Northeastern	1,358
Mid-Atlantic	1,631
All Occupants Observed by MSA	
Northeastern	6,015
Mid-Atlantic	7,279
Child Occupants Observed by MSA	
Northeastern	1,992
Mid-Atlantic	2,387

An initial review of the summary data showed that when the data were separated by MSA, sample sizes for some of the variables of interest were insufficient to confidently assess whether there were significant relationships in restraint use between groups using chi-square tests. In some instances the observed cases for a table cell were less than 10 or the total cases for the comparison of interest was below 50. Given the two MSAs were similar with respect to having urban and tourist characteristics, researchers attempted to maximize the opportunity to conduct significance testing on key variables of interest by combining the data from the two MSAs into one larger dataset. Results from a Rao-Scott's chi-square test of significance did not show a significant relationship between restraint use and MSA (X^2 (1, 13,294[4]) = 6.7, p = .58). Additionally, the relationship between the age distribution of the occupants observed and MSA was not statistically significant (X^2 (6, 13,294) = 24.91, p = .29). Based on these findings, data

[4] Observed age was not recorded for six vehicle occupants, three occupants in each MSA.

from the two MSAs were collapsed, and findings reported below reflect the analysis conducted on the total observations across both MSAs. Table 7 shows the number of observations recorded and weighted percentages for various vehicle occupant and restraint use characteristics. Unless otherwise noted, the percentages reported in this section are weighted percentages, and counts (n) are unweighted.

Table 7. Observed vehicle occupant and restraint use characteristics

	Characteristic	**Unweighted *N***	**Weighted Percentage**
Occupant Age Group	Infant (<1 year)	156	1.0%
	Toddler (1-3 years)	417	3.0%
	Child (4-12 years)*	3,806	29.0%
	Youth (13-17 years)	708	5.0%
	Young (18-24 years)	194	1.0%
	Adult (25-69 years)	7,780	59.0%
	Older (70+ years)	227	2.0%
Child Sex	Male	2,409	54.4%
	Female	1,942	45.6%
Child Race	White	2,916	65.1%
	Black	451	9.3%
	Asian	553	16.0%
	Other	457	9.6%
Children by Site Type	Airports	2,136	38.0%
	Other Points of Interest	2,243	62.0%
Child Restraint Use	Rear-Facing	131	2.3%
	Forward-Facing	144	2.6%
	High-Back Booster	46	0.9%
	No-Back Booster	113	2.3%
	Travel Vest	11	0.2%
	Seat Belt	1,905	41.3%
	Unrestrained	2,029	50.4%

*Child age group included a wider range of 4 to 12 years because unlike other CRS studies, such as NSUBS or the National Child Restraint Use Special Study, data collectors estimated and recorded age group based on observation, not via interview.

Among child occupants, 87.5% were 4 to 12 years old, 9.0% were 1 to 3 years old, and 4.0% were under 1 year old (see Figure 2).

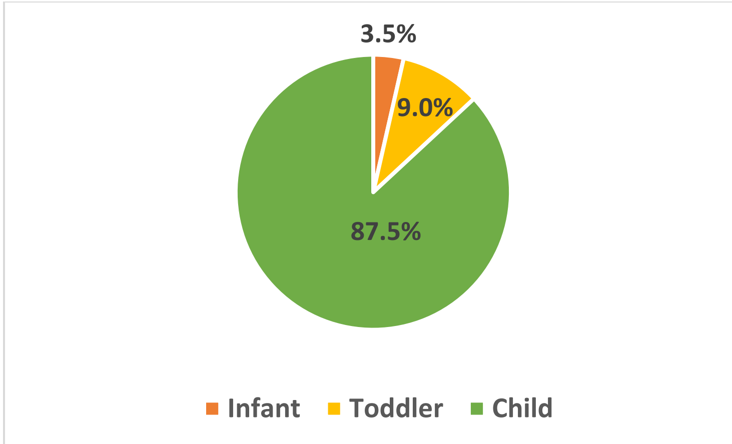

Figure 2. Percentages of child occupants observed by age group

Overall, 54.4% of the children were male and 45.6% were female. Some 65.1% of children were observed to be White, 16.0% observed to be Asian, 9.3% observed to be Black, and 9.6% observed to be Other. There was no statistically significant difference in restraint use by child sex (X^2 (2, 4,351) = .43, p= 0.8) or race (X^2 (4, 4,477) = 28.5, p=0.08). Almost two thirds of the children (62.0%) were observed at various POI across the two MSAs (e.g., museums, zoos), while the remainder (38.0%) were observed at airports.

About half of the children observed were traveling unrestrained in ride-share vehicles, 41.3% were using the vehicle seat belt, and 8.3% were using a CRS or booster seat. Note, 11 of the children observed were using travel vests (.2%) (see Figure 3). Travel vests are marketed to the public as an alternative to belt positioning boosters for children when traveling in ride-share vehicles or carpooling.

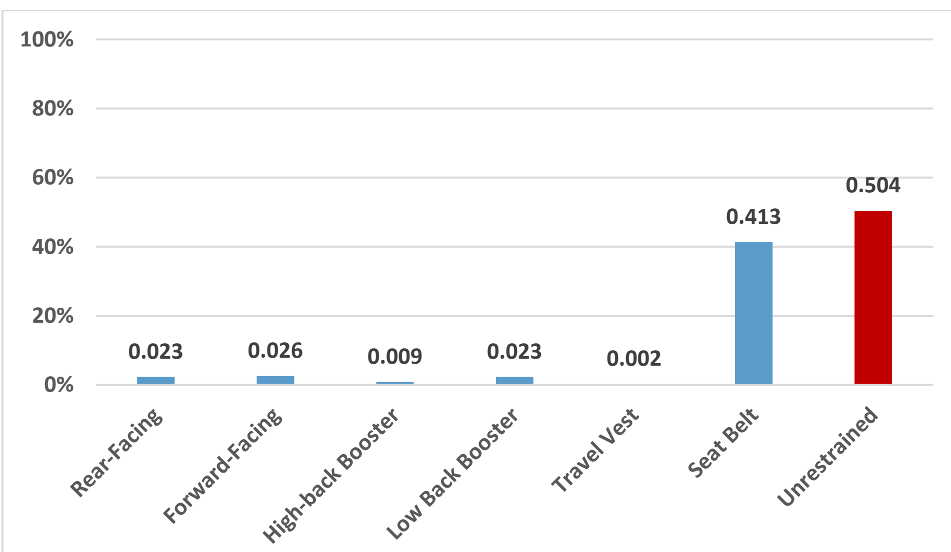

Figure 3. Observed child restraint use

Table 8 shows the number of vehicles observed and weighted percentages for various vehicle and trip characteristics.

Table 8. Observed vehicle and trip characteristics

	Unweighted *N*	Weighted Percentage
	Platform Type	
Taxi	696	20.0%
Ride-Share	2,293	80.0%
	Ride Type	
Drop-Off	1,251	44.2%
Pick-Up	1,738	55.8%
	Vehicle Type	
Sedan	910	31.3%
Minivan	501	14.5%
SUV	1,476	50.9%
Other	102	3.3%

Eighty percent of the vehicles observed were classified as ride-share vehicles (e.g., Uber, Lyft, or other type of service). Based on observation, a smaller percentage of vehicles were taxis (20%). Most of the vehicles observed were SUVs (50.9%) or sedans (31.3%), while minivans and other vehicle types represented only 17.8% of the vehicles observed. Researchers did not find differences in child restraint use for the different platforms, taxis versus the other ride-share companies (X^2 (1, 4,379) =2.28, p= 0.59), or vehicle types (X^2 (3, 4,379) = 16.49, p= 0.42).

Child Restraint Use

Overall, 49% of children observed were either using the vehicle seat belt (41.3%) or some type of CRS (8.1%). As noted above, children were recorded as unrestrained based on the following: they were sitting on the vehicle seat or a booster seat and the vehicle shoulder belt was not visible; the shoulder belt was positioned under the occupant's arm or behind their back; they were in a forward-facing or rear-facing CRS, but **both** harness straps did not come over their shoulders or the harness retainer, i.e., chest clip and buckle at the hips were not secured.

Once data collection was completed and researchers were preparing the data for analysis, an occupant was classified as being restrained if the data collector observed them using any type of restraint systems. A child's restraint use was further classified as appropriate or inappropriate based on the child's observed age (See Table 9). To illustrate, if a data collector recorded that a toddler (1 to 3 years) was using a seat belt when traveling in a ride-share vehicle, when the data was being reviewed and prepared for analysis, restraint use was coded as Not Age-Appropriate.

Table 9. Classification of restraint use by age group

Age Group	Restraint Use/ Age-Appropriate	Restraint Use/ Not Age-Appropriate	Unrestrained
Infant (0 to 11 Months)	Rear-facing	Forward-Facing, High-Back Booster Seat, No-Back Booster Seat, Seat Belt	Unrestrained
Toddler (1 to 3 Years)	Rear-facing, Forward-facing	High-Back Booster Seat, No-Back Booster Seat, Seat Belt	Unrestrained
Child (4 to 12 Years)	Forward-Facing, High-Back Booster Seat, No-Back Booster Seat, Seat Belt	Rear-Facing	Unrestrained

Among the different age groups infants were observed with the highest rate of age-appropriate restraint use (52.0%), followed by children (4 to 12 years; 49.3%) and toddlers (31.4%). A substantial percentage of child occupants in all three age groups were unrestrained (see Figure 4). Approximately 21% of the children were using inappropriate restraint systems for their age (Infants: 1.5%, Toddlers: 19.6%). No children ages 4 to 12 were observed in inappropriate restraints; however, this could have been because the age range for this group was large and age-appropriate restraints included use of a seat belt and all CRSs except for rear-facing only. Seat belts were the primary type of restraint use observed (41.3%) for children 4 to 12, suggesting that some of the younger children in this age group may have been using a restraint system that was not appropriate for their age.

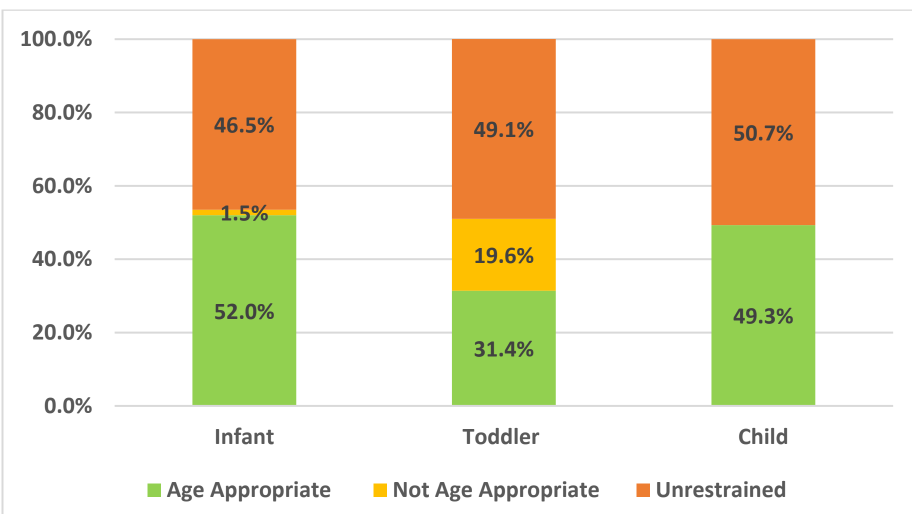

Figure 4. Child restraint classification by child age group

Due to the low percentage of child occupants classified as using restraints that were not age-appropriate, researchers collapsed restraint use into two categories: restrained and unrestrained for additional analysis.

Adult and Child Restraint Use

Overall, 85% of drivers riding with children were using seat belts. However, there was a significant difference in restraint use of children travelling with unbelted drivers relative to restraint use for children travelling with belted drivers, X^2 (1, 4,238) = 80.8, p < .001. Fifty-two percent of children traveling with belted drivers were restrained, while 33.0% of children were restrained when traveling with unbelted drivers (Figure 5). Conversely, 67.0% of the children were unrestrained when traveling with unbelted drivers.

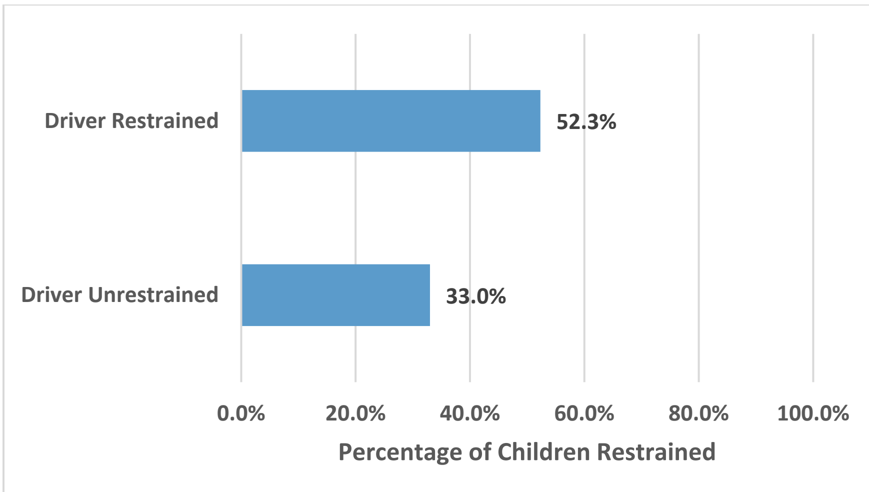

Figure 5. Child restraint use by driver restraint use

There was not a significant difference in the child's restraint use based on the number of adult passengers in the vehicle (one adult passenger versus two or more adult passengers) X^2 (1, 4,379) = 4.83, p =.27. However, children were more likely to be restrained in ride-share vehicles when all adult passengers were belted (89.3%) compared to vehicles where all the adult passengers were not belted (17.1%) (see Figure 6). The relationship between these variables was significant, X^2 (1, 4,379) = 2,260.7, p < .001.

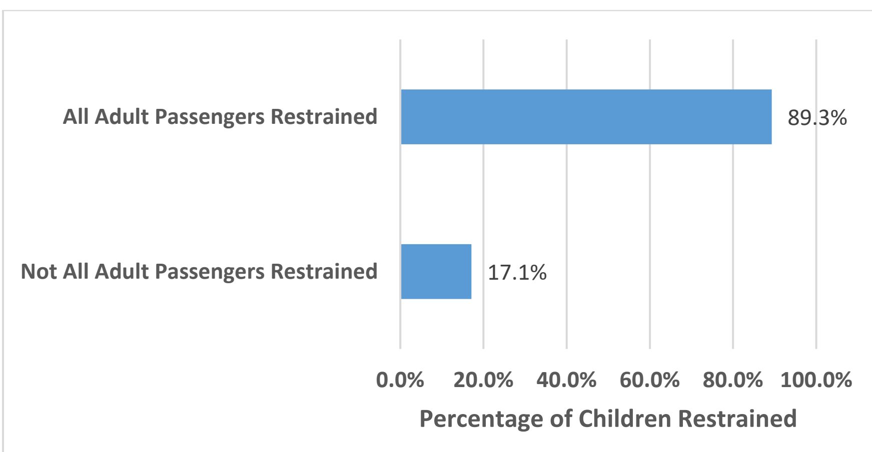

Figure 6. Child restraint use by adult passenger restraint use

Child Restraint Use by Site Type and Day of Week

Child restraint use differed across site type, with a higher percentage of children traveling restrained at the airport sites (60.0%) compared to other POI (43.2%) (see Figure 7) (X^2 (1, 4,379) = 116.26, $p < .001$). Seventy-seven percent of infants observed at airports were properly restrained as compared to 14% of the infants observed at other POI. Similarly, a greater percentage of toddlers (47%) and child occupants (57%) were properly restrained at airports compared to other POI.

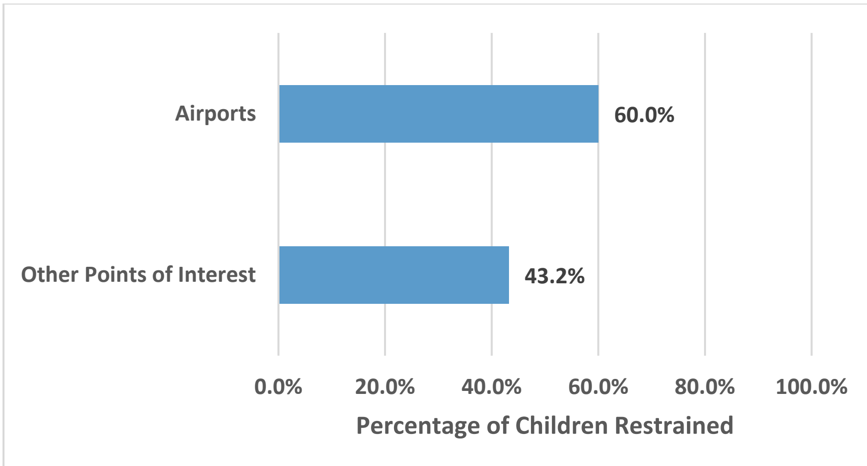

Figure 7. Child restraint use by site type

Differences in restraint use on weekends and weekdays were not statistically significant (X^2 (1, 4,379) =10.96, p=0.07).

Child Restraint Use Ownership and Bulky Items

In comparing child restraint use for CRS carried by the passenger versus CRS provided by the ride-share vehicle, no significant difference was identified (X^2 (1, 4,379) = 2.28, p = 0.59).

Caregivers have said CRSs are difficult to carry (Keshavarz et al., 2006). The current study included observing and recording the presence of bulky items as a potential barrier to CRS use in ride-share vehicles. Bulky items included but were not limited to strollers, backpacks, diaper bags, and shopping bags. The difference in observed child restraint use for cases in which the passengers were observed carrying bulky items was not statistically significant (X^2 (1, 4,378) =33.97, p= 0.07).

Discussion

National restraint use rates for children 12 and younger in private vehicles was 89.8% in 2021 (Boyle, 2023). The programs and countermeasures used to achieve this high usage rate are recognized as a success by traffic safety advocates. Conversely, the current observational survey in two urban/tourist areas with relatively high use of ride-share services contributes to a growing body of research highlighting the continued risk to child safety as the popularity of ride-share vehicles grows as a mode of transportation. Overall, 49% of children observed were either using the vehicle seat belts or some type of CRS. The percentages of restrained children observed in ride-share vehicles in the selected MSAs is significantly lower than the national estimate for children traveling in private vehicles and is more aligned with what was reported by other studies

(Owens et al., 2019; Keshavarz et al., 2006). In the current study substantial percentages of children in each age group (infant: 46%, toddler: 49%, and child: 51%) were unrestrained. Furthermore, observed CRS use rate was very low (8.1%); with a higher percentage (41%) of restrained children using seat belts, suggesting that while some of the children were restrained, they were not always using the proper restraints for their height and weight.

Like other observational studies, restraint use of drivers and other vehicle occupants was positively related to child restraint use. With respect to driver restraint use these findings may be related to the ride-share drivers encouraging restraint use as well as the effects of local laws. Both MSAs were in States with CRS laws; however, neither State's law specifies whether the CRS requirements apply to ride-share vehicles. With regard to ride-share vehicles, the relationship between the child occupant's restraint use and adult passenger's restraint use was stronger than the relationship with the driver's restraint use. This might be expected as adult passengers have emotional connections to the children; they might be more motivated to secure the children if they also use seat belts.

Infants, toddlers, and children observed at airports were more likely to be restrained than were those observed at other POI, and these children were more likely to be restrained properly. Caregivers might be more likely to travel with CRSs when traveling greater distances with children, due to perceptions of higher safety risk. Alternatively, caregivers may identify greater need for the CRSs as they can be used in vehicles to travel to and from the airport, on the plane itself, then at their trip destinations. Finally, the increased restraint use may be related to perceived enforcement due to the enhanced security at the airport drop-off or pick-up locations.

There are still many States that exempt ride-share vehicles from their CRS laws (McCourt et al., 2022), which could contribute to low CRS use rates among these vehicles. Lack of understanding when it comes to CRS laws by caregivers and how these laws apply to ride-share vehicles is also a challenge. Ride-shares already add a layer of difficulty to the logistics of travel plans, and parents face additional difficulties when using CRSs in ride-shares. The results of this study demonstrate a need for developing countermeasures that will have an immediate impact on caregiver behavior by educating the public on the importance of using a CRS for all trips regardless of the type of vehicle (private versus ride-share).

This study provides insight into caregiver behavior when traveling with children in ride-share vehicles. However, to interpret these findings and increase child passenger safety, future researchers must have a better understanding of caregiver and driver beliefs, attitudes, perceptions, and assessment of risk when traveling in ride-share vehicles with children. This knowledge is needed to inform the development of public policy, regulations, enforcement measures, educational campaigns, and practical solutions for increasing child safety in every vehicle. Using the findings from this observational study, researchers could employ qualitative methods to better identify the barriers to restraint use in general and CRSs in particular in the ride-share environment.

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