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Use of Top Tethers with Forward-Facing Child Restraints: Observations and Driver Interviews

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ABSTRACT

Objective: Despite the safety benefits, many parents do not use top tethers with forward-facing child restraints. Detailed information was collected about why parents are not using tethers.

Methods: The sample included 479 drivers who had forward-facing child restraints installed in passenger vehicles equipped with tether anchors. The survey was conducted primarily at shopping centers, recreation facilities, child care facilities, car seat check events, and health care facilities in mostly suburban areas surrounding Philadelphia, Washington, DC, Fredericksburg (VA), and Seattle. Drivers were surveyed about their knowledge and use of tethers and experience with child restraints. Tether use was observed to verify whether tethers were being used correctly.

Results: Fifty-six percent of forward-facing child restraints were installed with the tether; 39% were installed with the tether used correctly. The tether was used with 71% of LATCH lower anchor installations and 33% of seat belt installations. Drivers who installed child restraints without tethers most often said they did not know about the tether or how to use it.

Conclusions: Although the tether use rate was slightly higher in the current research than in previous studies, many parents and caregivers still use forward-facing child restraints without attaching the tether. Because the main problem is lack of awareness of the tether or how to use it, public education should focus specifically on the safety benefits of tethers and how to use them.

INTRODUCTION

In the United States, LATCH (Lower Anchors and Tethers for CHildren) is a system for attaching child restraints to vehicles. Mandated in 1999 by the National Highway Traffic Safety Administration (NHTSA),[1] LATCH was intended to improve the ease of child restraint installation. LATCH has two distinct components that pertain to forward-facing child restraints with internal harnesses: lower attachments on child restraints that connect to anchors at the vehicle seat bight, and a tether on the top of child restraints that attaches to an anchor located on the rear shelf, seat back, floor, cargo area, or ceiling. The lower attachments are designed to replace the vehicle seat belt as the primary attachment to the vehicle, whereas the tether should be used when installing a forward-facing restraint with either the lower attachments or the vehicle seat belt. Lower anchors were required in all vehicles manufactured on or after September 1, 2002, and lower attachments were required on child restraints manufactured on or after September 1, 2002. Tether anchors were required in all vehicles manufactured on or after September 1, 2000, and tether straps were required on all forward-facing child restraints manufactured on or after September 1, 1999. In addition, many older vehicles can be retrofitted with tether anchors.

Laboratory studies comparing forward-facing child restraints installed with and without tethers have found that tethers reduce child crash test dummy head excursion in front and side sled tests.[2-6] Tethers also reduce other injury measures, including head acceleration and neck loads.[2,3,6] A computational modeling study found benefits of using a tether in reducing head acceleration, neck loads, and head excursion.[7]

Some studies of forward-facing child restraints suggest that tethers may be beneficial even with common types of misuse. In a series of sled tests, tether use reduced head excursion, head acceleration, and neck loads even when the tether had moderate degrees of slack, although the no-slack condition provided the greatest benefit.[3] Tether use consistently resulted in lower head excursions and neck loads in conditions with common misuses of LATCH, including loose or misrouted lower anchor straps and improper seat back inclination.[6] Relative to no tether, tether use also was found to reduce head excursion when the seat belt was loose or improperly routed.[5]

Despite the benefits, many parents do not use tethers with forward-facing child restraints. An observational field study of more than 1,500 forward-facing child restraints found that tethers were used

43% of the time.[8] An earlier observational study with more than 1,000 children in forward-facing restraints found that tethers were used 51% of the time.[9] A national study of Safe Kids car seat checkup events conducted in 2009-2010 reported that 28% of the 15,521 forward-facing restraints were tethered upon arrival.[10]

In 2007, NHTSA conducted a national telephone survey of 1,262 parents and caregivers who transported a child younger than 9.[11] Seventy-one percent of the survey respondents said there was a tether strap on their forward-facing child restraint, and 60% of this group said they used the tether on every trip. Among drivers who did not use the tether on every trip, the most common reason (51%) was that there was not a place in the vehicle to attach the tether. Because information on the vehicle model and year was not collected, it was impossible to determine how many of these survey respondents did not have a tether anchor in their vehicle.

In a study designed to identify characteristics of vehicle LATCH systems that increase the likelihood of correct installation of child restraints, 36 volunteer parents performed several child restraint installations in different vehicles.[12] The parents used tethers just 48% of the time with forward-facing child restraints, and none of the vehicle characteristics measured in the study was associated with tether use.

The primary objective of the present study was to gather detailed information about why parents and caregivers are not using tethers. Drivers who had forward-facing child restraints installed in their vehicles were surveyed about their knowledge and use of tethers and previous experience with child restraints. Tether use was observed to determine whether drivers were using tethers correctly.

METHODS

Participants

Drivers with a forward-facing child restraint installed in their vehicle were approached at selected locations and offered a \$10 cash or gift card incentive for participation in a 10-minute car seat survey. Approximately 10% declined to participate due to time constraints, lack of interest, or other reasons. Partial or complete interviews with 515 drivers and observations of all the forward-facing child restraints in the vehicles were conducted. Of the observed vehicles, 462 were identified as models that were manufactured with factory-installed tether anchors, and an additional 17 vehicles were observed to have

tether anchors. All analyses were based on the 479 vehicles that had tether anchors. The reported characteristics of the drivers of these vehicles are shown in Table 1. Where multiple forward-facing child restraints were present, one restraint was randomly selected for analysis.

Data were collected at approximately 50 sites in mostly suburban areas surrounding Philadelphia, Washington, DC, Fredericksburg (VA), and Seattle. The survey was conducted at shopping centers, recreation facilities, child care facilities and schools, car seat check events, health care facilities, residential areas, a service station, and a church. Data collection sites met the following criteria: parents or caregivers were present with child restraints installed; suitable for safe, efficient data collection (e.g., limited entrances and exits, adequate parking spaces, and positions for observers to spot candidate target vehicles and conduct surveys); and permission and cooperation could be obtained from property owners and management.

Data Collection Procedures

Teams of two certified Child Passenger Safety Technicians collected the data. All data collectors were trained in the interview and observation forms and conducted pilot surveys at car seat check events. One person handled the greeting, permission, and interview questions, and the other observed use and misuse of the top tether for all forward-facing child restraints in the vehicle. Following the interview, drivers were given informational materials on child restraint safety and locations for car seat check events. Most interviews were completed in 5 minutes or less.

The interview included questions regarding drivers' awareness, knowledge, and perceived importance of tethers, why they do or do not use tethers, experience with installing child restraints, the child's age and weight, and demographic information on the driver. Drivers were asked for their residential zip code, and the median household income associated with each zip code was obtained from the American Community Survey.[13] For each forward-facing child restraint, the observer collected information on tether use and misuse. The observer also recorded whether the child restraint was installed with the lower anchors or the seat belt, whether the installation was tight, whether a tether anchor was present for the seating position where the child restraint was located, and the number of child safety seats in the vehicle. The make, model, model year, and VIN of the vehicle and the make and model of the forward-facing child restraints were recorded.

Data Analysis

The proportion of vehicles with tether hardware, restraints using tethers, and restraints using tethers correctly were calculated. The percentages of restraints using tethers were computed as a function of characteristics of the installation, vehicle, and child. Drivers' characteristics and responses to the interview questions were examined by whether or not tethers were used among a subset of 343 drivers (72%) who had installed the forward-facing child restraint. The significance of the association of tether use with these variables was evaluated with a chi-square test of association ($p < 0.05$). Unless otherwise noted, refusals and missing data were excluded.

RESULTS

Overall Tether Use and Misuse

Of the 479 vehicles with tether anchors, 91% had both a tether anchor for the seating position and a tether on the forward-facing child restraint (Table 2). The tether was used for 56% of the child restraints, but was used correctly for only 39% of the restraints. Among the restraints installed with tethers, the most common misuses were loose (17%), incorrectly routed (14%), and twisted (11%) tether straps. Overall, 31% of the child restraints installed with tethers were used incorrectly.

Characteristics Associated with Tether Use

More than half (57%) of child restraints were attached with LATCH lower anchors, 35% were attached with the seat belt, and 7% were attached with both. There was a significant association between tether use and type of attachment ($\chi^2(2) = 59.6, p < 0.0001$). Tether use was more likely for child restraints attached with lower anchors (71%) than for those attached with seat belts (33%) or both the seat belt and lower anchors (55%). The tether use rate also was significantly higher for tightly attached child restraints compared with loose installations (66% vs. 40%) ($\chi^2(1) = 24.3, p < 0.0001$). The tether use rate did not differ significantly by vehicle type but was higher in 2001 and newer models than in older vehicles (57% vs. 29%) ($\chi^2(1) = 5.2, p = 0.02$).

Tether use was higher when multiple child restraints of any type, including booster seats, were observed in the vehicle (63-66%) compared with one child restraint (52%) ($\chi^2(2) = 7.6, p = 0.02$). Tether use did not differ significantly by the reported age or weight of the child.

Among drivers who installed the child restraint, the driver's reported race/ethnicity was significantly related to tether use ($\chi^2(4)=18.9, p=0.0008$). Tether use rates were 73% among Asian drivers, 60% among white drivers, 34% among black drivers, 24% among Latino drivers, and 54% among other racial/ethnic groups. The driver's age group was significantly related to tether use ($\chi^2(5)=15.1, p=0.02$). Tether use rates were 40% among drivers ages 16-20, 39% among ages 21-30, 62% among ages 31-40, 49% among ages 41-50, 64% among ages 51-60, and 70% among drivers age 61 and over. Compared with lower income zip codes, tether use was higher among drivers who lived in zip codes with median household incomes of \$50,000 and above (61% vs. 41%) ($\chi^2(1)=4.0, p=.0457$). The driver's gender and relationship to the child were not significantly related to tether use.

Association of Driver Knowledge, Opinions, and Experience with Tether Use

Among the drivers who installed the child restraints, tether users were significantly more likely than drivers not using tethers to have heard the term "top tether" (81 vs. 45%), to have heard the term and be aware that their child restraint had a tether (80 vs. 41%), and to also correctly identify the top tether (77 vs. 39%) (Table 3). After answering these questions, drivers were told that the top tether is a strap on the back of the car seat and asked whether their vehicle had a designated attachment location for the tether. Among drivers who installed the child restraints, 51% of those not using the tether were aware that they had tether anchors. Among drivers who had tether hardware available for the seating position but installed the child restraint without the tether, 27% had heard the term "top tether" and also could correctly identify the tether on the child restraint and the tether anchor in the seating position (not shown in table).

All drivers who installed the child restraint were asked to explain the purpose of the tether. As shown in Table 3, tether users most often thought the purpose is to reduce the forward movement of the top of the child restraint in a crash, and tether users were significantly more likely to give this reason than drivers not using the tether (58 vs. 29%). A majority of the drivers thought that using tethers is very or extremely important to a child's safety, but tether users were significantly more likely to rate tether use as very or extremely important compared with drivers not using the tether (93% vs. 62%).

Among drivers who installed the child restraint, virtually all reported that they had seen or heard information about how to use a child restraint within the past 10 years (Table 4). The child restraint

manual was the most common source of information among both tether users and drivers not using the tether (49% and 41%, respectively).

Among the drivers who installed the child restraints, most had not used a tether with a rear-facing restraint, but tether users (16%) were significantly more likely to report having done so, compared with those not using the tether (10%) (Table 5). A larger percentage of tether nonusers than tether users said they moved the child restraint a few times a month or more often (32% vs. 12%). About one-quarter of tether users and almost one-third of tether nonusers said that there is something hard about using tethers. When asked what makes tether use hard, tether users most often said that the tether strap was difficult to tighten or loosen (33%), and tether nonusers most often were unsure where to attach the tether (34%).

Reasons for Tether Use and Nonuse

As shown in Table 6, the most common reasons for using tethers among the drivers who installed restraints were to make the installation tighter or more secure (42%), to reduce forward movement of the top of the seat or reduce head excursion (35%), to get a tighter installation (27%), or because the manual said to use it (20%). The most common reasons for not using the tether were that the driver didn't know the tether was there (22%), didn't know how to use it (15%), was in a hurry or didn't have enough time (13%), or didn't know where to attach the tether (10%).

Among the 31 drivers who had heard the term "top tether" and could identify the tether on the child restraint and the tether anchor for the seating position, the top reasons for not using the tether were being in a hurry/not enough time (23%) and believing that tethers are not important or needed (23%).

DISCUSSION

The current study of 479 vehicles with tether anchors and forward-facing child restraints revealed higher tether use (56%) than previous observational studies, which found rates of 43%^[8] and 51%.^[9] Consistent with a previous IIHS study,^[8] tether use was much higher in 2001 and newer model vehicles. With respect to top tether misuse, the current findings are similar to a NHTSA study^[9] for tether looseness (both 18%), twisted tether straps (11% vs. 12%, respectively), improper routing (14% vs. 9%, respectively), and not attached to the proper tether anchor (3% vs. 4%, respectively).

The main purpose of the current survey was to understand why parents and caregivers do not use tethers. Seventy-two percent of the parents interviewed had installed the child restraint, and most analyses focused on these parents. Among these parents, the main reason for not using tethers was lack of awareness of tethers or how to use them. Fewer than half of the tether nonusers had heard the term “top tether,” and even after the tether was described, less than half could correctly identify the tether anchor. Tether users were much more knowledgeable about tether hardware, yet 1 in 5 had not heard the term “top tether,” suggesting the terminology is not universally understood among parents and caregivers.

Tether use was particularly low with child restraints installed with seat belts, about half the use rate for child restraints installed with the LATCH lower anchors. This finding suggests that many drivers do not understand that the tether should be used with either type of installation. Education should focus specifically on the safety benefits of using the tether with forward-facing child restraints and should take care to reinforce the message that the tether is needed whether the restraint is installed with the seat belt or the LATCH lower anchor. Because child restraint manuals are a common source of information about how to install child restraints, it is important that these manuals provide clear information about using tethers.

Another reason for low tether use rates is that some parents and caregivers find tethers difficult to use. Approximately 1 in 4 drivers reported that there was something difficult about using tethers, although many drivers were using tethers despite these difficulties. Among tether users, the most common problems were that the tether anchor was difficult to access and the tether strap was difficult to tighten or loosen. In some vehicles, tether anchors may be placed in locations that are difficult for drivers to locate or access, such as at the bottom of the seat back.[12] The location of tether anchors also may make it difficult to properly tighten the strap if the distance between the child restraint and tether anchor is too short.[14] Among tether nonusers, the most common problems were that drivers were unsure where to attach the tether and found the tether anchor difficult to access. One-quarter of tether nonusers did not answer this question or responded that they did not know if anything made the tether difficult to use, reinforcing the lack of awareness of tethers.

It was hypothesized that another potential factor in the nonuse of tethers is the belief that tethers are not needed or would not increase safety. However, few tether nonusers gave these as reasons for not

using tethers. In contrast, the drivers who used the tethers demonstrated a high degree of understanding of the safety advantages of tethers. When asked why they used tethers, the top reasons were to make the installation safer, more secure, or tighter, and to reduce movement of the child restraint or child's head.

A limitation of the current study is that the sample may not be representative of the general population of parents and caregivers who transport children in forward-facing child restraints. The drivers interviewed were not as ethnically diverse as the general population. In the present study, 6% described themselves as Latino, compared with 17% among the general U.S. population.[15] In addition, the sampled drivers lived in zip codes with median household incomes of about \$78,000. In comparison, the median household income among U.S. households with children under age 18 is \$58,000.[16] Although the participation rate was quite high, it is possible that parents who declined to participate may have been different in important respects, including use of tethers, than those who participated.

Parents have been responsive to law changes and education campaigns about ways to keep their children safer when they travel. Child restraint use is very high, especially for restraints with internal harnesses, and the large majority of young children now sit in the back seat.[17] Using a tether is a relatively simple step parents can take to keep their children safer. It is likely that parents would respond to clear and compelling messages about the importance of using tethers to reduce the likelihood of injury in crashes.

Although the rate of tether use in the current study was slightly higher than in previous studies, many parents and caregivers continue to use forward-facing child restraints without attaching the tether. Increasing tether use and reducing common misuses continue to be important goals. As the main obstacle to higher tether use is the lack of awareness of the tethers or how to use them, it is important that public education initiatives for parents and caregivers focus specifically on the safety benefits of tethers and how to use them.

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Table 1 Characteristics of drivers in sample

	Percent (N=479)
Age (years)	
16-20	1.3
21-30	24.7
31-40	50.5
41-50	11.3
51-60	4.8
61 and older	4.4
Unknown	3.1
Race/ethnicity	
White	71.8
Black	10.2
Latino	6.3
Asian	4.6
Other/unknown	2.9
Gender	
Female	69.5
Male	28.0
Unknown	2.5
Income (median household income for driver's residential zip code)	
Less than \$25,000	<1.0
\$25,000 to \$49,999	8.6
\$50,000 to \$74,999	22.8
\$75,000 to \$99,999	47.2
\$100,000 and greater	14.8
Unknown	6.5

Note: Percentages do not always sum to 100% due to rounding.

Table 2 Observed tether use and misuse with forward-facing child restraints

	Percent (N=479)
Tether observations	(N=479)
Tether anchor present for seating position	94.4
Tether present on forward-facing child restraint	94.2
Tether anchor and strap present	91.2
Tether used	56.2
Tether used correctly	38.8
Among restraints installed with tethers, types of tether misuses	(N=269)
Tether strap loose	17.5
Tether strap routed incorrectly	14.1
Tether strap twisted	11.2
Tether connector in the wrong direction	5.6
Attached to cargo tie down, LATCH lower anchor, or seat belt	1.9
Attached to tether anchor for different seating position	1.1

Table 3 Knowledge and opinions about tethers among drivers who installed the child restraint

	Tether users	Tether nonusers	<i>p</i>
Percentage who had heard the term “top tether” as it relates to installing a car seat	(N=181) 80.7	(N=133) 45.1	<0.0001
(Among those with a tether present) Percentage who had heard term “top tether” and knew that the child restraint had a tether	(N=180) 80.0	(N=121) 41.3	<0.0001
(Among those with a tether present) Percentage who had heard of top tether, knew they had it, and correctly identified it on child restraint	(N=180) 77.2	(N=121) 38.8	<0.0001
Percentage who knew vehicle has a designated attachment location for tether	(N=182) 96.7	(N=133) 50.8	<0.0001
(Among those who had a tether anchor in the seating position) Percentage who identified the correct tether anchor for the seating position	NA*	(N=120) 49.2	
Percentage who think the purpose of tether is...	(N=181)**	(N=129)**	
Reduce forward movement of top of child restraint in a crash	57.5	28.7	<0.0001
Make installation tighter	43.1	45.7	0.64
Reduce distance head moves forward in a crash	24.9	13.2	0.01
Don't know	1.7	8.5	0.004
Percentage who said importance of using tether for child's safety is....	(N=182)	(N=153)	
Extremely important	64.3	26.1	<0.0001
Very important	29.1	36.0	
Somewhat important	6.6	30.7	
Not at all important	0.0	7.2	

*Drivers using tethers were not asked this question.

**Multiple responses were permitted; percentages may sum to more than 100.

Table 4 Sources of information about child restraints among drivers who installed the child restraint

	Tether users	Tether nonusers
Percentage who saw or heard information about how to use forward-facing restraint within the past 10 years	(N=181) 99.5	(N=133) 94.0
	$\chi^2(1)=8.2, p=0.004$	
(Among those who saw or heard information) Percentage who got information from the following sources	(N=180)*	(N=125)*
Child restraint manual	49.4	40.8
Child Passenger Safety Technician	26.7	13.6
Doctor, nurse, or prenatal class	13.3	15.2
Internet	24.4	12.0
Labels on the car seat	13.3	14.4
Friend or relative	13.9	8.0
Vehicle manual	7.2	1.6
Fire department	2.8	3.2
Retail store or salesperson	2.8	5.6
Other	5.0	3.2

*Multiple responses were permitted; percentages may sum to more than 100.

Table 5 Experience with child restraints and top tethers among drivers who installed the child restraint

	Tether users Percent	Tether nonusers Percent
Have ever used tether with rear-facing child restraint	(N=179) 15.6	(N=155) 9.7
	$\chi^2(2)=15.1, p=0.0005$	
Frequency of moving forward-facing child restraint to another vehicle	(N=173)	(N=152)
Daily	0.6	2.6
Few times a week	2.3	7.9
Weekly	2.9	7.9
Few times a month	5.8	13.8
About once a month	23.7	15.1
Never	64.7	52.6
	$\chi^2(5)=21.7, p=0.0006$	
Thought there is something that makes tether use hard	(N=183)	(N=160)
Yes	23.5	29.4
No	74.9	46.3
Refused/don't know	1.6	24.4
	$\chi^2(2)=48.5, p<0.0001$	
(Among those who thought tether use is hard) Reasons why	N=43*	N=47*
Tether anchor is difficult to access	20.9	23.4
Unsure of where to attach the tether	11.6	34.0
Tether strap is difficult to tighten or loosen	32.6	17.0
Connector clip is too hard to squeeze	11.6	10.6
Instructions were insufficient	2.3	6.4
Other reasons	25.6	17.0

*Multiple responses were permitted; percentages may sum to more than 100.

Table 6 Reasons for using or not using tethers among drivers who installed the child restraint

	Percent
(Among tether users) Reasons for using the tether	(N=182)*
Make the installation safer or more secure	41.8
Reduce movement of the car seat or head	35.2
Get a tighter installation	26.9
Child seat manual said should use it	19.8
Child Passenger Safety Technician recommendation	11.5
Because it's there	2.2
Other	5.0
Don't know	1.7
(Among tether nonusers) Reasons for not using the tether	(N=134)*
Didn't know it was there	22.4
Don't know how to use it	14.9
In a hurry/not enough time	13.4
Don't know where to attach	10.5
Not important or not needed	9.0
Didn't know they had tether anchor	8.2
No tether anchor in the seating position	5.2
Too hard to unhook	3.0
Too hard to attach	1.5
Other	9.0
Don't know	12.7

*Multiple responses were permitted; percentages may sum to more than 100.