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Special Report from the CDC

Use of child safety seats and booster seats in the United States: A comparison of parent/caregiver-reported and observed use estimates ☆

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ABSTRACT

Background: Motor-vehicles crashes are a leading cause of death among children. Age- and size-appropriate restraint use can prevent crash injuries and deaths among children. Strategies to increase child restraint use should be informed by reliable estimates of restraint use practices. *Objective:* Compare parent/caregiver-reported and observed child restraint use estimates from the FallStyles and Estilos surveys with the National Survey of the Use of Booster Seats (NSUBS). Methods: Estimates of child restraint use from two online, cross-sectional surveys—FallStyles, a survey of U.S. adults, and Estilos, a survey of U.S. Hispanic adults—were compared with observed data collected in NSUBS. Parents/caregivers of children aged ≤ 12 years were asked about the child's restraint use behaviors in FallStyles and Estilos, while restraint use was observed in NSUBS. Age-appropriate restraint use was defined as rear-facing child safety seat (CSS) use for children aged 0–4 years, forward-facing CSS use for children aged 2–7 years, booster seat use for children aged 5–12 years, and seat belt use for children aged 9–12 years. Age-appropriate restraint users are described by demographic characteristics and seat row, with weighted prevalence and corresponding 95% confidence intervals (CI) calculated. *Results:* Overall, child restraint use as reported by parents/caregivers was 90.8% (CI: 87.5–94.1) (FallStyles) and 89.4% (CI: 85.5–93.4) for observed use (NSUBS). Among Hispanic children, reported restraint use was 82.6% (CI: 73.9–91.3) (Estilos) and 84.4% (CI: 79.0–88.6) for observed use (NSUBS, Hispanic children only). For age-appropriate restraint use, estimates ranged from 74.3% (CI: 69.7–79.0) (FallStyles) to 59.7% (CI: 55.0–64.4) (NSUBS), and for Hispanic children, from 71.5% (CI: 62.1–81.0) (Estilos) to 57.2% (CI: 51.2–63.2) (NSUBS, Hispanic children only). *Conclusion and Practical Application:* Overall estimates of parent/caregiver-reported and observed child restraint use were similar. However, for age-appropriate restraint use, reported use was higher than observed use for most age groups.

1. Introduction

Motor-vehicle crashes are a leading cause of death among children (CDC, 2020). Each year more than 600 children aged 12 or younger are killed (NHTSA, 2021), and over 91,000 are treated in emergency departments for injuries sustained as occupants in motor-vehicle traffic crashes (CDC, 2020). Proper restraint use is key to preventing injuries and deaths in crashes. Child safety seat (CSS) use reduces the risk for injury in a crash by 71–82% for children (Arbogast et al., 2004; Zaloshnja et al., 2007) when compared with seat belt use alone. Booster seat use reduces the risk for serious injury by 45% for children aged 4–8, when compared with seat belt use alone (Arbogast et al. 2009). For older children and adults, seat belt use reduces the risk for death and serious injury by approximately half (NHTSA, 2020; Kahane, 2000).

In 2018, 33% of children aged ≤ 12 years who died in crashes were unrestrained (among those for which restraint use was known; NHTSA, 2020). Some racial/ethnic minority groups have higher death rates and higher proportions of unrestrained deaths. Hispanic children have higher proportions of unrestrained deaths when compared with White children (NHTSA, 2009; Sauber-Schatz, West, & Bergen, 2014). Additionally, Macy and Freed (2012) found Hispanic children were more likely to be unrestrained or improperly restrained than White children.

Research has identified several strategies that are effective at increasing child restraint use and decreasing motor-vehicle injuries and deaths among children, including the following: child

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passenger restraint laws and improvements to extend the ages covered by these laws; CSS distribution plus education programs; and community-wide information plus enhanced enforcement campaigns (Zaza et al., 2001; Ehiri et al., 2006; Richard et al., 2018; Mannix et al., 2012; Farmer et al., 2009; Benedetti et al., 2017; Sartin, Lombardi, & Mirman, 2021). A study of states that expanded their booster seat laws to cover children through age 7 or 8 years found that the rate of CSS/booster seat use increased nearly three-fold, while the rate of fatal and incapacitating injuries decreased 17% (Eichelberger et al., 2012). A study among children involved in crashes found that restrained children were 66% more likely to be appropriately restrained if their state law followed best practice recommendations (Benedetti et al., 2017). Mannix et al. (2012) found the death rate among 7-year-olds was 25% lower for children in states with booster seat laws covering 7-year-olds compared with children in states without booster seat laws covering 7-year-olds.

Strategies to increase child restraint use need to be informed by reliable and timely estimates of restraint use practices. Restraint use data have often been collected through both self-reported and direct observation surveys. Self-reported data are typically affordable to collect and easy to obtain, but responses can be subject to social desirability bias (Tourangeau & Yan 2007). While data collected by directly observing restraint use allow for objective measure, they are often costly and time-consuming to obtain, and usually can only be collected in populated areas during daytime hours (NHTSA, 2016). To evaluate restraint use measurements from these differing data sources, previous studies have compared self-reported with observed restraint use, but these studies have focused on seat belt use among adults (Shakya et al., 2020; Ibrahimova et al., 2011).

Comparisons of parent/caregiver-reported versus observed child restraint use are limited. Therefore, the aim of this study is to compare parent/caregiver-reported data on child restraint use behaviors from two surveys—one from the general U.S. population and the other from the U.S. Hispanic population—with a survey of observed child restraint use data, all of which were collected within 10 months of each other. Finally, we explore strengths and limitations of using parent/caregiver-reported versus observed surveys for assessing child restraint use.

2. Methods

2.1. Data sources

Parent/caregiver-reported child restraint data were obtained from two online, cross-sectional Porter Novelli surveys—FallStyles and Estilos. FallStyles is an annual survey that gathers information about health experiences, attitudes, and behaviors of U.S. adults aged ≥ 18 years. Porter Novelli uses an online panel that is representative of the noninstitutionalized U.S. population. Existing panel members are randomly recruited for surveys by mail using probability-based sampling by address to reach respondents. Households are provided with a laptop or tablet and internet access to take surveys, if needed. Respondents receive cash-equivalent reward points for their participation in these surveys, which are redeemable online for gift cards and prizes (estimated value $10). Respondents from the spring wave of the 2014 ConsumerStyles (SpringStyles) survey were randomly selected and invited to take the FallStyles survey, which was fielded from October 2–22, 2014. Of 4,594 randomly selected participants, 3,520 completed at least half of the survey (77% response rate). FallStyles data were weighted to match 2014 U.S. Census Current Population Survey proportions for gender, age, race/ethnicity, household income, household size, education, census region, metropolitan statistical area, and internet access.

Estilos is an annual survey that gathers information about health experiences, attitudes, and behaviors of U.S. Hispanic adults (aged ≥ 18 years). The Estilos survey was fielded from October 10–November 10, 2014. Of 2,649 randomly selected participants, 1,006 completed the survey. Estilos surveys were available in English and Spanish. Estilos data were weighted to match 2014 U.S. Census American Community Survey proportions for gender, age, household income, household size, education, census region, country of origin, and acculturation (based on years living in the United States, language spoken at home, cultural self-identification, and use of Spanish language media). The Estilos response rate was 42%.

FallStyles or Estilos survey respondents who reported being the parent or caregiver for a child ≤12 years old were invited to complete the child passenger safety module of the survey (FallStyles n = 572, Estilos n = 446). The child passenger safety module was only added to a single survey year for both FallStyles and Estilos. Adding this module in 2014 allowed for comparison of these data with observed data that were collected within 10 months of each other. Identical questions were asked in both the FallStyles survey and the English version of the Estilos survey. The Spanish version of the Estilos survey was translated by a native Spanish speaker. Respondents were asked about the age, race, ethnicity, and gender of the youngest child for whom they were parents or caregivers, as well as their relationship with the child. They were also asked, "How do you usually buckle up this child while riding in a passenger vehicle (car, van, SUV, or pick-up truck)?" Response options included 'rear-facing car seat,' 'forward-facing car seat,' 'booster seat with seat belt,' 'seat belt,' 'this child is not usually buckled up,' or 'don't know.' In addition, respondents were asked, "In the past 30 days, how often did you buckle up this child?" Response options included 'always,' 'most of the time,' 'sometimes,' 'rarely,' or 'never.' Moreover, respondents were asked, "During the past 30 days, how often did this child sit in the front seat of the vehicle?" with response options of 'always,' 'most of the time,' 'sometimes,' 'rarely,' or 'never.' Respondents were also asked about reasons for not buckling up the child in the past 30 days. Only a small number of respondents selected at least one reason for the child not being buckled up in the past 30 days; therefore, this question was only used to exclude respondents with inconsistent responses.

For both surveys, children with missing information or 'don't know' responses for child age or restraint type, inconsistent responses (reported child was 'always' buckled in the past 30 days but also selected a reason for not buckling child in the past 30 days, or reported varying ages for the child in different parts of the survey), or implausible responses (children aged ≥ 5 years in a rear-facing CSS, children aged ≥ 8 years in a forward-facing CSS, or grandparents aged 25–26 years) were excluded (FallStyles n = 111, Estilos n = 137). To compare restraint characteristics of Hispanic children, Estilos responses were limited to respondents who indicated the child was Hispanic. This resulted in a final analytic sample size of 461 children for FallStyles and 269 children for Estilos.

Data were also obtained from the National Survey of the Use of Booster Seats (NSUBS), a probability-based, nationwide observational survey conducted by the National Highway Traffic Safety Administration (NHTSA). NSUBS collects data on restraint use for all child occupants aged ≤ 12 years in the United States, with the primary purpose of estimating booster seat use among children aged 4–7 years. Methodology details have been previously described (NHTSA, 2015; NHTSA, 2016). Briefly, NSUBS captures children conveyed by passenger vehicles to gas stations, day care and recreation centers, or fast-food chains. NSUBS data are collected through (1) direct observational surveys for restraint use, including restraint type (rear-facing CSS, forward-facing CSS, high-back booster seat, backless booster seat, seat belt, or unrestrained), seat row, and seating position, followed by (2) interviews with an adult occupant (usually the driver) for race/ethnicity for all

occupants, and height, weight, and age of child occupants ≤ 12 years. Data collectors subjectively assess approximate age and gender of all occupants aged ≥ 13 years. For the 2015 survey, observations were collected from July 16–August 6, 2015, during daylight hours (NHTSA, 2016). To obtain national estimates, observations were weighted based on the inverse of selection probabilities, with weights adjusted for site and occupant nonresponse. In 2015, of the 806 observation sites selected from 30 primary stage sampling units, 384 (47.6%) participated. Only children of adult occupants who completed interviews were included in the survey (n = 8,165).

2.2. Measures

For all surveys, age-appropriate restraint use was defined using best practice recommendations during the study period, which were rear-facing CSS use for children aged 0–4 years, forward-facing CSS use for children aged 2–7 years, booster seat use for children aged 5–12 years, and seat belt only use for children aged 9–12 years (AAP, 2011). Child age was grouped into categories of <2 years, 2–4 years, 5–8 years, and 9–12 years to coincide with best practice recommendations for age-appropriate restraint use during the study period. To evaluate whether the child was restrained (buckled), for FallStyles and Estilos, the respondent had to also indicate that the child was 'always' buckled in the past 30 days; for NSUBS, a point in time observation was collected. Similarly, seat row of child was defined as sitting in the back seat of the vehicle if the child was observed in the back seat (a point in time observation for NSUBS). For FallStyles and Estilos, seat row of child was defined as sitting in the back seat if the respondent indicated the child never sat in the front seat of the vehicle during the past 30 days. Race/ethnicity was analyzed by four mutually exclusive categories: Hispanic (of any race), and three non-Hispanic racial groups–White, Black, and multiple/other race.

2.3. Analysis

As FallStyles and Estilos were weighted to match the U.S. adult population, we hypothesized that the weighted distribution of children ≤12 years in these surveys might differ from the distribution in the U.S. population or NSUBS. To compare the demographics of children in the three surveys, unweighted counts and weighted distributions of the samples were calculated by age group and gender for all surveys, and additionally by race/ethnicity for FallStyles and NSUBS. Additionally, distributions of the 2014 and 2015 U.S. populations of children ≤ 12 years were queried from CDC WONDER's bridged-race populations (https://wonder.cdc.gov/Bridged-Race-v2014.HTML and https://wonder.cdc.gov/Bridged-Race-v2015.HTML), by age group, gender, and race/ethnicity for all children and additionally among Hispanic children by age group and gender, for comparison with the survey distributions.

To compare restraint characteristics estimated from each survey, the weighted prevalence and corresponding 95% confidence intervals (CIs) for restraint use and sitting in the back seat were calculated. Age-appropriate restraint use was calculated by age group, gender, and seat row of child; for FallStyles and NSUBS, it was also calculated by race/ethnicity. To compare NSUBS estimates with Estilos estimates, NSUBS restraint characteristics were also calculated separately for Hispanic children.

Comparisons of restraint use prevalence by survey were analyzed by examining overlapping CI's. While not a statistical test, the method conservatively indicates significant differences between estimates (Schenker & Gentleman, 2001). Analyses were performed using SAS 9.3 (Cary, NC), using survey procedures to account for survey weights and designs. Variances for NSUBS CIs were calculated using a jackknife estimation method.

3. Results

3.1. Differences in demographic characteristics between surveys and U.S. population distribution

Prevalence of restraint use was estimated for 461 children aged ≤ 12 years from the 2014 FallStyles survey and for 269 Hispanic children aged ≤ 12 years from the 2014 Estilos survey. Estimates from the 2015 NSUBS were based on observations of 8,165 child passengers aged ≤ 12 years of all races/ethnicities; of those, 1,554 were Hispanic children (Tables 1 and 2). Comparing demographic characteristics of the NSUBS sample to the FallStyles sam-

Table 1
Characteristics of children aged ≤ 12 years in the FallStyles Survey, 2014, and in the National Survey of the Use of Booster Seats (NSUBS), 2015, compared with U.S. population distribution, 2014 and 2015.

			U.S. population[a]	
	FallStyles, 2014	NSUBS, 2015	2014	2015
	n (weighted %)	*n* (weighted %)	*N* (%)	*N* (%)
Total	461	8,165	52,666,129	52,747,095
Age Group				
<2	83 (17.3)	971 (11.9)	7,910,473 (15.0)	7,946,602 (15.1)
2–4	136 (31.0)	2,817 (33.4)	11,966,410 (22.7)	11,960,679 (22.7)
5–8	147 (31.5)	2,764 (33.8)	16,412,734 (31.2)	16,353,612 (31.0)
9–12	95 (20.1)	1,613 (20.9)	16,376,512 (31.1)	16,486,202 (31.3)
Gender				
Male	242 (51.4)	4,183 (51.3)	26,892,961 (51.1)	26,938,198 (51.1)
Female	219 (48.6)	3,982 (48.7)	25,773,168 (48.9)	25,808,897 (48.9)
Race/Ethnicity				
White, non-Hispanic	300 (57.8)	4,189 (51.6)	27,967,660 (53.1)	27,833,663 (52.8)
Black, non-Hispanic	42 (9.7)	1,704 (22.6)	7,966,852 (15.1)	7,993,630 (15.2)
Other race, non-Hispanic	43 (11.5)	718 (7.8)	3,501,271 (6.6)	3,553,133 (6.7)
Hispanic	72 (20.9)	1,554 (18.0)	13,230,346 (25.1)	13,366,669 (25.3)
Seat row[b]				
Back seat	357 (76.4)	7,387 (89.3)	–	–
Front seat	103 (23.6)	778 (10.7)	–	–

Note: n = unweighted count; N = population.
[a] Bridged-race U.S. resident population estimates accessed from https://wonder.cdc.gov/Bridged-Race-v2014.HTML and https://wonder.cdc.gov/Bridged-Race-v2015.HTML.
[b] For FallStyles, seat row of child was considered back seat if child 'never' sat in the front seat during the past 30 days. For NSUBS, seat row was a point in time observation.

Table 2
Characteristics of Hispanic children aged ≤ 12 years in the Estilos Survey, 2014, and in the National Survey of the Use of Booster Seats (NSUBS), 2015, compared with U.S. population distribution, 2014 and 2015.

			U.S. Hispanic population[a]	
	Estilos, 2014	NSUBS, 2015	2014	2015
	n (weighted %)	*n* (weighted %)	*N* (%)	*N* (%)
Total	269	1,554	13,230,346	13,366,669
Age Group				
<2	54 (15.5)	177 (11.2)	2,032,466 (15.4)	2,049,924 (15.3)
2–4	84 (22.1)	539 (33.3)	3,098,704 (23.4)	3,093,616 (23.1)
5–8	72 (28.7)	530 (34.6)	4,169,579 (31.5)	4,192,254 (31.4)
9–12	59 (33.6)	308 (20.8)	3,929,597 (29.7)	4,030,875 (30.2)
Gender				
Male	154 (51.3)	778 (49.4)	6,739,353 (50.9)	6,810,119 (50.9)
Female	115 (48.7)	776 (50.6)	6,490,993 (49.1)	6,556,550 (49.1)
Seat row[b]				
Back seat	185 (62.0)	1,409 (89.1)	–	–
Front seat	84 (38.0)	145 (10.9)	–	–

Note: *n* = unweighted count; *N* = population.
[a] Bridged-race U.S. resident population estimates accessed from https://wonder.cdc.gov/Bridged-Race-v2014.HTML and https://wonder.cdc.gov/Bridged-Race-v2015.HTML.
[b] For Estilos, seat row of child was considered back seat if child 'never' sat in the front seat during the past 30 days. For NSUBS, seat row was a point in time observation.

ple, the NSUBS sample had a smaller percentage of children < 2 years, both before and after weighting, with 11.9% of the children being aged < 2 years, while 17.3% of the children in FallStyles were < 2 years (weighted percent). Other age group proportions were similar. NSUBS had a higher percentage of Black (non-Hispanic) children than FallStyles (22.6% vs. 9.7%, weighted). Compared with Estilos, the Hispanic NSUBS sample again had a smaller percentage of children < 2 years, both unweighted and weighted, and also differed from Estilos in the proportion of all other age groups. The distribution by gender of all three survey samples was similar.

Compared with children aged ≤ 12 years in the 2014 and 2015 U.S. populations, the proportions of all surveys by gender were similar to the U.S. population distributions (Tables 1 and 2). For FallStyles and NSUBS, the percentages of children aged 2–4 years were higher than the U.S. population, and the percentages of children aged 9–12 years were lower. The distribution of Estilos by age group closely matched the U.S. Hispanic population of children aged ≤ 12 years. The Hispanic NSUBS sample had lower proportions of children < 2 years and 9–12 years and a higher proportion of children 2–4 years. By race/ethnicity, unweighted and weighted sample distributions for FallStyles and NSUBS differed slightly from the U.S. population distribution, with the percentage of children of other races being larger in FallStyles than in NSUBS and the U.S. population, and the percentage of Black children being smaller in FallStyles.

3.2. Comparison of restraint use behavior estimates for children in FallStyles with children in NSUBS

Estimates of restraint use (by any restraint type) were similar between FallStyles and NSUBS (FallStyles: 90.8% [CI: 87.5–94.1], NSUBS: 89.4% [CI: 85.5–93.4]) (Table 3). By seat row, 76.4% (CI: 71.9–80.8) of children sat in the back seat (FallStyles), while NSUBS estimates were significantly higher at 89.3% (CI: 87.7–90.9).

In FallStyles, 74.3% (CI: 69.7–79.0) of children used age-appropriate restraints, while NSUBS estimates of age-appropriate restraint use were significantly lower at 59.7% (CI: 55.0–64.4) (Table 3). Prevalence of age-appropriate restraint use among children aged 2–4 years was significantly higher in FallStyles (78.5% [CI: 70.7–86.3]) compared with NSUBS (59.9% [CI: 54.0–65.8]). Sample sizes in the FallStyles survey for children aged < 2 years, aged 5–8 years, and aged 9–12 years were small (<100 children), so estimates are considered unstable and should be interpreted with caution. Prevalence of age-appropriate restraint use by gender was significantly higher for each gender in FallStyles (males: 71.8% [CI: 65.2–78.3], females: 77.0% [CI: 70.5–83.6]) compared with NSUBS (males: 59.5% [CI: 55.1–63.9], females: 59.9% [CI: 54.6–65.2]). By race/ethnicity, sample sizes in the FallStyles survey for all categories other than White were small, such that these estimates are considered unstable. FallStyles estimates for age-appropriate restraint use among White children were significantly higher than NSUBS estimates (FallStyles: 79.8% [CI: 74.8–84.9],

Table 3
Prevalence of restraint characteristics of children aged ≤ 12 years in passenger vehicles, FallStyles Survey, 2014, and the National Survey of the Use of Booster Seats (NSUBS), 2015.

	FallStyles (*n* = 461) % (95% CI)	NSUBS (*n* = 8,165) % (95% CI)
Restraint use[a]	90.8 (87.5–94.1)	89.4 (85.5–93.4)
Sitting in back seat[b]	76.4 (71.9–80.8)	89.3 (87.7–90.9)
Age-appropriate restraint use[a,c]		
Overall	74.3 (69.7–79.0)	59.7 (55.0–64.4)
Age Group		
<2	72.2 (61.2–83.1)[d]	55.1 (50.4–59.8)
2–4	78.5 (70.7–86.3)	59.9 (54.0–65.8)
5–8	62.9 (53.7–72.0)[d]	47.1 (40.9–53.4)
9–12	87.6 (79.5–95.8)[d]	82.2 (76.3–88.1)
Gender		
Male	71.8 (65.2–78.3)	59.5 (55.1–63.9)
Female	77.0 (70.5–83.6)	59.9 (54.6–65.2)
Race/ethnicity		
White, non-Hispanic	79.8 (74.8–84.9)	67.6 (63.8–71.4)
Black, non-Hispanic	52.5 (35.4–69.6)[d]	42.6 (34.6–50.5)
Other race, non-Hispanic	73.5 (57.8–89.2)[d]	62.6 (55.9–69.2)
Hispanic	70.2 (58.0–82.5)[d]	57.2 (51.2–63.2)
Seat row[b]		
Back seat	77.6 (72.7–82.5)	60.3 (56.0–64.5)
Front seat	63.3 (52.2–74.4)[d]	54.9 (44.4–65.3)

Note: %=weighted percent.
[a] For FallStyles, child was considered restrained if child was 'always' buckled in the past 30 days. For NSUBS, buckled was a point in time observation.
[b] For FallStyles, seat row of child was considered back seat if child 'never' sat in the front seat during the past 30 days. For NSUBS, seat row was a point in time observation.
[c] For both surveys, age-appropriate restraint use was defined as rear-facing CSS use for children aged 0–4 years, forward-facing CSS use for children aged 2–7 years, booster seat use for children aged 5–12 years, and seat belt only use for children aged 9–12 years.
[d] Sample sizes were < 100; therefore, estimates might be unstable.

Table 4
Prevalence of restraint characteristics of Hispanic children aged ≤ 12 years in passenger vehicles, Estilos Survey, 2014, and the National Survey of the Use of Booster Seats (NSUBS), 2015.

	Estilos (n = 269) % (95% CI)	NSUBS (n = 1,554) % (95% CI)
Restraint use[a]	82.6 (73.9–91.3)	84.4 (79.0–88.6)
Sitting in back seat[b]	62.0 (50.9–73.1)	89.1 (86.3–91.4)
Age-appropriate restraint use[a,c]		
Overall	71.5 (62.1–81.0)	57.2 (51.2–63.2)
Age Group		
<2	69.1 (51.5–86.8)[d]	59.1 (48.2–69.2)
2–4	77.9 (65.8–90.0)[d]	59.6 (51.8–66.9)
5–8	58.7 (40.9–76.5)[d]	42.7 (34.3–51.5)
9–12	79.4 (58.0–100.0)[d]	76.4 (68.0–83.2)
Gender		
Male	70.7 (58.7–82.6)	57.5 (51.6–63.1)
Female	72.5 (57.8–87.1)[d]	56.9 (48.5–64.9)
Seat row[b]		
Back seat	77.0 (66.0–87.9)	57.8 (51.4–63.8)
Front seat	62.7 (44.8–80.6)[d]	52.5 (37.2–67.2)

Note: %=weighted percent.
[a] For Estilos, child was considered restrained if child was 'always' buckled in the past 30 days. For NSUBS, buckled was a point in time observation.
[b] For Estilos, seat row of child was considered back seat if child 'never' sat in the front seat during the past 30 days. For NSUBS, seat row was a point in time observation.
[c] For both surveys, age-appropriate restraint use was defined as rear-facing CSS use for children aged 0–4 years, forward-facing CSS use for children aged 2–7 years, booster seat use for children aged 5–12 years, and seat belt only use for children aged 9–12 years.
[d] Sample sizes were <100; therefore, estimates might be unstable.

NSUBS: 67.6% [CI: 63.8–71.4]). Within each survey, the proportion of age-appropriate restraint use did not differ significantly by seat row, although estimates for front seat restraint use in FallStyles were unstable. The NSUBS estimate for age-appropriate restraint use in the back seat (60.3% [CI: 56.0–64.5]) was significantly lower than the FallStyles estimate (77.6% [CI: 72.7–82.5]).

3.3. Comparison of restraint use behavior estimates from Hispanic children in Estilos with Hispanic children in NSUBS

The pattern of restraint use prevalence observed in Estilos as compared with Hispanic children in NSUBS was similar to the pattern observed for FallStyles and NSUBS (Table 4). Estimates of restraint use (by any restraint type) for Hispanic children were similar between Estilos and NSUBS (Estilos: 82.6% [CI: 73.9–91.3], NSUBS: 84.4% [CI: 79.0–88.6]), while estimates for sitting in the back seat differed by more than 25 percentage points between the surveys (Estilos: 62.0% [CI: 50.9–73.1], NSUBS: 89.1% [CI: 86.3–91.4]).

NSUBS age-appropriate restraint use estimates were generally less than those of Estilos; however, estimates from Estilos for all age groups, females, and children sitting in the front seat were unstable due to small sample sizes. Prevalence of age-appropriate restraint use among males was higher in Estilos (70.7% [CI: 58.7–82.6]) compared with NSUBS (57.5% [CI: 51.6–63.1]), although not significantly. The NSUBS estimate for age-appropriate restraint use in the back seat (57.8% [CI: 51.4–63.8]) was significantly lower than Estilos (77.0% [CI: 66.0–87.9]). Estilos estimates were less precise than NSUBS estimates.

4. Discussion

Comparison of estimates of parent/caregiver-reported and observed restraint use behaviors among children from the 2014 FallStyles and Estilos surveys and the 2015 NSUBS revealed similar patterns. First, parent/caregiver-reported and observed estimates for any type of restraint use were similar. We found that overall restraint use (by any restraint type) was reported for 91% (FallStyles) and observed for 89% (NSUBS) of children ≤ 12 years in the United States. Among Hispanic children, overall restraint use (by any restraint type) was reported for 83% (Estilos) and observed for 84% (NSUBS) of children ≤ 12 years. However, overall estimates for children sitting in the back seat were more than 10 percentage points lower for reported estimates (FallStyles: 76%, Estilos: 62%) compared with observed estimates (NSUBS: 89%, all children and Hispanic-only children). For estimates of age-appropriate restraint use, the opposite was true. Reported age-appropriate restraint use (FallStyles and Estilos) was higher than observed use (NSUBS)—differing by 10 percentage points or more. Both reported and observed estimates (ranging from 57% to 74%) indicate that age-appropriate restraint use can be improved. NSUBS estimates always had the best precision.

The finding that overall estimates of reported and observed restraint use (by any restraint type) among children are similar is consistent with previous reports comparing self-reported and observed restraint use among adults (Shakya et al., 2020; Ibrahimova et al., 2011). For our study, it is notable that although the surveys differed from each other and the U.S. population with respect to the proportion of children in many of the age and race/ethnicity categories, the overall restraint use estimates were similar. However, two other overall measures—sitting in the back seat and age-appropriate restraint use—did differ, and those estimates might be biased in part from the effect estimates from each age and race/ethnicity category have on the overall survey estimates. Additionally, parent/caregiver-reported age-appropriate restraint use estimates may have been biased by respondents not properly understanding the type of restraint (e.g., forward-facing CSS vs. booster seat) being described. Future parent/caregiver-reported surveys could include pictures of each restraint type to help respondents better understand terminology used in survey questions.

Although data collected by directly observing restraint use are considered the gold standard (NHTSA, 2016), observed data are typically costly and time-consuming to collect, and usually can only be collected in populated areas during daytime hours. Self- or parent/caregiver-reported data are typically more affordable and easier to collect, but responses can be subject to issues including misinterpretation of questions and social desirability bias. An additional weakness with parent/caregiver-reported surveys in this study was the small sample size associated with each survey, which resulted in unstable estimates for some characteristics of interest. NSUBS, on the other hand, had a very large sample size, which enabled analysis of precise estimates for many cross-classifications.

Previous research has suggested that as restraint use rates have increased and self-reported and observed rates among adults have converged, that social desirability may not be as much of a concern. Furthermore, guarantee of anonymity may also help reduce social desirability bias (Streff & Wagenaar, 1989; Stulginskas et al., 1985). Therefore, self- or parent/caregiver-reported data, if of adequate sample size, can complement data from observational surveys to provide a more complete understanding of restraint use behaviors among children and inform evaluations of strategies to increase child restraint use. For example, future research should explore using parent/caregiver-reported data to better understand barriers to age-appropriate restraint use. Additionally, the use of parent/caregiver-reported data to evaluate local and state-level strategies to increase child restraint use may be beneficial given the relative convenience, ease, and affordability of collecting reported data.

The current study confirmed racial/ethnic differences in restraint use, which have been previously reported in studies using observed data. Macy and Freed (2012) found Hispanic children were more likely to be improperly restrained or unrestrained than White children. Similarly, the current study found observed age-appropriate restraint use among Hispanic children (NSUBS: 57%) to be lower than that of White children (NSUBS: 68%). Even though racial/ethnic differences in restraint use have been previously established, confirmation of this difference helps to solidify the need for focused effective interventions including education plus distribution programs and/or CSS inspection events in convenient, accessible locations in Hispanic communities (Istre et al., 2011; Yellman et al., 2018).

This study has some limitations. First, methodologies and definitions used between surveys differed. Parent/caregiver-reported estimates were based on 'always' engaging in each child restraint use behavior in the past 30 days. Observed estimates were based on a point in time observation. Second, observed data were collected during daytime hours, whereas reported data encompassed anytime restraint use. Third, age-appropriate restraint use estimates may have been inaccurate in parent/caregiver-reported surveys as respondents might not have properly understood the type of restraint (e.g., forward-facing CSS vs. booster seat) being described. Fourth, observed estimates may be overestimates as the most rural areas are not surveyed in NSUBS (NSUBS, 2015). Fifth, observed estimates in NSUBS do not capture children of families who did not visit the specific gas stations, day care and recreation centers, or fast-food chains that were observed. Sixth, conclusions from parent/caregiver-reported data were limited because sample sizes were small. Reported estimates based on small samples were often unstable, especially for subgroups. Finally, although survey questions were translated by a native speaker, there were some discrepancies between the English and Spanish versions of Estilos that could have led to differences in question interpretations.

Despite these limitations, this study is unique as it compares parent/caregiver-reported and observed estimates of restraint use in a pediatric population. Overall estimates of reported and observed restraint use among children were similar. All estimates (reported and observed) indicate that age-appropriate restraint use can be improved. The importance of estimate differences between reported and observed surveys will depend on the purposes and situations for which these estimates are to be used. For example, parent/caregiver-reported surveys could provide rapidly available data for helping guide policy and program decisions. Parent/caregiver-reported data can complement observed data to provide a more complete understanding of restraint use behaviors among children and inform evaluations of strategies to increase restraint use among children.

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Conflicts of interest

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