



Attitude change in youths after being exposed to different road safety interventions in two Mexican cities

Martha Híjar^{a,b}, Ricardo Pérez-Núñez^a, Dzoara Santoyo-Castillo^{*c}, Jeffrey C. Lunnan^d, Aruna Chandran^d, Alfredo Celis^e, Socorro Carmona-Lozano^f

^aCenter for Health Systems Research, National Institute of Public Health, Cuernavaca, Mexico

^bFundación Entornos, A. C., Cuernavaca, Mexico

^cCentro Regional de Investigaciones Multidisciplinarias, CRIM-UNAM, Cuernavaca, Mexico

^dJohns Hopkins International Injury Research Unit, Johns Hopkins Bloomberg School of Public Health, Baltimore, USA

^eCentro Universitario de Ciencias de la Salud de la Universidad de Guadalajara, Guadalajara, México

^fFacultad de Medicina de la Universidad de Guanajuato, campus León, México

KEYWORDS

Intervention studies
Social marketing
Road safety education
Attitude change
Mexico
Latin America
Youths
Road traffic injury
Risk factors

ABSTRACT

Objective: To assess the reach of three different types of road safety interventions (social marketing, education and law enforcement) implemented as part of the *Iniciativa Mexicana de Seguridad Vial y Prevención de Lesiones en el Tránsito* (Mexican Initiative for Road Safety and the Prevention of Road Traffic Injuries) among youth in two Mexican cities (Guadalajara-Zapopan, Jalisco and León, Guanajuato), and to examine students' self-reported attitude change after being exposed to these interventions.

Methods: A cross-sectional design was utilized to evaluate the reach of the city-wide interventions among a random sample of public and private high school and college students from October to December 2011. A total of 5,114 students completed a self-administered questionnaire.

Results: In both cities, students reported a greater exposure to social marketing (73% in Guadalajara-Zapopan and 64% in León) as compared to educational interventions (29.3% in León and 21.6% in Guadalajara-Zapopan) and law enforcement activities (~12% in both). Among respondents, self-reported attitude change was higher after being exposed to educational interventions than law enforcement. Social marketing yielded the lowest prevalence of self-reported attitude change.

Discussion: Our results show a potential moderate impact, measured as self-reported attitude change, resulting from the three intervention approaches under study. Future studies should address the intensity of exposure as well as the translation of attitude change into safer behaviors. Information generated by this study could be useful for local authorities in the intervention areas to inform their activities.

© 2013 Elsevier Ltd. All rights reserved.

Introduction

In Mexico, road traffic injuries (RTIs) are the leading cause of death among persons aged 5–15 and the fourth cause of death among persons aged 16–64 years.¹ Around 65% of all RTI-related deaths occur during the most economically productive years (20–59 years).² However, youths aged 15 to 29 years are the most affected. This age group is clearly identified as a high-risk population globally because their behaviors are strongly associated with expectations and social pressures that promote risk-taking on the road, such as not using safety devices (i.e. seatbelt and motorcycle helmets), speeding, and drinking and driving. Globally, a teenage driver's risk of crashing (especially

those aged 16–17 years) has been reported to be greater than any other comparable age group.³

In Mexico, age also plays a significant socio-cultural role in the incidence of RTI since it is accepted and expected that young people begin driving at an early age, usually without going through a pre-professional training and without taking theoretical and practical exams.⁴ Similarly, it has been reported that risk of RTI is particularly high during the first 12 months of driving.³ In addition, alcohol consumption is also a socially accepted behavior that plays an important role in socializing among peers and constitutes a symbolic initiation into adulthood.⁵ Despite the fact that legislation prohibiting drinking and driving exists in Mexico, its enforcement has been shown to be very low.⁶ As a consequence, studies have demonstrated that alcohol is one of the key risk factors for RTIs in this setting. It is present in around 10% of the reported crashes, as well as in approximately 8–9% of persons admitted to public sector hospitals for RTI, and in 20% of all RT deaths in whom toxicology testing was performed.^{5,7–9}

* Corresponding author at: Av. Universidad s/n, Circuito 2, Col. Chamilpa, Cuernavaca, Morelos; México 62210.

Tel.: +52 777 329 1837; Fax: +52 777 317 5981

E-mail address: dzoara.santoyo@outlook.com (D. Santoyo-Castillo).

In order to control and reduce the high burden that RTIs represent in Mexico, several strategies have been put in place in recent years. One of the most important initiatives is the *Iniciativa Mexicana de Seguridad Vial y Prevención de Lesiones en el Tránsito* [Mexican Initiative for Road Safety and the Prevention of Road Traffic Injuries] (IMESEVI). Launched in 2008 with support from Bloomberg Philanthropies, IMESEVI was a partnership between the World Health Organization (WHO)/Pan American Health Organization (PAHO), the Mexican Ministry of Health and the National Center for Accident Prevention and its primary goal was to reduce the burden of injuries and deaths from road traffic crashes.¹⁰ Between 2008–2010, IMESEVI-related activities were principally focused on conducting baseline measurements of key risk factors associated with RTI in four areas (Guadalajara, Jalisco; León and Celaya, Guanajuato; Mexico City, DF; and Monterrey, Nuevo Leon) and raising awareness about road safety in Mexico via social marketing campaigns. In January 2010, Bloomberg Philanthropies funded a consortium of international partners with the aim of improving road safety across 10 countries.^{11,12} This project, originally referred to as the *Road Safety in 10 Countries* (RS10) project is now known as the *Bloomberg Philanthropies Global Road Safety Programme*, included Mexico and built upon IMESEVI.¹² Targeted risk factors were drinking and driving and seatbelt/child restraint use, and intervention activities were limited to Guadalajara, which now included an accompanying municipality, Zapopan, and León.

In the period 2010–2011, one of the key components of the newly streamlined IMESEVI was the development of city-wide social marketing campaigns and educational interventions targeted specifically to youth. Additionally, police sobriety checkpoints were implemented as part of this initiative. However, no evidence has been documented regarding the reach of these interventions and the potential impact they have on attitudes among young persons. The overall goal of this study was to provide both an assessment of the reach of the three different type of interventions (social marketing, education and law enforcement) being implemented within the context of ongoing road safety work focused on youth in two Mexican cities (Guadalajara–Zapopan, Jalisco and León, Guanajuato), as well as the self-reported attitude change among youths who had been exposed by the different intervention activities. Attitude change was also explored for those youths reporting ever having experienced a road traffic crash.

Methods

Description of the interventions

Beginning in fall 2010, intervention activities implemented by IMESEVI included social marketing campaigns and educational activities such as school lectures and assemblies, which often involved the use of crash simulators and or the use of goggles and a buggy to simulate the effects of drink driving. One of the main target populations for these activities was school-aged youth. In addition, interventions included additional sobriety checkpoints for driver alcohol screening. Since, at that time, local legislation did not allow the police to stop drivers for random alcohol testing, one of the strategies employed by local authorities has been to stop drivers for a primary offence (i.e. speeding) and then test those suspected of being under the influence of alcohol.

Design of the study

Using a cross-sectional design, the reach of social marketing campaigns and educational interventions as well as exposure to law enforcement efforts were assessed in the cities of Guadalajara–

Zapopan and León among a random sample of high school and college students from October to December 2011. The sample size was estimated by considering the total number of students registered during the previous year, 2% precision, and an expected exposure prevalence of 50%. After assuming a non-response rate of 10%, the sample size estimated for each city was 2,668 students.

Study population

A random sample of high school and college students in each intervention city was selected in two steps. First, a stratified sampling of 10% of all schools, both public and private, was randomly selected in each city using a census of all registered schools. A total of 71 different schools, 45 in Guadalajara–Zapopan and 26 in León were selected. Around 29% of schools in Guadalajara–Zapopan were public, compared to 27% in León. Institutional authorities were approached and invited to participate in this survey. The estimated sample size was assigned proportionally to the number of registered students in each selected school. Only those schools that agreed to participate were included in this study; those who decided not to participate (three schools representing 4% of the total sample) were substituted by pre-selected replacements. Secondly, a sample of classrooms inside those schools that agreed to participate was randomly selected until the sample size for that school was met. All students present in classrooms during the study period were invited to participate after giving informed consent or assent, depending on the age of the student.

Data collection

Information was obtained through a self-applied questionnaire. A pilot test was conducted prior to the questionnaire being applied to the selected sample. Questionnaires were distributed to students in a special session after classes had ended to be filled out individually. A supervisor was present in classrooms to encourage students to answer questions themselves. Students were informed that their responses would be kept confidential. The questionnaire included the following components:

- Knowledge of road safety:

A categorical variable was created to measure the students' knowledge on 4 basic road safety factors: a) speed limit in their city of residence, coded as correct when students responded that the maximum allowable speed limit within the metropolitan area was 40–60 km/h; b) number of alcoholic drinks allowed before driving, this item was coded as correct when the respondents indicated that 2 alcoholic drinks are allowed before driving; c) seatbelt use, this item asked students "who must fasten their seatbelt?", if they responded "all vehicle occupants" then it was coded as correct; and d) motorcycle helmet use, students that responded that all motorcycle passengers must wear a helmet were coded as correct. As items c) and d) measured the students' knowledge on the use of safety devices, both were combined into one variable. Based on the three basic road safety variables (speed limit, number of alcoholic drinks generally permissible to consume before driving, and use of safety devices) mentioned above, the variable *Knowledge of road safety* was created with three categories: high (if a student correctly answered all three items), medium (if a student correctly answered two items), and low (if a student correctly answered just one item or none).

- Involvement in road traffic crash event:

The experience of having been involved in a road traffic crash event in the last 12 months, whether as a driver or as a passenger, was explored among all respondents.

- **Exposure to social marketing campaigns:**
In order to measure students' exposure to the different social marketing strategies, a variable of exposure to informative advertising campaigns was created: a) TV announcements, b) radio spots, c) web advertisements, d) posters or billboards, e) pamphlets, brochures, etc. First, each item was coded as 1 if students reported having been exposed to a component of the social marketing campaign and 0 if they had not. A composite variable comprising all five items was coded = 1 when students were exposed to any type of campaign strategy media and 0 otherwise.
- **Exposure to educational strategies such as:**
a) talk/lecture on road safety at school, b) goggles for alcohol consumption simulation, c) crash simulator, d) free alcohol testing at recreational sites, e) driving a buggy (called the "anti-alcohol buggy") with goggles designed to simulate driving under the influence of alcohol; and f) attending a road safety camp was also explored. Each item was coded 1 when the respondent self-reported having been exposed to the activity. Additionally, a variable reporting exposure to any of the six educational strategies was also generated; it was coded as 1 when the respondents were exposed to any educational strategy and 0 if otherwise.
- **Exposure to law enforcement whether as a driver or a passenger in a vehicle, such as:** a) being stopped in a police sobriety checkpoint, and b) being detained after speeding.
- **Perception of attitude change:**
Respondents were required to give their perceptions on whether their attitude changed after experiencing a road traffic crash event, an approach previously validated for the Mexican context.¹³ In addition, the questionnaire explored students' perceptions of their own attitude change after having been exposed to components of social marketing campaigns, educational strategies and law enforcement. The study also incorporated questions regarding peers' attitude change, as adolescents often report behaviors and changes among peers more honestly than about themselves. Responses were limited to the following possible answers: "yes," "a little/more or less," "no, not at all," and "I don't know." From these questions the dependent variable in our analysis ("behavior change") was generated equal to 1 when respondents answered "yes" to any of the above questions and 0 when responses were "no, not at all," "a little/more or less," or "I don't know."
- **Socio demographic variables:**
Sex, age (grouped for the analysis as: 13–15, 16–18, 19–21 and 22 and over), time living in the city (≤ 1 year and > 1 year living in the city), vehicle ownership, availability of a car for their own use, and knowing how to drive were collected for analytical purposes. Additionally, the most commonly used means of transportation was explored among the respondents (i.e. private car, taxi, public transportation, walking, motorcycle and bicycle use). This variable was further classified into three categories: students who reported using a private car and/or taxi were identified as automobile occupants; those students reporting using public transportation or walking were identified as pedestrians; and students using a motorcycle or bicycle were classified as "other."

Data analysis

A descriptive analysis was performed using Stata 12.1©. Univariate analysis was conducted to report summary measures for each city (frequencies and percentages for nominal and ordinal variables). In order to evaluate factors associated with

being exposed to social marketing campaigns, educational activities and law enforcement, three logistic regression models were used. The regression models included all variables available and found to be associated at the bivariate analysis with a P -value < 0.25 in order to control for possible confounding effects. To identify multicollinearity of variables included in final models, the variance inflation factor test was evaluated. The final models were assessed in terms of their residuals and leverage.

Ethical issues

This study was approved by the ethics committee of Fundación Entornos, A.C. in Mexico. Verbal informed consent was obtained from each student aged 18 years or older who agreed to participate in the study. Students younger than 18 years of age were required to provide written informed consent from their parents and also give verbal assent.

Results

A total sample of 5,115 students was interviewed: 2,479 in Guadalajara-Zapopan, and 2,636 in León. Of the student participants, 65.7% attended a public school (62.5% in Guadalajara-Zapopan and 69.6% in León). Table 1 presents the distribution of the variables included in the study and a descriptive analysis of the independent variables by type of exposure. The sample consists of 53.6% females and 46.4% males. The majority of the students (44.7%) are concentrated in the 16–18 age group. Also, approximately 6 in 10 students included in the sample indicated that they mainly utilize public transportation to get around and 27.4% used a private car. When grouping the students according to the most common means of transportation, 34.8% were classified as automobile occupants, 62.5% as pedestrians, and less than 3% as "other." The majority of the participants have inhabited in the city for over a year (96.2%). Approximately 53% of the sample reported knowing how to drive, although of those just 34% had a vehicle available to them for personal use. A small percentage of the respondents had high knowledge of road safety (5.9%) (i.e. correctly responded to the questions asked). Only 33.8% of the total sample reported having been involved in a road traffic crash event.

As regards social marketing, analyzing the students' awareness of road safety messages (slogans) transmitted in their cities showed that 57.2% and 7.4% of students in León knew the messaging (there were two phrases). Moreover, 58.7% recalled at least one of the two slogans, which was slightly higher among females as compared to males (64.7% vs. 52.6% respectively). In Guadalajara-Zapopan there were three slogans, which were known by 1.9%, 10.7% and 54.2% of students respectively. At least 57% of students recalled one or more slogans without there being any differences between the sexes.

Table 2 presents descriptive statistics disaggregated by the distinct interventions that were implemented in both cities by intervention type: social marketing, educational activities, and law enforcement. Youth in the city of Guadalajara-Zapopan self-reported greater exposure to social marketing (73% vs. 64% in León), while in the city of León students self-reported more exposure to educational activities (29.3% vs. 21.6% in Guadalajara-Zapopan). In both cities, exposure to law enforcement was less than 12%. As seen in Table 3, from the students self-reporting having been exposed to a social marketing campaign, only 38.8% and 38.4% (in León and Guadalajara-Zapopan respectively) reported attitude change after hearing the messages.

Regarding educational activities, 15.9% and 23.2% of students self-reported having been exposed in Guadalajara-Zapopan and León respectively. Youth in both cities reported the greatest

Table 1
Descriptive analysis of students' characteristics by independent type of exposure to road safety activities

Variables	(n)	%	Type of exposure					
			Social marketing campaigns (%)		Educational activities (%)		Law enforcement (%)	
			Yes	No	Yes	No	Yes	No
Sex	5,066		***		*		***	
Male	2,350	46.4	65.3	34.7	24.3	75.7	17.4	82.6
Female	2,716	53.6	70.7	29.3	26.6	73.4	7.0	93.0
Age groups	5,035		***		***		***	
13–15	617	12.3	68.2	31.8	25.8	74.2	7.5	92.5
16–18	2,252	44.7	70.9	29.1	29.2	70.8	10.4	89.6
19–21	1,109	22.0	67.5	32.5	23.4	76.6	11.8	88.2
22 and over	1,057	21.0	63.1	36.9	20.0	80.0	17.2	82.8
Transportation commonly utilized	5,074		n/s		*		***	
Private car	1,391	27.4	67.7	32.3	24.9	75.1	18.1	81.9
Taxi	63	1.2	71.4	28.6	27.0	73.0	27.0	73.0
Public transportation	3,082	60.7	67.4	32.6	25.6	74.4	8.7	91.3
Walking	366	7.2	74.3	25.7	24.9	75.1	7.1	92.9
Motorcycle	65	1.3	73.8	26.2	43.1	56.9	35.4	64.6
Bicycle	107	2.1	65.4	34.6	27.1	72.9	13.1	86.9
Time residing in the city	4,489		**		n/s		n/s	
Less than 1 year	170	3.8	59.4	40.6	25.3	74.7	11.9	96.2
Over 1 year	4,319	96.2	68.9	31.1	25.4	74.6	12.4	87.6
Knows how to drive	5,084		n/s		n/s		***	
Yes	2,673	52.6	67.7	32.3	25.4	74.6	18.4	81.6
No	2,411	47.4	68.6	31.4	25.2	74.2	4.6	95.4
Vehicle for her/his own use	4,994		n/s		n/s		***	
Yes	936	18.7	67.1	32.9	23.6	76.4	25.4	74.6
No	4,058	81.3	68.8	31.2	26.1	73.9	8.9	91.1
Road safety knowledge	5,115		n/s		n/s		***	
High	301	5.9	67.8	32.2	27.6	72.4	15.3	84.7
Medium	2,110	41.3	67.7	32.3	25.8	74.2	13.4	86.6
Low	2,704	52.9	68.3	31.7	25.1	74.9	10.2	89.8
Involvement in road traffic crash event	4,662		**		***		***	
Yes	1,578	33.8	70.5	29.5	28.6	71.4	19.8	80.2
No	3,082	66.2	67.4	32.6	23.8	76.2	8.2	90.8

Row percentages for each type of exposure add to 100%. Chi-square tests of group differences. Significance levels of variables are presented as: * $p < 0.10$; ** $p < 0.05$; *** $p < 0.0001$ and n/s = not significant.

exposure to talks on road safety education and the least exposure to the anti-alcohol buggy activity (1.3% in León and 2.1% in Guadalajara-Zapopan). Descriptive results show that more than half of the students who were exposed to one of the educational interventions indicated that their attitudes changed as a result (56.6% in Guadalajara-Zapopan and 55.5% in León).

Self-reported attitude change resulting from having been exposed to any law enforcement activity was 45.2% in León and 43.5% in Guadalajara-Zapopan. It is noteworthy that the participants' perceptions of their friends/peers' attitude changing as a result of this intervention was lower than the self-reported change, as in the case of the two other types of interventions. There was no difference in terms of attitude change among those who reported having consumed alcohol and being detained in a sobriety checkpoint and those who had been detained but had not consumed alcohol.

Table 3 shows the variables associated with exposure to three types of interventions explored. In the three models it was found that the student's sex was associated with their exposure; whereas males were less exposed to social marketing and educational interventions, they were predominately exposed to law enforcement activities as compared to females. In terms of age groups, a statistically significant association existed between the exposure to educational activities among youths aged less than 18 years and students aged 22 or more. Student participants

in the city of Guadalajara-Zapopan show a greater exposure to social marketing interventions but less exposure to educational interventions than the students from León. Also having been involved in a road traffic crash event is positively associated with exposure to whichever intervention activity, especially law enforcement activities. Of note, 427 student participants did not answer the question, which explored whether or not they had been involved in a road traffic crash event, whether as a driver or a passenger. These results in the three models presented in Table 3 do not include 8.3% of the youths surveyed.

Regarding factors associated with self-reported behavior change after being exposed to any social marketing intervention, Table 4 shows that males reported less behavioral change than females as well as those who reported involvement in a road traffic collision. Those aged 22 years or more reported more behavior change than the other age groups. Although it was analyzed, the great majority of variables of interest showed no association with self-reported behavior change after exposure to each of the educational and law enforcement interventions; thus these results are not presented.

Finally, it is important to note that knowledge of road safety was not statistically different among those students exposed to social marketing interventions ($p=0.740$) and educational activities ($p=0.847$) and those who had not been exposed. However, youth exposed to law enforcement had a better

Table 2

Participants' exposure to road traffic crash and to different road safety interventions in León and Guadalajara-Zapopan, 2011.

Variables	Guadalajara (N=2,478)			León (N=2,636)		
	% Exposed	% of exposed that reported attitude change		% Exposed	% of exposed that reported attitude change	
		Self*	Peers*		Self	Peers
Was involved in a road traffic collision	32.2	41.9	N/A	29.6	45.9	N/A
Social marketing						
TV	71.1	N/A	N/A	62.2	N/A	N/A
Radio	54.0	N/A	N/A	46.2	N/A	N/A
Web	32.4	N/A	N/A	28.3	N/A	N/A
Billboards, posters	49.6	N/A	N/A	45.0	N/A	N/A
Leaflets, dossiers, etc.	35.7	N/A	N/A	30.8	N/A	N/A
Saw/heard any road safety message	73.3	38.4	11.0	64.3	38.8	13.6
Educational activity						
Talk/Lecture on road traffic injuries organized by students' school	15.9	56.2	22.8	23.2	56.3	22.4
Goggles	6.5	44.1	21.1	4.9	46.2	23.9
Crash simulator	3.6	54.6	36.4	3.3	52.9	34.5
Driving the "anti-alcohol Buggy"	2.1	40.4	28.9	1.3	42.4	36.4
Alcohol testing	2.3	50.0	37.9	2.1	49.1	47.3
Road safety camp	3.2	39.7	25.6	2.2	39.7	34.5
Any educational strategy	21.6	56.6	27.5	29.3	55.5	25.2
Law enforcement						
Stopped at an alcohol check-point	7.8	36.5	28.7	8.9	39.7	25.2
Stopped at an alcohol check-point while driving under the influence	25.5‡	33.3	N/A	35.5§	45.1	N/A
Fined for speeding	7.1	40.9	N/A	5.2	46.7	N/A
Any of these actions	11.8	43.5	N/A	11.8	45.2	N/A

*Self-reported changed in their attitudes toward road safety after being exposed to the intervention(s) under study; +: Opinion on whether their peers had changed their attitude toward road safety after being exposed; ‡48 out of 188 (since 4 respondents did not answer) drivers stopped; §82 out of a total 231 (since 3 respondents did not answer) drivers stopped. N/A: Not applicable.

Table 3

Logistic regression analysis of variables associated with participants' exposure to different road safety interventions.

Variables	Model 1: Exposure to social marketing campaigns	Model 2: Exposure to educational activities	Model 3: Exposure to law enforcement
	AOR (95% CI)	AOR (95% CI)	AOR (95% CI)
Sex (female)			
Male	0.811 (0.712 - 0.923)***	0.822 (0.715 - 0.945)***	2.461 (2.018 - 3.001)***
Age (22 +)			
13-15	1.190 (0.944 - 1.498)	1.609 (1.246 - 2.077)***	0.524 (0.363 - 0.757)***
16-18	1.396 (1.179 - 1.652)***	1.879 (1.554 - 2.272)***	0.769 (0.608 - 0.971)**
19-21	1.179 (0.976 - 1.424)*	1.240 (0.998 - 1.541)*	0.899 (0.691 - 1.169)
Type of transportation most frequently used (Pedestrians)			
Occupant	1.124 (0.979 - 1.291)*	1.021 (0.883 - 1.181)	2.055 (1.693 - 2.494)***
Other	0.889 (0.601 - 1.316)	1.551 (1.041 - 2.312)**	2.172 (1.356 - 3.480)***
City (León)			
Guadalajara	1.452 (1.274 - 1.655)***	0.596 (0.518 - 0.686)***	1.018 (0.842 - 1.231)
Involvement in any road traffic crash event (No)			
Yes	1.209 (1.051 - 1.392)***	1.398 (1.209 - 1.617)***	2.122 (1.754 - 2.569)***
Log likelihood	-2771.0342	-2530.1066	-1530.8209
P-value associated to Hosmer&Lemeshow goodness of fit test	0.61	0.78	0.35

N=4,556. AOR = Adjusted Odd Ratio (adjusted by time of living in the city). The reference category of independent variables is in parenthesis. 95% CI = 95% confidence intervals are in parenthesis. Reported P values are: *<0.10 **<0.05 ***<0.01

understanding of road safety (15.9% vs. 11.7% as compared to those who had not been exposed, $p=0.045$).

Discussion

The results of this study show a potential moderate impact measured as self-reported attitude change resulting from the

three intervention approaches under study. In the two samples (Guadalajara-Zapopan and León) the highest percentage of self-reported attitude change, both the students surveyed as well as their perception of their friends/peers' attitude change, was observed among students self-reporting being exposed to educational activities, followed by law enforcement and social marketing. Nevertheless, it is noteworthy that the absolute

Table 4

Logistic regression analysis of self-reported attitude change after being exposed to social marketing interventions.

Variables	Model 1: Aggregated Social Marketing N= 3152 AOR (95% CI)
Sex (female) Male	0.74 (0.64,0.86)***
Age (22 +) 13–15 16–18 19–21	0.69 (0.53,0.90)*** 0.78 (0.64,0.95)** 0.73 (0.58,0.92)***
Type of transportation (Pedestrians) Occupant Other	1.31 (0.83,2.09) 0.97 (0.83,1.13)
City (León) Guadalajara	1.03 (0.89,1.20)
Time residing in the city (less than a year) One year and more Don't know / Didn't answer	0.81 (0.52,1.24) 0.79 (0.49,1.28)
Involvement in road traffic crash event (No) Yes	0.77 (0.66,0.91)***
Log likelihood	-2081.413
P-value associated to Hosmer&Lemeshow goodness of fit test 0.67	

AOR = Adjusted Odd Ratio. The reference category of independent variables is in parenthesis. 95% CI = 95% confidence intervals are in parenthesis. Reported P values are: * <0.10 ** <0.05 *** <0.01

number of students who reported some attitude change (although with less impact) corresponds with social marketing since the number of students who reported being exposed to social marketing was much higher than those exposed to educational activities. Whether self-reported attitude change results in behavior change is beyond the scope of the present study.

As observed in Table 2, a road traffic crash event was an experience which elicited greater self-reported attitude change among youths in both sites than exposure to social marketing campaigns alone. However, results presented in Table 4 indicate experiencing a road traffic crash is negatively associated with attitude change among those who reported being exposed to social marketing campaigns. Therefore, one possible explanation of this apparently contradictory result could be that attitude change may occur at the time of experiencing the event and any subsequent exposures to social media campaigns may not impact attitude further. Since the present study does not address specific attitudes toward road safety, but rather whether or not the participant experienced a change after a given intervention activity or event, future studies could provide more in depth analysis of types of attitude change.

While interpreting our results it is important to note that isolated strategies that seek to raise awareness, which are impersonal and designed for the greatest coverage, such as social marketing campaigns, tend to be less effective in terms of yielding behavior change.¹⁴ Furthermore, it has even been observed that such social marketing interventions often create more inequality in terms of potential benefits they offer.¹⁵ It is only when a law is vigorously implemented that social marketing campaigns are useful for raising awareness about changes in legislation or about the enforcement of said legislation.¹⁴ Nor is there conclusive evidence that targeted educational programmes are effective.¹⁴ Other studies have found that attitude change is not accomplished by educational interventions alone but the

effort must be reinforced by other campaigns.¹³ It should be noted, seeing results requires a considerable investment of time with constant reinforcements, which apart from being expensive, often have little reach in terms of the general population in the short-to-medium term.^{16,17} Self-reported attitude change among those students who were exposed to goggles, crash simulators, driving the anti-alcohol buggy and alcohol testing: these four interventions led to a prevalence of self-reported attitude change of more than 40% despite reaching less than 7% of the student participants. Human behavior is not only governed by knowledge and individual skills, but also by the surrounding environment and further research is necessary to determine whether attitude change translates into behavior change among participants.

This study has several limitations that should be taken into account when interpreting the results. First, the data collection is based on self-reporting. As is well known, these studies have a tendency to overestimate positive attitudes and underestimate negative ones. The net effect of this trend would be that our results are above those actually present in the study population. Given the impossibility of verifying whether attitude change translated into safer behaviors, we are not able to quantify the magnitude of the bias. Moreover, the students surveyed do not necessarily represent all youth. According to the 2010 census, 88% of youths aged 15–19 years old attend school in León. In Guadalajara-Zapopan this percentage is slightly higher (91%). As expected, this percentage is lower in the 20–24 age group: 59% in León and 64% in Guadalajara-Zapopan.¹⁸ As has been reported, people from lower socio-economic status tend to drop out of school more frequently and thus they would also benefit the least from the IMESEVI interventions, which highlights potential social inequities.¹⁹ Future studies should also try to evaluate the reach of these interventions among non-student youths in these cities. In addition, most social marketing and educational activities were designed for motor vehicle occupants and thus do not address risks among pedestrians or cyclists.

Finally, it is highly plausible that youths exposed to multiple types of interventions might experience greater attitude change than those exposed to only one intervention. Given that one of this study's primary objectives was to compare interventions in terms of their potential effect, attitude change was explored individually by each of the intervention activities and likewise analyzed separately. This impeded the observation of potential interactive effects among the interventions that might be worth studying in future works. In addition, a measure of intensity of exposure was not obtained as part of the current effort and should be addressed in subsequent studies.

Conclusions

The results of this study suggest that social marketing, educational activities, and law enforcement are important interventions for youths, especially in Mexico. Educational activities and law enforcement yielded the most self-reported attitude change, however it is necessary to recognize that this change depends on many additional factors which must be taken into account. Information generated by this study could be useful for local authorities in the intervention areas to inform their activities, particularly as IMESEVI is ongoing.

Contributorship statement

MH and RPN conceived the study. MH, DSC and RPN made preliminary analysis and drafted the first version of this manuscript. JCL, AC, AC, MSCL helped analyze and interpret the data, and revised previous drafts of this paper. All authors approved the final version.

Acknowledgements

This data was collected as part of the Global Road Safety Programme: Mexico supported by Bloomberg Philanthropies, New York, USA. The study sponsors played no role in the study design, collection and analysis of information, interpretation of data, writing of the report, or the decision to submit the paper for publication. Key elements to developing the present study were the facilitations and help provided by authorities at different schools in the intervention cities. We would like to acknowledge the invaluable help provided by Elisa Hidalgo-Solórzano for the development of the sampling strategy in this study and to Adnan A. Hyder for commenting an earlier version of this manuscript. We are in debt for the tireless work provided at every stage of the project to Juan Daniel Vera-López. In addition, we thank María Elena Ávalos Muñoz, Mariana Ambriz, Karina Nuño, Ana Méndez Magaña, Dra. María de Jesús Orozco Valerio and Martha Lucía Castañeda Cediell for their invaluable help during the data collection phase. Finally, we would like to give very special thanks to all of the youth that kindly responded this survey for sharing with us their experiences, allowing us to learn and think about this important public health topic.

Conflict of interest

All authors declare no conflict of interest.

References

- Dirección de Información en Salud. Sistema Nacional de Información en Salud. México, D.F.: Secretaría de Salud; 2012.
- Híjar M, Chandran A, Pérez-Núñez R, Lunnen JC, Martín Rodríguez-Hernández J, Hyder AA. Quantifying the underestimated burden of road traffic mortality in Mexico: a comparison of three approaches. *Traffic Inj Prev* 2012;**13**(Suppl 1):5–10.
- Peden M, Scurfield R, Sleet D, Mohan D, Hyder AA, Jarawan E, et al. *World Report on Road Traffic Injury Prevention*. Geneva: World Health Organization; 2004.
- Híjar M, Vázquez Vela E. Foro Nacional sobre Accidentes de Tránsito en México. *Enfrentando los retos a través de una visión intersectorial*. México: INSP2003; 2009.
- Híjar M, Flores M, Lopez MV, Rosovsky H. Alcohol intake and severity of injuries on highways in Mexico: a comparative analysis. *Addiction* 1998;**93**:1543–51.
- Híjar M, Pérez-Núñez R, Inclán-Valadez C, Silveira-Rodrigues EM. Road safety legislation in the Americas. *Rev Panam Salud Pública* 2012;**32**:70–6.
- INEGI. *Accidentes de tránsito terrestre en zonas urbanas y suburbanas*. 1990–2010. Aguascalientes: INEGI.
- Dirección General de Epidemiología. *Sistema de Vigilancia Epidemiológica de las Adicciones (SISVEA)*. México, D.F.: Secretaría de Salud; 1994–2011.
- Pérez Núñez R, Híjar M, Celis de la Rosa A, Hidalgo-Solórzano E. *Lesiones causadas por el tránsito: hora de poner el freno. Documentos Analíticos. Encuesta Nacional de Salud 2012. Evidencia para la política pública en salud: Instituto Nacional de Salud Pública, Secretaría de Salud; 2012.*
- CENAPRA. Iniciativa Mexicana de Seguridad Vial y Prevención de Lesiones en el Tránsito (IMESEVI). Construcción de Línea Base. Reporte final. México, D.F.: Secretaría de Salud; 2009.
- Hyder AA, Allen KA, Di Pietro G, Adriazola CA, Sobel R, Larson K, et al. Addressing the implementation gap in global road safety: exploring features of an effective response and introducing a 10-country program. *Am J Public Health* 2012;**102**:1061–7.
- Hyder AA, Bishai D. Road Safety in 10 Countries: A Global Opportunity. *Traffic Inj Prev* 2012;**13**(Suppl 1):1–2.
- Hidalgo-Solórzano E, Híjar M, Mora-Flores G, Treviño-Siller S, Inclán-Valadez C. Accidentes de tránsito de vehículos de motor en la población joven: evaluación de una intervención educativa en Cuernavaca, Morelos. *Salud Pública de México* 2008;**50**:S60–8.
- Task Force on Community Preventive Services. Recommendations to reduce injuries to motor vehicle occupants: increasing child safety seat use, increasing safety belt use, and reducing alcohol-impaired driving. *Am J Prev Med* 2001;**21**(Suppl 4):16–22.
- Lorenc T, Petticrew M, Welch V, Tugwell P. What types of interventions generate inequalities? Evidence from systematic reviews. *J Epidemiol Community Health* 2012;**67**:194–7.
- Rose G. Sick Individuals and Sick Populations. *Int J Epidemiol* 1985;**14**:32–8.
- Híjar-Medina MC, Carrillo-Ordaz CE, Flores-Aldana ME, Anaya R, López-López MV. Factores de riesgo de lesión por accidentes de tráfico y el impacto de una intervención sobre la carretera. *Rev Saude Pública* 1999;**33**:505–12.
- INEGI. Censo de Población y Vivienda 2010. Aguascalientes: INEGI2010.
- CEPAL. Panorama social de América Latina, 2010. 1a ed. Santiago de Chile: CEPAL/CEPALSTAT; 2010.