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Observed child restraint misuse in a large, urban community: Results from three years of inspection events

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ABSTRACT

Problem: Child restraints (CRs) are vital for optimizing child passenger safety and reducing the risk of pediatric injury and fatality in motor vehicle crashes. However, most CRs are installed improperly. *Methods:* This present study was an assessment of observed instances of CR misuse. Participants were recruited through advertisements for CR inspection events in Los Angeles County, California. Child Passenger Safety Technicians collected information about each child passenger, vehicle, and aspects of CR selection and installation. *Results:* Of 693 CRs installed upon arrival, only 3.8% were used with no instances of misuse. The most common misuses were inappropriate use of the top tether and failure to secure the seatbelt in locked mode. *Conclusions:* The majority of observed CRs were installed with instances of misuse. CRs in newer vehicles were less likely to be installed in front of airbags and more likely to have the seatbelt routed inappropriately compared to those in older vehicles. Older children were more likely to be prematurely restrained in the front vehicle seat. *Practical Applications:* The majority of CRs are installed improperly. We identified specific instances of CR misuse that are common in a large, urban community and present recommendations to improve child passenger safety practices and education.

1. Introduction

Motor vehicle crashes (MVCs) are the leading cause of unintentional morbidity and mortality in children in the United States (Centers for Disease Control and Prevention, 2007). Between 2001 and 2010, 20,448 children ages 14 and under died from MVC-related injuries, and another 2,074,550 were treated in the emergency department for injuries sustained in MVCs (Centers for Disease Control and Prevention, 2013). Each year, MVC-related injuries and fatalities in children account for more than $825 million in medical expenditures (Centers for Disease Control and Prevention, 2013).

Child restraints (CR) are well-documented for protecting children from MVC-related injury and fatality (Durbin, & Committee on Injury, Violence, and Poison Prevention, 2011). When chosen and installed correctly, CRs have been demonstrated to significantly reduce the risk of injury and death in children of all ages (Rice & Anderson, 2009; Ma, Layde, & Zhu, 2012). Despite their protective value, the majority of CRs continue to be used improperly (Koppel & Charlton, 2009; Rogers, Gallo, Saleheen, & Lapidus, 2012; Klinich et al., 2013; Koppel, Charlton, & Rudin-Brown, 2013; Nie, Colunga, McCoy, Stephens-Stidham, & Istre, 2013; Mathieu, Peter, Yvan, & Philippe, 2014). Improper use of CRs, including the use of age- or weight-inappropriate CRs, places a child passenger at elevated risk for MVC-related injury and fatality (Kapoor et al., 2011; Ma et al., 2012). According to recent assessments of CR use, the most common instances of misuse include harness strap errors, seatbelt errors, missing or incorrect use of locking clips, tether errors, CR placement in vehicle errors, and infant placement in CR errors (Koppel & Charlton, 2009; Rogers et al., 2012; Koppel et al., 2013).

Many factors have been shown to be associated with CR misuse, including certain CR and vehicle features, having multiple children in a vehicle, and a child's resistance to being restrained. Further, parents and caregivers with lower education and income levels are more likely to use CRs improperly or not at all (Keay et al., 2013; Oliveira et al., 2012; Rogers et al., 2012; Yanchar, Kirkland, LeBlanc, & Langille, 2012). Child passenger age has been shown to be associated with premature placement in the front seat and premature graduation to seatbelt (Macy & Freed, 2012). Finally, misuse and nonuse of CRs have been reported as more common among non-white compared to white parents (Macy & Freed, 2012; Rogers et al., 2012; Macy, Cunningham, Resnicow, & Freed, 2014).

While these studies have revealed a variety of factors associated with CR misuse, few have examined which specific instances of misuse are associated with demographic characteristics of drivers and passengers. Recently, Macy and Freed (2012) examined racial/ethnic associations with CR use, being unrestrained, and sitting in the front seat, but did not examine more specific aspects of CR use. Further, several recent studies assessing the prevalence of CR misuse have relied on parent self-reports rather than direct observation of CR use by nationally certified

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child passenger safety technicians (Arbogast, Durbin, Morris, & Winston, 2000; Macy et al., 2012; Macy et al., 2014; Raman et al., 2013). Comparisons of observational and self-report methodologies have shown that observational techniques were more accurate in assessing true use of CRs (Quistberg, Lozano, Mack, Schwartz, & Ebel, 2010; Snowdon et al., 2010). By using reliable methods to understand which specific aspects of misuse are the most common among certain populations, assessments of CR misuse can be used to inform policy, education, and outreach efforts.

In the present study, we aimed to provide an up-to-date assessment of the prevalence of many specific instances of CR misuse in the diverse, urban community of Los Angeles County, California. Here, the term "misuse" was used to describe CR use not consistent with best practice recommendations outlined by the American Academy of Pediatrics (AAP) in the United States (Durbin, & Committee on Injury, Violence, and Poison Prevention, 2011). We sought to determine whether three factors – vehicle age, child passenger age, and child passenger weight – predicted specific aspects of CR misuse. We expected that CRs observed in older vehicles would more commonly have inappropriate seatbelt routing, snugness of CR fit to seat, and locking of seatbelt. We also expected that older children would be more likely to be prematurely restrained in the front seat and prematurely graduated to a vehicle seatbelt.

2. Materials and methods

2.1. Study design

The present study is a retrospective analysis of CR inspection data gathered through an inspection program conducted in Los Angeles County, California, between 2011 and 2013. The study was approved by the supervising hospital's Institutional Review Board.

2.2. Study population and recruitment

The studied population included children of parents and caregivers that responded to advertisements for free CR inspection events sponsored by a freestanding Level I Pediatric Trauma Center. Advertisements were displayed at the pediatric tertiary hospital, childcare centers, churches, community centers, schools, and grocery stores. Inspection events were conducted at locations throughout Los Angeles County, California, USA, an ethnically and socioeconomically diverse urban community, by nationally certified Child Passenger Safety Technicians (CPSTs). CR inspections and child passenger safety education were provided free-of-charge to all participants, and all inspections were overseen by a certified Child Passenger Safety Technician Instructor (CPSTI). There were no child age or weight restrictions for participation in the inspection events.

2.3. Instrument and measurements

Inspection data were recorded on an inspection instrument developed by a CPSTI. The instrument was created based on existing child restraint inspection tools from SafetyBeltSafe USA, Safe Kids Worldwide, Cincinnati Children's Hospital Medical Center, and California Highway Patrol. During each inspection, an inspection form was completed by a certified CPST after observation of each restrained child passenger. For inspections in which multiple child passengers arrived in a single vehicle, each child and his or her CR was inspected separately.

Information collected during each inspection included vehicle make, model, and year of manufacture, as well as age, weight, and ethnicity of the child passenger. Children were weighed at the time of inspection by CPSTs. Information regarding CR position within vehicle, expiration date, recall date, ownership, and involvement in a crash were also recorded on the inspection form. For assessment of CR use, the inspection form included a checklist of 13 items regarding restraint installation and selection. For each item, the responding CPST selected "Yes" to indicate appropriate use, "No" to indicate misuse and/or use not consistent with best practice recommendations outlined by the AAP (Durbin, & Committee on Injury, Violence, and Poison Prevention, 2011), or "N/A" if the item was not relevant. For instance, harness clip and LATCH information was not considered to be relevant for inspected booster seats. Information collected from inspection forms for the purposes of analyses, including the 13 studied aspects of CR use, is presented in Table 1.

In most cases, child passenger and vehicle information were self-reported by participants. These fields were completed by a CPST in the event they were left uncompleted by participants.

2.4. Data analysis

Relevant inspection data were reviewed and coded onto a spreadsheet by members of the research team. Data were stored on a secure, password-protected network requiring invitation for access. Analysis was conducted with SAS v9.2 (Cary, NC). Inspections in which all relevant data (vehicle year, child age, child weight, and aspects of CR use) were missing were excluded from all analyses. Additionally, in some inspections, certain aspects of use were not relevant; these "N/A" responses were excluded from all analyses. Because ethnicity data were collected for less than half of all inspections and the studied sample included primarily participants of Hispanic ethnicity, differences in the CR use among ethnic groups were not investigated.

Summary statistics (frequencies) were used to describe characteristics of the studied sample and the frequency of each inspected aspect of CR use. Univariate logistic regression analyses were conducted to determine whether vehicle year, child age, and child weight were associated with specific instances of CR misuse. Logistic regression analyses were performed for each of three predictor variables (vehicle year, child age, child weight) as both categorical and continuous variables. For these analyses, categories for child age and weight (see Table 2) were established in accordance with standards of the National Highway Traffic Safety Association (NHTSA) in the United States for ease of comparison with existing misuse and crash data (Glassbrenner, 2009). Categories for vehicle year (presented in Table 2) were established based on two milestones of child passenger safety-related policies and standards in the United States: the mandate of lockable seatbelt systems in vehicles manufactured after September 1995 and the introduction of the Lower Anchors and Tethers for Children (LATCH) system in vehicles manufactured after September 2002. Results of the categorical analysis were less informative than those of the continuous analysis and are not included in the current report.

Table 1
Information collected on child restraint inspection forms.

Child passenger information	Age
	Weight
	Ethnicity
Vehicle information	Year of manufacture
CR information	CR facing correct direction
	CR not in front of airbag
	CR in rear vehicle seat
	Harness straps snug
	Harness retainer clip present
	Harness retainer clip at armpit level
	Harness retainer clip threaded properly
	LATCH anchor used properly
	Top tether used properly
	Safety belt routed properly
	Safety belt/LATCH holding CR tightly
	Safety belt in locked mode
	Child within CR height/weight limits

CR = child restraint; LATCH = Lower Anchors and Tethers for Children system.