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ORIGINAL ARTICLE

The use of seatbelts and child seats in drivers and passengers of motor vehicles in four metropolitan areas in Mexico

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Abstract

Objectives: *To estimate the prevalence of safety belt and child safety seats use in drivers and passengers of motor vehicles in four metropolitan areas of Mexico (Guadalajara, León, Monterrey and Mexico City), as well as to assess the impact of the Mexican Initiative for Road Safety (IMESEVI) on this regard.* **Material and methods:** *Information was collected when the IMESEVI was initially implemented (June 2008) and one year later (October 2009) in the four participating metropolitan areas, on the use of safety belt and children seats by passengers of automobiles, vans and light freight vehicles. The sample included 28,412 (pre) and 52,274 (post) individuals, out of which 1,454 (pre) and 1,679 (post) were younger than 5 years of age. Data was analyzed with a hierarchical logistic model.* **Results:** *Overall, the likelihood of using safety restraint devices was 46% (95% confidence interval [CI]: 43-49%) in the pre- and 52% (95% CI; 48-55%) in the post measurement, with large differences between the four metropolitan areas. Factors that introduce significant differences in the use of such devices include the individual's position in the vehicle, type and age of vehicle and sex of the subject. The use of child car seats is scarce: it increased from 17% (95% CI: 11-25%) to 26% (95% CI: 19-34%) after the IMESEVI in children up to 4 years of age; in children aged 5 years or more, the rate of special seats use is virtually zero.* **Conclusions:** *It remains important for public to be made aware on the use of safety restraint devices, especially for passengers in rear seats of vehicles, as well as on the use of safety seats for small children.* (Gac Med Mex. 2015;151:50-60)

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Introduction

Among the factors that considerably reduce the seriousness of traffic-related injuries stands out the use of safety restraint systems: safety belts in adults and safety infant seats for babies and small children. Numerous studies have shown the protecting effect of safety belts by reducing traffic-related mortality and seriousness of injuries. Usually, safety restraint devices reduce mortality in case of accident by 40-70%; variation of these figures is associated with the type of impact (frontal, lateral or rear) and the place of the passenger in the vehicle (driver, front-seat passenger or rear-seat passenger)[1-4]. Additionally, the use of safety restraint devices by rear seat passengers may

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prevent for them to hit passengers riding in the front seat, thus reducing by 25% the risk for the latter to suffer serious or fatal injuries[4]. With regard to infant safety seats, recent studies estimate they reduce mortality by approximately 75% in children up to 2 years of age and about by 60% in children aged 3 or 4 years[5-8]. Studies that have compared the effectiveness of infant safety seats and safety belts in children younger than 4 years conclude that the protection offered by infant safety seats decreases mortality 40% more than seat belts[7,8].

In Mexico, reliable data on the use of safety belt are scarce. As far as we know, no large systematic studies based on direct observations have been conducted. There is a database, that the National Institute of Statistics and Geography (INEGI – *Instituto Nacional de Estadística y Geografía)* has maintained and extended since 1997, which provides information on traffic accidents in urban and suburban areas of the entire country and includes some variables on driver characteristics and conditions under which the accident happened[9]. These data show a continuous increase in the use of safety belt over the last decade, to the point that, currently, nearly 50% of drivers involved in an accident are wearing it. However, information in this database is incomplete in many regards: in more than half of the cases, information on the use of seat belt is missing –the above reported percentage is based only on the cases that do include the information– and the data fail to include information on passengers other than the driver. In addition, the information does not allow for the use of safety belt to be estimated in the entire population, since subjects involved in traffic accidents included in the INEGI database do not form a random sample of the population of public roads users. With regard to the use of child safety seats in Mexico, no records have been systematically kept up to this moment.

The study of the evolution of the rates of safety belt and child safety seat use in time (in the same place), or of the existing variation in a given moment between states or countries as a function of current laws or new initiatives, allows for the effects of interventions intended to promote an appropriate behavior to be better understood. Two studies of this kind, both conducted in the U.S.A., provide overwhelming evidence on the positive effects that both laws that mandate for all passengers in a vehicle to wear safety belts and initiatives to increase control by law enforcement authorities[10,11]. A similar study conducted by European investigators[12] arrived to similar results. Awareness programs can also be helpful to promote the use of safety belt among the general population[13-15].

In 2008, the Mexican Ministry of Health, through the National Center for Prevention of Accidents (CENAPRA – *Centro Nacional de Prevención de Accidentes)* and with support of the Panamerican Health Organization (PAHO), started up the Mexican Initiative for Road Safety and Prevention of Road Traffic Injuries (IMESEVI – *Iniciativa Mexicana de Seguridad Vial y Prevención de Lesiones en el Tránsito).* This initiative aimed at a reduction of road traffic injuries and deaths in Mexico through the development of strategic actions for the promotion of road safety. It included, in particular, the following components: development of a comprehensive information system; a public campaign to raise awareness among the general population; training of those responsible for road safety; and legislative initiatives for the promotion or ammendment of existing transit regulations. One of the areas where the project aimed to have an impact was the use of safety belts and child safety seats. A complete description of the IMESEVI can be found in the document *"Esto no es un accidente. La memoria de IMESEVI"* (This is not an accident. Report on IMESEVI), available at the CENAPRA website[16].

In the pilot phase, the project was implemented in 4 of the most important metropolitan areas of Mexico: León (in the state of Guanajuato), Guadalajara (Jalisco), Monterrey (Nuevo León [N.L.]) and Mexico City (Distrito Federal [D.F.]). The selection of cities was partialy driven by their high rates of road accidents[9]. Within the assessment framework of the project, an extensive data collection was conducted in each one of the participating metropolitan areas, in two different periods: a few months prior to the start of the project ("pre" measurement) and one year after the project was started ("post" measurement).

In this paper, we analyze data collected trying to answer the following two questions: what is the prevalence of the use of safety belt and child safety chairs in the four cities participating in the IMESEVI? and what are the immediate results of the assessment of the impact of the IMESEVI on the use of safety restraint devices?

Methods

Sampling

Two municipalities participated from each one of the Guadalajara, Monterrey and D.F. metropolitan areas:

Table 1. Distribution of 28 traffic lights at 28 observation blocks all 7 days in a week*

	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
7:00-10:30 h	L1	L5	L9	L13	L17	L21	L25
10:30-14:00 h	L2	L6	L10	L14	L18	L22	L26
14:00-17:30 h	L3	L7	L11	L15	L19	L23	L27
17:30-21:00 h	L4	L8	L12	L16	L20	L24	L28

*L1-28 represent the selection of 28 traffic lights. At each traffic light, data are collected during 3.5 h blocks at the indicated day and hour.

Guadalajara and Zapopan, Monterrey and San Pedro Garza García and the Gustavo A. Madero and Cuauhtémoc boroughs *("delegaciones")*, respectively (for the sake of simplicity, from here on we will use the term municipality to refer not only the territorial subdivisions of the states, but also the D.F. boroughs). The León metropolitan area included only one municipality. It should be noted that, even though the Guadalajara, León and Monterrey metropolitan areas include parts of other municipalities, the selected municipalities cover most part of the respective metropolitan areas. In each municipality, a three-level hierarchical sampling was applied in both observation periods:

- Level 1: traffic lights sample. For the pre measurement, 28 traffic lights were randomly selected out of a list of crossings at each participating municipality. The fulfillment of a combination of logistic factors and methodological criteria was verified in the selected traffic lights. The 28 traffic lights of each municipality were randomly assigned to 28 3.5 h-blocks, which combined covered all seven days of a week, from 7:00 to 21:00 h (Table 1). In total, 196 traffic lights were sampled in the first observation period. For the post measurement, similar sampling procedure was applied as in the first measurement. However, the sample included 56 traffic lights per municipality (instead of 28), since for the second measurement, 2 traffic lights were assigned to each block. However, due to certain logistic difficulties, some traffic lights were changed from the originally assigned block (in this regard, it is important mentioning that, in the D.F., the morning schedule blocks were moved to the second schedule) and others had to be completely removed (specially in San Pedro Garza García, where observations were made only in 28 traffic lights). The final sample of the second period included 353 traffic lights. Since the reasons for some traffic lights to be removed or changed to other schedule were idependent from non-observed data, and taking into account that the statistical model included schedules and blocks as explicative variables, we can assume that the analysis leads to non-biased inferences[17,18].
- Level 2: vehicle sample. For each one of the traffic lights, the vehicle population potentially crossing during the assigned observation block was considered. Following a strict procedure (see "Procedure" section), a random sample was drawn out of this vehicle population. In total, 15,219 vehicles were included during the pre and 30,797 during the post measurement.
- Level 3: sample of people. Vehicle occupants comprised the most basic sampling level. The driver and all passengers of each selected vehicle were included, except in the rare cases where the vehicle had more than 5 occupants (in these cases, the oldest subjects were excluded from the sample). The entire sample included 28,412 and 52,274 individuals in the pre and post measurements, respectively. For the use of child restraint devices estimation, all 1,454 (pre) and 1,679 (post) children aged 4 years or younger were considered.

Design

The above-mentioned sampling leads to a pre-post design, without a control group, with different samples at both moments, which Shadish et al. characterize as being quasi-experimental[19]. The pre measurement was carried out in June 2008, and the post, in October 2009.

Procedure

A two-survey taker team was assigned to each traffic light during the 3.5 h-block. At the start of the block, the survey takers randomly elected the traffic direction (in two-way streeets). Then, they provided values for the following variables associated with the first sampling level: traffic flow (less than 5 vehicles per lane and traffic light-cicle, between 5 and 15, more than 15, or traffic standing still), presence (yes/no) of a police officer and weather conditions (just rained, light rain, clouded or sunny).

As a general rule (standard procedure), both survey takers approached the vehicle in the second position on the extreme left lane (or the only lane when there was only one) at each traffic light cicle (when the light was red). The sample included only sedans, family vans, taxis and light freight vehicles (pick-up or truck). An important exception to deviate from the standard procedure arised when the vehicle thereby selected had no passengers younger than 15 years of age but a vehicle apparently carrying children did stop in the same left lane; in such case, a special procedure was applied, i.e., the vehicle with children was included in the sample. It is important pointing out that in order for the validity of the results no to be compromised, the procedure whereby the vehicle was selected had to be taken into account (see the "Data analysis" section).

Using a special form, the following second-level variables were recorded from the selected vehicle: type of vehicle (sedan, family van, taxi or light freight vehicle), manufacture year estimation (before 2000, 2000, or later), and number of passengers riding in the vehicle.

Finally, the following data were recorded for each occupant of the selected vehicle as third level-associated variables: seating position (driver, front seat passenger, rear seat passenger), sex (male or female) and use of any safety restraint device (none, safety belt or child safety seat). Additionally, the driver was asked to answer to a brief survey on marital status (married, civil union, single, divorced, widowed), birth year and, in the case of children aged less than 15 years being transported, their ages (categorized into three goups (0-4, 5-9, or 10-14 years). Of note, about 15% of the drivers refused to answer the survey and, in this case, the last variables had missing values. Table 2 presents descriptive statistics for each variable.

Prior to their performance, the survey takers received a 2 h-training (theoretical and practical). In addition, the quality of the data collection procedure was controlled by means of an extensive supervision and self-assessment system. From these self-assessment and supervision reports, it can be concluded that, in spite of some irregularities, the data-collection process complied with the quality required to draw reliable conclusions from the study.

Data analysis

Two analyses were carried out. The first focused on the use of safety restraint devices overall, and data originated from all vehicles selected by the standard procedure. The second analysis included only children younger than 5 years, in order to assess the use of child safety seats, and data were obtained from any vehicle of the sample that carried children of this age group. Of note, we decided to limit the sample for the second analysis only to the smallest children (0-4 years), after a previous analysis showed that the rate of special seats use (such as the so-called booster seats) for children aged 5 years or older is virtually zero.

Considering the hierarchical structure of the data, we specified a 3-level mixed-effect logistic model for the binary variable that indicates the use or not of a safety restraint device[20,21]. The fixed effects of the model are shown in table 3. Of note, although data of both the first and the second measurement were analyzed together, different parameters were considered for both moments. The model did not include an intersection parameter; we decided to include a parameter for each municipality in order to facilitate its interpretation (in terms of device global use in the municipality). It should be noted that, for obvious reasons, some variables (those lacking numeric values in the two last columns) were eliminated when the use of child seats was analyzed. Random effects are the first and second level constants (traffic lights/intersections and vehicles, respectively). The models were estimated using the HLM 6.08 software[22]. To solve the problem of missing values, we applied the multiple imputation method[17,18]. (Detailed information on the employed methodology, including the adjusted statistical models, can be requested from the second author of this article).

Results

Table 3 shows the main results of the two conducted analyses. Specifically, the odds are presented for each municipality and the odds ratios (OR) for the other factors included in the analysis, for both dependent variables and for both measurements. In order to simplify the interpretation, tables 4 and 5 show the adjusted probabilities (derived under the assumptions of the model) for all categories in variables with a statistically significant effect (with 95% confidence intervals) on the dependent variable.

Table 2. Number of observations and relative distribution frequency for independent study variables

	First measurement (pre)		Second measurement (post)	
	Total	Range*	Total	Range*
Number of observations				
Traffic lights	196	28-28	353	28-57
Vehicles	15,219	1,988-2,725	30,797	3,707-5,809
Occupants	28,412	3,437-5,119	52,274	5,539-10,513
Children ≤ 4 years	1,454	110-332	1,679	149-418
Level 1 variables (traffic lights)				
Presence of police:				
Yes	14%	0-31%	16%	0-30%
No	86%	69-100%	84%	70-100%
Traffic flow:				
< 5 vehicles/cycle	15%	4-29%	16%	2-35%
5-15 vehicles/cycle	50%	36-64%	52%	45-61%
> 15 vehicles/cycle	34%	18-55%	31%	14-46%
Traffic standing still	1%	0-4%	1%	0-4%
Weather conditions				
Sunny	73%	33-93%	58%	45-73%
Clouded	21%	7-54%	37%	28-48%
Just rained	1%	0-4%	≈ 0%	0-2%
Light rain	5%	0-24%	5%	0-12%
Level 2 variables (vehicles)				
Type of vehicle:				
Taxi	11%	5-20%	12%	5-27%
Sedan	58%	52-65%	57%	55-60%
Family van	20%	12-30%	19%	12-29%
Light freight	11%	6-20%	12%	6-19%
Age:				
Older than model 2000	35%	15-46%	28%	16-37%
Model 2000 or newer	65%	54-85%	72%	63-84%
Number of occupants:				
1 (driver)	48%	42-56%	53%	43-64%
2	29%	26-33%	30%	26-35%
3	13%	11-16%	11%	7-15%
4	6%	4-7%	4%	3-6%
5	3%	2-3%	2%	1-3%
> 5	1%	0-1%	≈ 0%	0-1%
Collaboration with survey:				
With collaboration	84%	70-95%	87%	71-95%
Without collaboration	16%	5-30%	13%	5-29%
Level 3 variables (occupants)				
Seating position:				
Driver	54%	50-58%	59%	54-67%
Front seat passenger	25%	22-28%	25%	22-29%
Rear seat passenger	21%	19-26%	16%	11-23%
Driver's age:				
16-25 years	12%	9-16%	13%	11-18%
25-40 years	47%	43-52%	47%	42-50%
40-60 years	35%	30-41%	35%	31-39%
> 60 years	6%	4-7%	5%	3-8%

Continue

Table 2. Number of observations and relative distribution frequency for independent study variables *(continued)*

	First measurement (pre)		Second measurement (post)	
	Total	Range*	Total	Range*
Age of those younger than 15 years:				
0-4 years	33%	25-41%	29%	23-36%
5-9 years	41%	35-46%	40%	29-47%
10-14 years	26%	22-29%	31%	23-48%
Driver marital status:				
Single	26%	22-30%	27%	22-33%
Married	71%	67-76%	70%	63-74%
Other	3%	3-4%	3%	2-4%
Sex:				
Male	60%	53-65%	62%	58-67%
Female	40%	35-47%	38%	33-42%

*Rank refers to the number of observations or minimal and maximal percentage among all 7 municipalities.

Use of safety restraint devices in the general population

As the main result, overall probability of using safety restraint devices is about 50% in the 7 municipalities included in the study. However, there are large differences between municipalities: in the Mexican capital city, the use of safety restraint devices is more common than in the interior of the country (with 0.70 vs. 0.35 probabilities). There are also important differences between the users of different types of vehicles and between older and newer cars. However, the factor influencing the most on the use of safety belt is the place where the occupant seats in the vehicle: while most drivers wear it (with higher than 0.80 probabilities in the D.F.), the passengers, especially those riding in the rear seats, do not have the habit of protecting themselves (safety belt is used in the rear seats barely in 10% of the cases). Other individual variables with significant effect are sex, and in the second measurement, age.

With regard to the impact of the IMESEVI, we observed, on average, a slight increase between the first and the second measurement (from 0.46 to 0.52). In the D.F., however, the probability of using safety belt is slighty decreased, whereas in the other municipalities there is an increase between both moments (especially in Zapopan, Monterrey and San Pedro Garza García, the increase is considerable). It is worth mentioning thay the change between both measurements, which results statistically significant for each municipality ($p < 0.05$; by applying likelihood ratio tests), varies according to the type of vehicle, position of the occupant in the vehicle and age.

Use of child seats for children up to 4 years of age

Table 5 shows that the overall mean probability for a child to ride in a child safety seat is around 0.20. However, there are important differences between municipalities: in Cuauhtémoc and San Pedro Garza García, the use of child seats is more common. Additionally, in taxis and freight vehicles, as well as in old vehicles, the probability for children to ride in a child seat is observed to be low. On the other hand, after the IMESEVI, the probability increased in all 7 municipalities, although the difference was statistically significant only in Gustavo A. Madero, Cuauhtémoc and Zapopan. Otherwise, the increase seems to be uniform between the different subpopulations of the study.

Discussion

The use of safety belt is one of the most effective and inexpensive existing measures to reduce injuries (fatal and non-fatal) caused by traffic. However, the results of this study show that a high percentage of Mexicans do not wear the safety belt. In the D.F, the use of safety belt is more common, which is consistent with information from the INEGI[9] database that shows that in the year 2009, there were more people involved in traffic accidents with the seat belt on in the D.F. than in other states.

Table 3. Odds and ORs* for factors associated with the use of safety restraint devices among the general population and in children up to 4 years of age†

	Restraint device (general population)				Child seats (children up to 4 years of age)			
	Pre measurement		Post measurement		Pre measurement		Post measurement	
Factors	Odds	(95% CI)	Odds	(95% CI)	Odds	(95% CI)	Odds	(95% CI)
First level								
Municipality:								
Gustavo A. Madero (D.F.)	2.23	(1.9-2.6)	1.70	(1.4-2.0)	0.12	(0.1-0.2)	0.30	(0.2-0.4)
Cuauhtémoc (D.F.)	2.51	(2.1-3.0)	1.95	(1.7-2.3)	0.26	(0.1-0.5)	0.98	(0.6-1.7)
León (Guanajuato)	0.62	(0.5-0.7)	0.76	(0.7-0.9)	0.13	(0.1-0.2)	0.18	(0.1-0.2)
Guadalajara (Jalisco)	0.58	(0.5-0.7)	0.71	(0.7-0.8)	0.15	(0.1-0.3)	0.21	(0.1-0.3)
Zapopan (Jalisco)	0.54	(0.5-0.6)	0.85	(0.7-1.0)	0.22	(0.2-0.3)	0.37	(0.3-0.5)
Monterrey (N.L.)	0.40	(0.3-0.5)	0.86	(0.8-0.10)	0.22	(0.1-0.4)	0.25	(0.2-0.4)
San Pedro Garza (N.L.)	0.73	(0.6-0.9)	1.23	(1.1-1.4)	0.55	(0.4-0.9)	0.60	(0.4-1.0)
	OR	**(95% CI)**	**OR**	**(95% CI)**	**OR**	**(95% CI)**	**OR**	**(95% CI)**
Day of the week:								
Monday	1.00		1.00		1.00		1.00	
Tuesday	1.02	(0.8-1.2)	0.87	(0.7-1.1)	0.97	(0.5-1.9)	1.09	(0.7-1.8)
Wednesday	0.99	(0.8-1.2)	0.93	(0.8-1.1)	0.70	(0.4-1.4)	1.21	(0.7-2.0)
Thursday	0.99	(0.8-1.2)	0.99	(0.8-1.2)	1.03	(0.5-2.0)	1.30	(0.8-2.1)
Friday	1.03	(0.9-1.3)	0.94	(0.8-1.1)	0.74	(0.4-1.4)	1.02	(0.6-1.7)
Saturday	1.17	(1.0-1.4)	0.90	(0.7-1.1)	0.81	(0.4-1.6)	0.88	(0.5-1.4)
Sunday	1.00	(0.8-1.2)	0.97	(0.8-1.2)	0.69	(0.4-1.3)	0.86	(0.5-1.4)
Schedule:								
7:00-10:30 h‡	1.00		1.00		1.00		1.00	
10:30-14:00 h	0.88	(0.8-1.0)	0.94	(0.8-1.1)	0.89	(0.5-1.5)	1.39	(0.9-2.2)
14:00-17:30 h	0.86	(0.7-1.0)	0.94	(0.8-1.1)	1.03	(0.6-1.7)	1.03	(0.7-1.6)
17:30-21:00	0.95	(0.8-1.1)	0.87	(0.7-1.0)	0.61	(0.4-1.1)	1.12	(0.7-1.8)
Presence of police:								
No‡	1.00		1.00					
Yes	1.11	(1.0-1.3)	1.08	(0.9-1.3)				
Traffic flow§:								
Quiet‡	1.00		1.00					
Intense	1.08	(0.1-1.2)	1.09	(1.0-1.2)				
Weather:								
Sunny‡	1.00		1.00					
Clouded/rain	0.88	(0.7-1.0)	1.07	(1.0-1.2)				
Second level:								
Type of vehicle:								
Taxi‡	1.00		1.00		1.00		1.00	
Sedan	1.86	(1.6-2.1)	1.46	(1.3-1.6)	15.18	(3.5-66)	7.24	(3.2-1.6)
Family van	2.08	(1.8-2.4)	1.67	(1.5-1.8)	15.33	(3.4-69)	10.07	(4.3-24)
Light freight	1.14	(1.0-1.3)	0.86	(0.8-1.0)	2.94	(0.5-17)	1.58	(0.6-4.5)
Age of vehicle								
Older than model 2000	0.63	(0.6-0.7)	0.68	(0.6-0.7)	0.44	(0.3-0.6)	0.44	(0.3-0.6)
Model 2000 or newer‡	1.00		1.00		1.00			
Occupants:								
Only the driver	0.97	(0.9-1.0)	0.98	(0.9-1.0)				
With passengers§	1.00		1.00					

Continue

Table 3. Odds and OR* for factors associated with the use of safety restraint devices among the general population and in children up to 4 years of age† (continued)

	Restraint device (general population)				Child seats (children up to 4 years of age)			
	Pre measurement		Post measurement		Pre measurement		Post measurement	
Factors	Odds	(95% CI)	Odds	(95% CI)	Odds	(95% CI)	Odds	(95% CI)
Third level								
Age:								
< 15 years	0.85	(0.7-1.1)	1.46	(1.2-1.7)				
15-25 years	0.88	(0.7-1.1)	0.88	(0.8-1.0)				
25-40 years	0.83	(0.7-1.0)	0.91	(0.8-1.0)				
40-60 years	0.92	(0.8-1.1)	0.94	(0.8-1.1)				
> 60 years‡	1.00		1.00					
Seating position:								
Driver	42.95	(36-52)	16.28	(14-19)				
Front seat (co-pilot)	9.21	(7.6-11)	4.48	(4.0-5.1)				
Rear seat‡	1.00		1.00					
Marital status:								
Single/divorced/widowed‡	1.00		1.00					
Married/civil union	1.05	(1.0-1.2)	1.03	(1.0-1.1)				
Sex:								
Man/boy	0.71	(0.7-0.8)	0.73	(0.7-0.8)	1.25	(1.0-1.6)	0.79	(0.6-1.0)
Woman/girl	1.00		1.00		1.00		1.00	

*Compared to reference category.
†Empty cells in the columns corresponding to child seats indicate factors not included in the model.
‡Reference category.
§Traffic flow was re-codified as a binary variable: quiet (≤ 15 vehicles/cycle) and intense (> 15 vehicles/cicle or standing still).

The comparison of the June 2008 and October 2009 results indicates that one year after the IMESEVI implementation, the use of safety restraint devices was increased, except in the D.F. This increase in municipalities at metropolitan areas of Guadalajara, León and Monterrey can be regarded as an initial step towards a more lasting behavioral change, which will require a sustained, long-term effort. A possible explanation for the decrease in the D.F. is the suppression of the administered guidelines during the pre measurement by law enforcement authorities in order to sanction failure to use safety belt.

The use of safety restraint devices does not statistically differ between different days and observation schedules, nor does it vary with the presence of police officers at the observation site. Probably, wearing the safety belt is the result of an almost unconscious or automatic habit developing the same way in different circumstances. On the other hand, differences existing between users of different types of vehicles may be associated with false invulnerability feelings[23] in taxi drivers (due to their vast experience in traffic) and drivers and passengers of light freight vehicles (due to the size and robustness of the vehicles). The difference between old an new vehicles users may reflect a difference in socioeconomic level: previous studies have shown that higher socioeconomic classes use safety restraint devices more[24,25].

The largest differences are related to the seating position of the occupant in the vehicle. Especially people riding in rear seats are less likely to use safety restraint devices. Although the change between the two measurements being the greatest in this group is promising, the figure remains low in absolute terms, which suggests awareness-raising programs focused on wearing safety belt when riding in rear seats should be developed.

The use of child safety seats is relatively uncommon in Mexico. The series of results of this study suggests that socioeconomic level can be an important factor for the use of child seats. First, when neighboring municipalities of N.L. (Monterrey and San Pedro Garza García) and D.F. boroughs are compared, the highest socioeconomic level zones are more significantly associated with children that ride in child seats. Second, the children of old vehicles users are significantly less

Table 4. Adjusted probabilities for the use of safety restraint devices among the general population

	Average of 7 municipalities	D.F.		Guanajuato	Jalisco		N.L.	
		Gustavo A. Madero	Cuauhtémoc	León	Guadalajara	Zapopan	Monterrey	San Pedro Garza García
General	0.46 → 0.52	0.69 → 0.63	0.72 → 0.66	0.38 → 0.43	0.37 → 0.42	0.35 → 0.46	0.29 → 0.46	0.42 → 0.55
Type of vehicle:								
Taxi	0.33 → 0.44	0.57 → 0.56	0.60 → 0.59	0.27 → 0.36	0.26 → 0.35	0.24 → 0.39	0.19 → 0.39	0.30 → 0.48
Sedan	0.49 → 0.54	0.71 → 0.65	0.74 → 0.68	0.41 → 0.45	0.39 → 0.44	0.38 → 0.48	0.31 → 0.48	0.45 → 0.57
Van	0.51 → 0.57	0.74 → 0.68	0.76 → 0.71	0.43 → 0.48	0.42 → 0.47	0.40 → 0.52	0.33 → 0.52	0.33 → 0.44
Light freight	0.37 → 0.41	0.61 → 0.52	0.63 → 0.56	0.30 → 0.33	0.28 → 0.31	0.27 → 0.35	0.22 → 0.35	0.33 → 0.44
Vehicle age:								
Older than model 2000	0.39 → 0.45	0.62 → 0.57	0.65 → 0.60	0.31 → 0.37	0.30 → 0.36	0.29 → 0.40	0.23 → 0.40	0.35 → 0.49
Model 2000 or newer	0.50 → 0.55	0.72 → 0.66	0.75 → 0.69	0.42 → 0.46	0.40 → 0.45	0.39 → 0.49	0.32 → 0.50	0.46 → 0.59
Seating position:								
Driver	0.68 → 0.69	0.85 → 0.78	0.87 → 0.80	0.61 → 0.61	0.59 → 0.60	0.58 → 0.64	0.51 → 0.64	0.65 → 0.72
Front seat (co-pilot)	0.32 → 0.38	0.55 → 0.49	0.58 → 0.53	0.25 → 0.30	0.24 → 0.29	0.23 → 0.33	0.18 → 0.33	0.28 → 0.41
Rear seats	0.05 → 0.12	0.12 → 0.18	0.13 → 0.20	0.04 → 0.09	0.03 → 0.08	0.03 → 0.10	0.02 → 0.10	0.04 → 0.14
Sex:								
Male	0.51 → 0.57	0.74 → 0.68	0.76 → 0.71	0.43 → 0.48	0.42 → 0.47	0.40 → 0.51	0.33 → 0.51	0.47 → 0.60
Female	0.43 → 0.49	0.66 → 0.60	0.69 → 0.64	0.35 → 0.40	0.34 → 0.39	0.32 → 0.43	0.26 → 0.43	0.39 → 0.52
Age:								
< 15 years	0.45 → 0.62	0.68 → 0.72	0.71 → 0.75	0.37 → 0.54	0.36 → 0.52	0.34 → 0.57	0.28 → 0.57	0.41 → 0.65
15-25 years	0.46 → 0.50	0.69 → 0.61	0.72 → 0.64	0.38 → 0.41	0.37 → 0.40	0.35 → 0.44	0.29 → 0.44	0.42 → 0.53
25-40 years	0.44 → 0.51	0.68 → 0.62	0.70 → 0.65	0.37 → 0.42	0.35 → 0.41	0.34 → 0.45	0.27 → 0.45	0.41 → 0.54
40-60 years	0.47 → 0.52	0.70 → 0.63	0.73 → 0.66	0.39 → 0.43	0.38 → 0.41	0.36 → 0.46	0.30 → 0.46	0.43 → 0.55
> 60 years	0.49 → 0.53	0.72 → 0.64	0.74 → 0.67	0.41 → 0.44	0.40 → 0.43	0.38 → 0.47	0.31 → 0.47	0.45 → 0.56

*Probabilities were derived under the statistical method assumptions. The probability preceeding the arrow refers to the first measurement (pre), and the following, to the second measurement (post).

Table 5. Adjusted probabilities for the use of child seats for boys and girls aged up to 4 years

	Average of 7 municipalities	D.F.		Guanajuato	Jalisco		N.L.	
		Gustavo A. Madero	Cuauhtémoc	León	Guadalajara	Zapopan	Monterrey	San Pedro Garza García
General	0.17 → 0.26	0.11→ 0.23	0.21 → 0.49	0.12 → 0.15	0.13 → 0.17	0.18 → 0.27	0.18 → 0.20	0.35 → 0.38
Type of vehicle:								
Taxi	0.02 → 0.05	0.01 → 0.05	0.02 → 0.14	0.01 → 0.03	0.01 → 0.03	0.02 → 0.06	0.02 → 0.04	0.05 → 0.09
Sedan	0.23 → 0.29	0.15 → 0.26	0.27 → 0.54	0.16 → 0.18	0.17 → 0.20	0.23 → 0.31	0.24 → 0.23	0.44 → 0.42
Van	0.23 → 0.37	0.15 → 0.33	0.27 → 0.62	0.16 → 0.23	0.17 → 0.26	0.24 → 0.38	0.24 → 0.30	0.44 → 0.50
Light freight	0.06 → 0.08	0.03 → 0.07	0.07 → 0.20	0.04 → 0.04	0.04 → 0.05	0.06 → 0.09	0.06 → 0.06	0.13 → 0.13
Vehicle age:								
Older than model 2000	0.11 → 0.17	0.07 → 0.15	0.14 → 0.38	0.0 → 0.10	0.08 → 0.11	0.12 → 0.18	0.12 → 0.13	0.25 → 0.27
Model 2000 or newer	0.23 → 0.33	0.15 → 0.29	0.27 → 0.58	0.16 → 0.20	0.17 → 0.22	0.23 → 0.34	0.24 → 0.26	0.43 → 0.46
Sex:								
Girl	0.19 → 0.23	0.12 → 0.21	0.23 → 0.46	0.13 → 0.14	0.14 → 0.15	0.20 → 0.25	0.20 → 0.18	0.38 → 0.35
Boy	0.16 → 0.28	0.10 → 0.25	0.19 → 0.52	0.11 → 0.17	0.12 → 0.19	0.16 → 0.29	0.17 → 0.22	0.33 → 0.40

*Probabilities were derived under the statistical method assumptions. The probability preceeding the arrow refers to the first measurement (pre), and the following, to the second measurement (post).

protected. Finally, in the second measurement, in family vans (more common than sedan cars in high socioeconomic strata) children were observed to ride more in child seats. Considering this socioeconomic influence and the low level of income of many families, we suggest the authorities should implement initiatives in order for all families to have access to special seats to transport their babies.

The results presented in this article with regard to the use of child safety seats only include children up to 4 years of age, although, when the study was designed, the use of special seats for children up to 14 years was contemplated. The World Health Organization (WHO) recommends using booster seats for children aged 5-12 years[26]. However, our data show that, in Mexico, the use of such devices is virtually absent.

The IMESEVI project and the results thereof derived have served as a precursor for the 2011-2020 National Strategy for Road Safety, an agreement signed by the National Conference of Governors in Mexico[27]. In this agreement, the governors state their willingness to adopt initiatives intended to reduce injuries, disabilities and deaths caused by traffic by 50% before 2020, thus joining the Decade of Action for Road Safety proclaimed by the United Nations General Assembly in 2010[28].

Limitations of this study

For this study, only 2 of the 16 boroughs that comprise the D.F. were selected. Since it is uncertain if they are representative of the entire capital city, generalization of the presented results to the D.F. as a whole would be improper.

Considering the limited use of child safety seats, it is advisable that awareness raising programs recommend them among the general public. However, several studies conducted in the USA and Canada[29-31] provide evidence on improper use of child seats, so that promoting their use is not enough, but correct use has to be encouraged as well. Both instalation of the seats and the position children are placed are crucial to prevent injuries caused by traffic accidents and are relevant subjects for future investigations.

As previously mentioned, supervisions carried out by those responsible for this study revealed some irregularities in the data collection procedure by the survey takers. Although these lacks of compliance negatively affect validity, the performed supervisions allow for the assumption that survey takers performance was good enough to trust the study conclusions. Additionally, changes of schedule and missing observations at some traffic lights in the post measurements are a limitation of the study, although the analysis design includes a statistical control for these factors.

Finally, the most important limitation of this study is probably related to the quasi-experimental design which, by not including a control group, does not allow for the impact of the program to be separated from other influences during the period between the pre and post measurements. This means that, strictly speaking, the improvement observed in the use of safety restraint devices can not be attributed exclusively to the IMESE-VI. On the other hand, it would be a practical challenge finding a control group not exposed to the intervention that at the same time can be comparable with the experimental group in all other aspects.

Declaration of conflicts of interest

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Limitations of this study

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