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Effect of Structured Traffic Education Program (STEP) on Knowledge and Commitment Toward Traffic Rules at First Year of Legal Driving in Saudi Arabia

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Abstract

There is no traffic-related education in the general educational curriculum of Saudi Arabia, and teenagers can acquire a licence without receiving traffic education. Consequently, the lack of sufficient traffic education can be a contributing factor to road traffic crashes (RTCs). This quantitative research study implemented a Structured Traffic Education Program (STEP) among 270 male students, all 18 years old. The study assessed demographic and driving experience characteristics and their association with exposure to car crashes and traffic violations. It is also an intervention study where there is statistical testing between baseline and follow-up data collection mediated by an intervention education program. It also analysed the levels of knowledge and self-reported commitment to traffic rules related to risky driving behaviours (RDBs) before and after implementing STEP. It was found that 66.3 percent of participants started driving at an illegal age, and only 1.5 percent underwent traffic education at a related institution. In addition, 67.8 percent of participants were unlicensed, 45.9 percent received at least one traffic violation, 34.1 percent were the mistaken party (at-fault driver) in crashes, and 56 percent watched drifting scenes out of curiosity or desire to be involved. Using a mobile phone while driving was the most prevalent RDB (77.8%). Saudis, drivers who started driving at an illegal age, car owners, and major traffic violators were significantly associated with causing crashes as the mistaken party (at-fault driver). The STEP program improved knowledge, commitment to traffic rules, and patterns related to RDBs. Additionally, driving licences should not be granted without comprehensive traffic education at driving schools. This study aims to contribute to reducing the epidemic of road traffic injuries (RTIs) and emphasises the importance of incorporating traffic education into school curricula.

Key Findings

- In Saudi Arabia, 18-year-olds can acquire a licence without receiving traffic education
- A self-report survey of male students aged 18 years in Saudi Arabia found 66.3 percent of participants started driving at an illegal age and 67.8 percent of participants were unlicensed.
- Implementing the Structured Traffic Education Program (STEP) improved knowledge, commitment to traffic rules, and patterns related to risky driving behaviours.

Introduction

Every year, over a million people are killed in road traffic crashes (RTCs) worldwide (WHO, 2023). An additional 20 to 50 million individuals suffer injuries and disabilities as a result (2023). These fatalities and disabilities impose significant economic burdens on communities, including the cost of treatment, rehabilitation, investigation, and lost productivity for those affected and their caregivers. Young adults aged 15 to 44 years account for 59 percent of global road traffic deaths (WHO, 2021). The World Health Organization (WHO) recognises that despite being a preventable global health issue, road traffic injuries/deaths have been overlooked on the global health agenda for many years. The WHO reported that 1.19 million people are killed in road crashes annually (2023) and if the current trend continues without intervention, it is estimated that road traffic crashes will become the third leading cause of lost disability-adjusted life years (DALYs) by 2030 (WHO, 2021). Studies have reported that environment and vehicle-related factors account for 30 percent and 10 percent of traffic crashes, while human behavioural actions can contribute up to 90 percent of crashes (Assailly, 2017). Data from crash studies demonstrates that the introduction of new traffic regulations results in a subsequent rise in crash frequencies and while the impacts of police enforcement and infrastructural measures are well documented (Dragutinovic & Twisk, 2006), effectiveness of road safety education remains uncertain.

Road traffic injuries can be prevented but require comprehensive action by governments that involves multiple sectors such as transportation, law enforcement, health, and education. It is important to note that only seven percent of the global population resides in countries with stringent and effective regulations to mitigate the risk factors for road traffic crashes (RTCs) and have successfully implemented measures to control them (WHO, 2013). Effective interventions encompass a range of strategies, including the development of educational programs, the incorporation of safety features and infrastructure improvements in urban planning and transportation systems, enhancements to vehicle safety features, and the enhancement of post-crash care for crash victims. Equally important are the interventions that target the behaviour of road users themselves.

Adolescents face an increased risk of road injuries because of their propensity to engage in risky driving behaviours, which often serve developmental purposes such as identity formation, peer group integration, and the pursuit of adult status (Donovan, 1993; Evans & Wasielewski, 1983; Harré et al., 2000; Jonah, 1990; Moffit, 1993; Papadakis & Moore, 1991). In many European countries like France and Spain, road safety education has its place within the curriculum in primary and secondary schools (Catchpole & DiPietro, 2003). The primary objective of every road safety education program is to diminish the frequency of crashes and the resulting injuries. Consequently, assessing the success of road safety education programs involves considering the reduction in crashes as the paramount evaluation

criterion (Dragutinovic & Twisk, 2006). Many studies have reportedly shown the importance of traffic education programs for adolescents (Cutello et al., 2020; Markl, 2016; Senserrick et al., 2009). Remarkably, our literature review revealed that, to date, there has been no comprehensive Structured Traffic Education Program (STEP) focused on educating young individuals about traffic rules related to risky driving behaviours in the Jazan region of Saudi Arabia. This suggests that our country needs research insights to provide evidence-based recommendations for policymakers and higher authorities to implement effective policies and interventions aimed at minimising the prevalence of road traffic crashes and improving road safety.

The aims of this study were to assess demographic and driving experience characteristics and their association with exposure to car crashes and violations among 18-year-old male students. Additionally, to evaluate their baseline levels of knowledge and self-reported commitment to traffic rules related to risky driving behaviours (RDBs) and measure the changes in knowledge and commitment following STEP implementation.

Methodology

This quantitative study was an intervention study that investigated the effectiveness of the Structured Traffic Education Program (STEP). Questionnaires were used at baseline and follow-up post program. Ethical approval was obtained from the King Khalid University committee. All items and purposes of the questionnaire, as well as anonymity, confidentiality, and privacy, were explained in the consent form. Each participant had the choice to withdraw at any part of the study.

Study Area and Population

The study was carried out in Jazan, Saudi Arabia. Participants were all male, aged 18 years and attending their third year of secondary education. Through personal communication with the Jazan Education Directorate (JED), it was determined that there were five government-funded secondary schools for males in Jazan city. Among these schools, there were 1,364 students, with 466 of them enrolled in the third-year classes.

The exclusion criteria were males aged 18 years who had never driven a car or had not driven a car in the week prior to the intervention, or during the intervention week, as well as those who were absent during the baseline assessment or throughout the course of the intervention. Additionally, students from private schools and international schools were excluded because they might have received traffic education, potentially influencing the evaluation of the intervention program, as well as differing teaching environments and administrative regulations in these schools.

Data Collection Instrument

The data collection tool used in this study was adapted from a previously designed self-administered question-

Table 1. Chronology and approach of the study design

Stage 1 (Questionnaire 1)		Stage 2 (STEP)	Stage 3 (Questionnaire 2)
Cross-sectional	Pre-test	Intensive Interventional Course	Post-test
Demographics Risky driver behaviours (RDBs) Crashes Violations	Knowledge Commitment (Traffic Rules)		Knowledge Commitment (Traffic Rules)

Table 2. Intensive STEP Activities

Day (45min/ day)	Time		
	15 min	25 min	5 min
Day 1	Self-Administered Questionnaire (Pre-Test Assessment)	Epidemiology of car crashes in KSA (Lecture 1)	Students' projects* (Brainstorming 1)
Day 2	Street Terrorism (Video Session)		
Day 3	Highlights on Traffic Rules and Regulation Systems Related to RDBs in Saudi Arabia (Lecture 2)		Students' projects (Brainstorming 2)
Day 4	Whose Priority? Different Traffic Situations. (Workshop 1)		
Day 5	Find Out the Driver Error? Preventable Car Crashes Scenarios (Workshop 2)		
Day 6	Students' projects (Presentations)		
Day 7	Self-Administered Questionnaire (Post-Test Assessment)		Award best project winners and Closing

*Students were free to choose the topics of their interest.

naire, that was originally in the Arabic language (Supplementary Data 1 and 2). This questionnaire was obtained from a similar project, and the authors approved the use of the questionnaire in this study (Arishi & Al-Tell, 2012).

The questionnaire included a unique code for students known as the Student Unique Identifier (SUI). This code linked participant data in the pre-test and post-test phases. The code included the student's school number, class number, specialty, seat number in the classroom (i.e., table number), and the last four digits of their mobile phone number.

Intervention Program

A total of 315 minutes (45 minutes per day) was allocated over seven days for the intensive educational intervention. The project intervention, the Structured Traffic Education Program (STEP), was designed with the assistance of a social health academic professional from Jazan University. The designed STEP outline was evaluated by a lecturer from the Department of Community Medicine at Jazan University for review and validation. STEP consists of two assessment tests, two lectures, two workshops, two brainstorming sessions, one video session, and one student presentation by the winner among the top 20 in the student competition (Table 1, Table 2).

Lectures related to the epidemiology of RTCs in fatal and serious injury crashes, and traffic rules related to RDBs, explaining what they are and how to comply. Workshops were practical, class-based sessions that used videos to simulate real-world crash scenarios, for example, improper overtak-

ing or various situations involving cars at crossroads (e.g., determining priority). All students were expected to participate in these discussions. The video session was the most favoured educational resource; it was concise, informative, and had easily understandable messages. The brainstorming sessions aimed to prepare students for their final presentations, which were an integral part of their participation in this project. Student groups collaborated as a team on a project of their choice, with the goal of transferring the knowledge they gained from STEP to another community. Involving students in the educational process helped them digest the material and share what they had learned with their families, friends, or relatives. All group presentations took place on the sixth day, before the second assessment, ensuring students received the traffic information we intended to teach. On the last day of STEP, the winning team with the best project among the top five projects was selected by a school representative, highlighting the role of schools in STEPS, and awarded a surprise prize (Cash-300SR).

Projects were evaluated using the Students' Project Evaluation Checklist conducted by a panel of three evaluators: two lecturers from the Department of Community Medicine at Jazan University and a school representative. The items and structure of the intervention remained consistent throughout all course sessions to minimise variability in implementation.

To minimise recall bias, all questions were limited to a one-week period before the first and second stages of data collection, except for two specific cases: 1) 10 years for

questions related to deaths in the family due to a car crash, and 2) from the age of starting to drive for questions related to violations and crashes. To prevent inter-observer bias, all data collection and STEP activities were carried out solely by the researcher. To avoid intra-observer bias, all STEP sessions followed the same structure and design, and were presented in a consistent environment to the greatest extent possible.

At the end of the intervention education program, all students were expected to receive higher scores in the post-test compared to the pre-test, which measures the benefits derived from the program anticipated to be reflected in their driving behaviours later on.

Statistical Methods

The questionnaire's validity and reliability were assessed in the original article by Arishi & Al-Tell (2012) through correlation coefficients and Cronbach's alpha coefficient. Knowledge statement items in the questionnaire were coded as zero for inadequate knowledge and one for adequate knowledge. Similarly, commitment statement items were coded as zero for no commitment, one for occasional commitment, two for mostly commitment, and three for full commitment behaviours. All analyses were conducted using the IBM SPSS v22 statistical package. A five-step analysis was performed:

1. Descriptive analysis was carried out for demographic data, information related to driving experience, and risky driving behaviours (RDBs).
2. A chi-square test for independence was conducted to investigate the association between exposure to traffic crashes as a mistaken party (at-fault driver) or receiving traffic violations and potential risk factors associated with them.
3. A paired samples t-test was performed to assess the impact of the intervention on students' knowledge and commitment scores. This involved comparing the means of the total scores from the pre-test and post-test assessments for both variables of interest.
4. An independent samples t-test, along with Levene's test for equality of variances, was conducted to compare the differences in scores (difference = post-test score - pretest score, i.e., improvement score) between two independent groups, where the difference was defined as the post-test score minus the pretest score.
5. A one-way analysis of variance (ANOVA) between groups, with Levene's test and robust tests for equality of variances and means, respectively, and post hoc tests for multiple comparisons between groups, was conducted to explore the impact of multiple group factors on the differences in scores (improvement scores).

The level of significance was set at ≤ 0.05 with a 95% confidence interval.

Results

Demographic characteristics

A total of 270 male students, all 18 years old and enrolled in the third year of secondary school, met all the inclusion and exclusion criteria for this analysis. More than 75 percent of students ($n=203$) were Saudi nationals, while the remaining students were non-Saudis (24.8%). The non-Saudi nationalities included Yemeni (7.04%), Egyptian (5.93%), Syrian (2.59%), and Sudanese (2.22%). The remaining students (7.04%) did not specify their nationalities.

Driving experience characteristics

The mean age at which participants commenced driving was 15.4 years ($SD \pm 1.7$ years). Notably, some participants initiated driving at an exceptionally early age. A substantial majority, more than 66 percent of students, commenced driving prior to reaching the legal age of 18 years, and even before the exceptional age of 17 years. Interestingly, only 4 students (1.5%) had received formal traffic education at an accredited driving institution, while a significant proportion (75.2%) learned to drive with the assistance of their family members. Additionally, a notable 12.6 percent of students indicated that they acquired their driving skills solely through observation and later practiced independently. The majority of students (67.8%) were operating motor vehicles without a valid driving licence, making their driving illegal, while the remaining students held either permanent or temporary licences (Table 3). Approximately 9.6 percent of students reported a considerable number of traffic violations. An issue of concern was the observation of drifting scenes, including risky sports and inappropriate car use, reported by 32 students (11.9%). Further details pertaining to the participants' driving experiences are in Table 3.

Association between exposure to traffic crashes or violations and demographic or driving factors

The involvement of students in car crashes as an offending party was statistically significant in relation to factors such as car ownership, Saudi nationality, illegal driving age, and receiving traffic violation notifications (Table 4). Possession of a driver's licence was associated with greater involvement in crashes than not having a licence; in other words, licensed students were involved in more crashes than unlicensed students. In the same context, students from families with an average income of $\geq 15,000$ Saudi Riyals (approximately AUD \$4,000) were associated with being involved in crash as the at-fault driver and this association was statistically significant with a two-tailed p-value of 0.03 (Table 4).

Saudi nationals, particularly sons of working mothers, tended to start driving at a young, illegal age in their own cars and were the most frequent recipients of traffic violations compared to students who were Saudi nationals whose mothers did not work (Table 4). Students who were

Table 3. Students' characteristics related to driving experience (n=270)

Variable	N	%
Age at the commencement of driving (years) Mean=15.4 (SD $\pm$ 1.7)		
10	2	0.7
11	4	1.5
12	17	6.3
13	24	8.9
14	23	8.5
15	27	10.0
16	82	30.4
17	91	33.7
How student learned to drive		
Family assistance	203	75.2
Friends/relatives' assistance	29	10.7
Institution of driving education	4	1.5
By observation and practising alone	34	12.6
Has a driving licence		
No	183	67.8
Yes, I have an official driving licence	67	24.8
Yes, I have a temporary permit	20	7.4
Has own car		
No	138	51.1
Yes	132	48.9
Number of received violation announcements		
0	146	54.1
1	55	20.4
2-10	40	14.8
>10	3	1.1
Uncountable	26	9.6
Involved in a traffic crash and was the mistaken party		
No	178	65.9
Yes, once	69	25.6
Yes, twice	23	8.5
In the last 10 years, a family member died in a traffic crash		
No	209	77.4
Yes, one person	43	15.9
Yes, two people	16	5.9
Yes, three or more people	2	0.8
Type of car planned to buy		
Economical car at a reasonable price	77	28.5
Car with a strong engine and high-speed	46	17.0
Car looks; beautiful and stylish	147	54.4
Like to watch drifting scenes		
No	119	44.1
Yes, I love it, and I wish to be involved in those scenes	32	11.9
Watch them sometimes just out of curiosity nothing more	119	44.1

more likely to report receiving a traffic violation were sons of families with an average income of less than 15,000

Saudi Riyals and licensed students, with two-tailed p-values of 0.03 and less than 0.001, respectively.

Table 4: Factors associated with involvement in a traffic crash as a mistaken party and traffic violation (n=270)

Demographic / Driving experience factor	Involved in a traffic crash as the mistaken party		X ²	p-value (2-tailed)	Has received a traffic violation announcement		X ²	p-value (2-tailed)
	No N (%)	Yes N (%)			No N (%)	Yes N (%)		
Owens a car								
No	113 (81.9)	25 (18.1)	30.56	<0.001	101 (73.2)	37 (26.8)	39.97	< 0.001
Yes	65 (49.2)		67 (50.8)		45 (34.1)		87 (65.9)	
Average family income								
≥ 15000	84 (59.6)	57 (40.4)	4.73	0.030	67 (47.5)	74 (52.5)	4.57	0.033
< 15000	94 (72.9)		35 (27.1)		79 (61.2)		50 (38.8)	
Nationality								
Saudi	118 (58.1)	85 (41.9)	20.77	<0.001	92 (45.3)	111 (54.7)	23.84	< 0.001
Non-Saudi	60 (89.6)		7 (10.4)		54 (80.6)		13 (19.4)	
Mother occupation								
Not working					101 (59.4)	69 (40.6)	4.70	0.030
Working					45 (45.0)		55 (55.0)	
Age at the commencement of driving								
10-16 years (illegal age)	47 (48.5)	50 (51.5)	19.38	<0.001	25 (25.8)	72 (74.2)	47.06	< 0.001
17-18 years (exceptional and legal age)	131 (75.7)		42 (24.3)		121 (69.9)		52 (30.1)	
Has a driving licence								
No	135 (73.8)	48 (26.2)	14.49	<0.001	119 (65.0)	64 (35.0)	26.09	< 0.001
Yes	43 (49.4)		44 (50.6)		27 (31.0)		60 (69.0)	
Ever received a traffic violation announcement								
No	121 (82.9)	25 (17.1)	43.90	< 0.001	101 (59.4)	69 (40.6)		
Once	30 (54.5)		25 (45.5)		45 (45.0)			
More than once	27 (39.1)		42 (60.9)					

Change in level of knowledge and commitment towards traffic rules related to RDBs after STEP implementation

There was an increase in score for both total commitment and knowledge scores following participation in the STEP program. The mean commitment score during the pre-test assessment was 51.07 (± 16.31), which subsequently rose

to 64.79 (± 12.70) during the post-test assessment, out of a maximum achievable score of 83. The mean knowledge score during the pre-test assessment was 8.01 (± 3.35), and it increased to 12.04 (± 3.36) during the post-test assessment, with a maximum achievable score of 16. This increase in mean scores for students' commitment was statistically significant, with commitment scores of 13.71 (± 10.44), yielding a t-value of 21.59 and a one-tailed p-

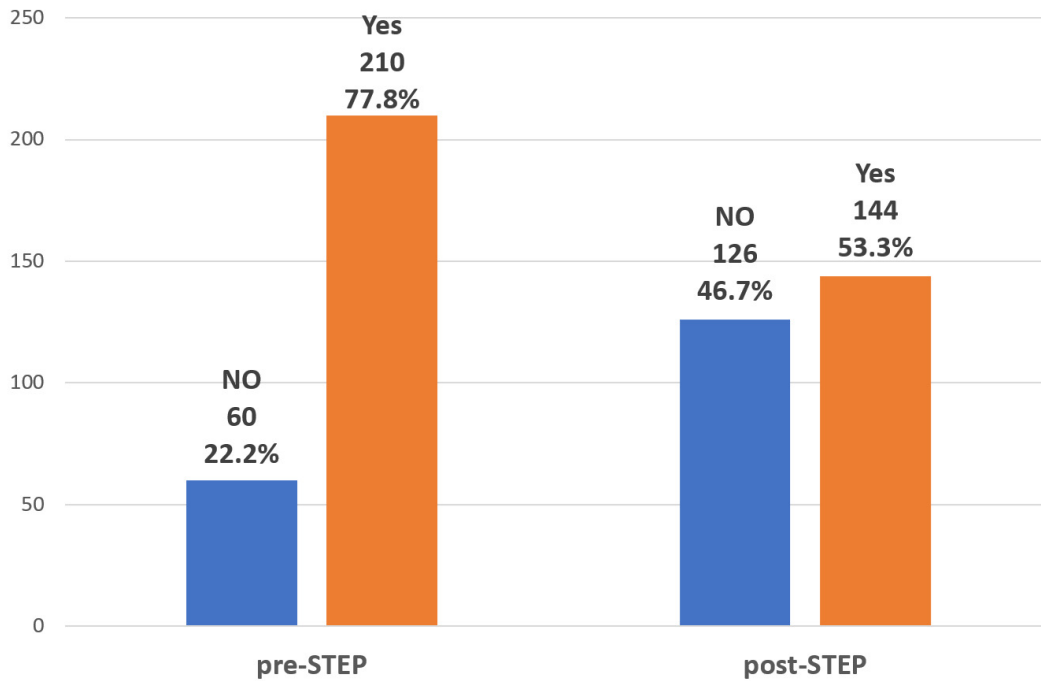


Figure 1. Prevalence of students using mobile phone while driving before and after STEP (n=270).

Table 5. Effect of STEP on mean difference between pre- and post-assessments of commitment and knowledge (n=270)

Parameter	Pairs	Mean $\pm$ SD	Mean Difference $\pm$ SD	t	p (1-tailed)
Total Commitment Score	Pre-test	51.07 $\pm$ 16.32	13.71 $\pm$ 10.44	21.59	<0.001
	Post-test	64.76 $\pm$ 12.70			
Total Knowledge Score	Pre-test	8.01 $\pm$ 3.35	4.03 $\pm$ 2.76	23.95	<0.001
	Post-test	12.04 $\pm$ 3.35			

value of <0.001. Similarly, the increase in mean scores for students' knowledge was also statistically significant, with scores of 4.03 ($\pm$ 2.76), a t-value of 23.95, and a one-tailed p-value of <0.001 (Table 5).

The differences in commitment and knowledge scores were assessed in relation to potential associated factors and nationality and average family income were found significant for commitment scores, with one-tailed p-values of less than 0.05 (Table 6).

Students possessing permanent driving licences, temporary driving permits, or those without licences were compared to assess differences in commitment and knowledge scores. We observed that a statistically significant difference existed only in the case of knowledge among the three groups, with an F-value of 3.11 and a p-value of 0.046. Differences in mean values for the educational background of the parents (Father/Mother), possession of a driving licence, and other factors were not statistically significant (Table 7).

Tables 8 presents examples of the top 10 Risky Driving Behaviours (RDBs) and the top 10 areas of insufficient knowledge both before and after the implementation of the

STEP intervention. These tables illustrate a distinct shift in the items listed, indicative of notable improvements. It is important to note that the order of RDBs and knowledge items is solely determined by the outputs of the current project. Additionally, there were other instances of insufficient knowledge not covered within the aforementioned 10 items, which were also evident in students' responses concerning the rule of not permitting driving below the age of 18 years. Approximately 35.9 percent of respondents either believed that driving below this age was allowed or were uncertain about the regulation.

The predominant behaviour observed among participants, accounting for more than three-quarters of respondents, was the use of mobile devices while driving for various purposes, including calling, texting, reading, and other activities. Following the implementation of STEP, there was a remarkable reduction in the prevalence of this behaviour, although it remained more than half (Figure 1).

Table 6. Differences between two independent groups in relation to demographics, driving experience and scores (commitment and knowledge) (n=270)

Demographic / Driving experience factor	Difference between means of commitment scores		t	p (1-tailed)	Difference Between Means of Knowledge Scores		t	p (1-tailed)
	N	M ± SD			N	M ± SD		
Nationality								
Saudi	203	14.76 ± 10.53	2.48	0.007	203	4.19 ± 2.78	1.66	0.049
Non-Saudi	67	11.30 ± 7.77			67	3.55 ± 2.63		
Average family income (SR/ Month)								
≥ 15000 (≥ approx. AUD\$4,000)	141	15.00 ± 10.91	1.90	0.029	141	3.96 ± 2.56	0.47	0.318
< 15000 (< approx. AUD\$4,000)	129	12.70 ± 8.82			129	4.12 ± 2.95		
Owns a car								
No	138	13.52 ± 11.36	0.64	0.262	138	4.07 ± 2.73	0.24	0.406
Yes	132	14.30 ± 8.41			132	3.99 ± 2.78		
Age at the commencement of driving								
10-16 years (illegal age)	97	15.15 ± 10.29	1.55	0.062	97	3.92 ± 2.57	0.52	0.303
17-18 years (legal and exceptional age)	173	13.20 ± 9.82			173	4.09 ± 2.85		
Involved in a traffic crash and were the mistaken party								
No	178	13.04 ± 10.47	1.97	0.025	178	3.93 ± 2.68	0.88	0.189
Yes	92	15.57 ± 8.86			92	4.23 ± 2.88		
In the last 10 years, a family member died in a traffic crash								
No	209	14.29 ± 10.20	1.19	0.118	209	4.01 ± 2.78	0.21	0.417
Yes	61	12.56 ± 9.32			61	4.09 ± 2.67		
Father Occupation								
Not working	52	12.54 ± 7.68	1.09	0.138	52	3.94 ± 2.89	0.27	0.396
Working	218	14.22 ± 10.49			218	4.06 ± 2.72		
Mother Occupation								
Not working	170	14.16 ± 10.39	0.57	0.286	170	3.96 ± 2.85	0.58	0.282
Working	100	13.45 ± 9.39			100	4.16 ± 2.57		

Table 7. Difference between means of commitment scores and knowledge scores in relation with demographic and driving experience factors from multiple independent groups. (n=270)

Demographic / Driving experience factor	Difference Between Means of Commitment Scores		F	p (1-tailed)
	N	M ± SD		
Father Education				
Not educated	12	13.75 ± 6.90	0.28	0.754
Secondary or less	122	16.00 ± 11.43		
University and above	136	13.46 ± 8.87		
Mother Education				
Non-educated	44	13.55 ± 8.11	0.18	0.839
Secondary or less	107	14.35 ± 11.29		
University and above	119	13.63 ± 9.49		
Has a driving licence				
No	183	13.89 ± 10.62	0.02	0.985
Yes, I have a permanent driving licence	67	14.03 ± 8.80		
Yes, I have a temporary permit	20	13.60 ± 8.44		
Demographic / Driving experience Factor	Difference Between Means of Knowledge Scores		F	p (1-tailed)
	N	M ± SD		
Father Education				
Non-educated	12	3.08 ± 3.55	0.97	0.382
Secondary or less	122	4.20 ± 2.90		
University and above	136	3.97 ± 2.53		
Mother Education (n=270)				
Non-educated	44	4.61 ± 3.09	1.28	0.280
Secondary or less	107	4.01 ± 2.88		
University and above	119	3.84 ± 2.48		
Has a driving licence				
No ^{*A}	183	4.03 ± 2.71	3.11	0.046 ^{*1}
Yes, I have a permanent driving licence ^{*B}	67	4.43 ± 2.91		
Yes, I have a temporary permit ^{*C}	20	2.70 ± 2.18		

*1: Post-Hoc Comparisons test indicated that ^{*B} is significantly different from ^{*C}. ^{*A} did not significantly differ from either group.

Discussion

Teaching and instilling safe traffic behaviour in children is a time-consuming endeavour. This is primarily due to the need for children to adapt to the rapidly changing traffic situations and comprehend traffic regulations. Unlike other subjects, traffic education is not part of the educational curriculum in Saudi Arabia, and it is possible to obtain a driver's licence without prior traffic education. Thus, for the current study, we implemented an intensive Structured Traffic Education Program (STEP) to address this issue. Driving before the age of 18 years is prohibited but still occurs, constituting a blatant violation of traffic regulations in Saudi Arabia. By focusing on 18-year-old teenagers, we are concentrating on the first year of official driving according to Saudi traffic regulations. By assessing their knowledge and providing them with an intensive dose of traffic education, we aim to emphasise this critical issue for policymakers.

Students with limited knowledge of road safety rules are at a greater risk of experiencing road traffic injuries (Dong et al., 2011). A prior study reported that drivers involved in crashes and frequent traffic violations exhibit a higher frequency of Risky Driving Behaviours (RDBs) on a daily basis (Evans & Wasielewski, 1982; Fergusson et al., 2003; Ivers et al., 2009; Merrikhpour et al., 2013; Vassallo et al., 2007; Yue et al., 2020). In our study, we employed traffic car crashes as a measure of identifying students who had been identified as at-fault in crashes and traffic violations as tools to gauge the burden of RDBs and attempted to correlate most of the issues with these two variables. Our findings indicated that driving at a very early age, before the legal limit, is a significant concern, with approximately 35.9 percent of students lacked knowledge of or possessed incorrect information regarding the legal driving age. Underage driving served as an indicator of risky behaviour, potentially leading to traffic violations and crashes. Our study revealed a significant association between underage driving and involvement in RTCs as offending parties, as well as

Table 8. Pattern of top 10 RDBs* and insufficient knowledge items before and after STEP implementation (n=270)

RDB (Risky Driving Behaviour)		Before STEP		After STEP	
		N %		N %	
1	Using mobile phone while driving (calling, texting, reading)	210	77.8	144	53.3
2	Continue driving even during drowsiness and fatigue	95	35.2	47	17.4
3	Do not buckle up at all (seat-belt)	86	31.9	25	9.3
4	Do not care about U-turns if allowed or not allowed	63	23.3	23	8.5
5	Going backward (reversing) on the highway	52	19.3	18	6.7
6	Allow passengers to put parts of their bodies out of the window	49	18.1	15	5.6
7	Overtake using the road shoulder**	47	17.4	20	7.4
8	Insist on overtaking	47	17.4	18	6.7
9	Compete with other cars while overtaking by increasing my car speed	43	15.9	7	2.6
10	Overtake whatever the signals or lines that prevent it	41	15.2	10	3.7
General Traffic Rules		Before STEP		After STEP	
		N	%	N	%
1	A driver is responsible for passengers not using a seatbelt and bears the consequences of that.	185	68.5	104	38.5
2	Traffic police have the right to stop you or give you a traffic violation when you break the speed limit even if there is no traffic sign determining speed.	185	68.5	91	33.7
3	It is strictly forbidden to sit children under the age of ten years in the front seat of the car, except in the absence of a rear car seat.	174	64.4	77	28.5
4	While driving at night; you should slow down less than the maximum allowable speed.	163	60.4	80	29.6
5	If there is no sign, the maximum speed should not exceed 80 km/h inside the city and 120 km/h outside the city.	143	53	75	27.8
6	You must comply with the instructions of the traffic police, even if it is against the traffic signal or sign boards.	142	52.6	33	12.2
Priority Rules					
7	At mountain roads the priority is for ascending cars.	185	68.5	112	41.5
8	Two vehicles beside each other, the first one intends to change direction and the second one going straight; the priority for second car	126	46.7	76	28.1
9	The priority for cars around the roundabout.	58	21.5	39	14.4
10	The priority is for cars going on the main road but not for those coming from the side road.	55	20.4	25	9.3

* According to current data only. ** The lane after the yellow line.

an increased frequency of traffic violations. This correlation aligns with the findings from a study conducted in Texas that found that between 1995 and 2000, 4,170 crashes were attributable to underage drivers (Huber Jr et al., 2006).

Sound driving learning methods were mostly not present in our participants. Students who initiated driving solely through observation of other drivers, without any supervision posed the greatest risk. These students used family cars without permission and lacked any prior driving experience, which is a highly dangerous practice. Additionally, driving without a licence served as an indicator of risky behaviour. In our study, most students were eligible to obtain a licence but did not possess one. A study conducted on 5,235 Saudi males aged 15 years and above revealed that approximately 86 percent of participants engaged in at least one risky behaviour while driving, with unlicensed drivers being predominantly involved in RDBs (El Bcheraoui et al., 2015). The United States, especially

southern and western states, have a higher percentage of fatal crashes involving young unlicensed drivers (Blows et al., 2005; Hanna et al., 2006, 2012). Our study demonstrated a significant relationship between possessing a driver's licence and improved knowledge among students, aligning with the results of a similar study showing that licensed drivers exhibit greater awareness of traffic rules and RDBs (McKnight & Peck, 2003). Furthermore, participants with their own cars were more frequently involved in car crashes as offending parties and recipients of traffic violations compared to students who did not own a car. A previous study also reached a similar conclusion for young male drivers, indicating that students who own cars tend to exhibit impulsive behaviours that lead to more crashes and violations (Dahlen et al., 2005).

In the case of students with early driving experience, getting caught, suspended (arrested), or at least receiving a traffic violation is an ominous sign for their future driving

habits. This includes students in our study who accrued numerous violations from the very beginning of their driving experience. Similarly, students who plan to purchase high-speed, powerful-engine cars, as well as those who observe Tafheet (an illegal street racing trend, where people drift cars left and right at dangerously high speeds) scenes out of curiosity or with the intent to participate or mimic them, represent potential contributors to RTCs and traffic violations. These unconventional thoughts or deviant behaviours may be rooted in personality traits, desire for thrill-seeking while driving, and propensity for risky road use. A study conducted in the United Kingdom investigated the associations between risky road user behaviour and individual characteristics among teenagers. Their findings concur with our study, with associations found between sensation-seeking, deviant behaviour, and attitudes toward risky road behaviour, particularly among participants around 14 years of age (Waylen & McKenna, 2008). Surprisingly, our study showed that mothers' employment was linked to more traffic violations, likely because higher family income makes it easier for children to own cars at a younger age. Additionally, our study indicates that nationality influences commitment to traffic rules related to driving behaviours, with Saudis showing more improved knowledge and commitment compared to non-Saudis.

Both knowledge and commitment to traffic rules pertaining to RDBs improved following the implementation of STEP in our study. This indicates that the course successfully achieved its objectives and underscores the significant role that traffic education can play in reducing RDBs and RTCs. Despite the brevity and intensity of our educational course, it yielded beneficial results, which prompts a critical question: How long will this knowledge and commitment be sustained? In reality, sustaining this knowledge and commitment requires continuous education and practice of traffic rules. The positive effects on RDBs, when converted into good behaviour, will take time to manifest fully. Therefore, our research emphasises that traffic education is an ongoing process that should not be discontinued. While the improvement scores for both knowledge and commitment did not reach optimal levels, this is normal as complete change or improvement does not occur instantaneously. This underscores the importance of ongoing education regarding road traffic rules.

Using a mobile phone while driving emerged as the riskiest behaviour in our study, leading to its inclusion as a highlighted variable in the top ten. This behaviour remained prevalent both before and after the STEP intervention. Traffic education programs have their limitations, as the knowledge imparted may not necessarily translate into behaviour in adolescents, or they can instil a level of confidence that does not match their skills. Also, early licensure may increase the probability of a crash risk (Raftery & Wundersitz, 2011). Based on our study results STEP emerged as a good initiative for enhancing knowledge related to RDBs. Further research with sustained positive outcomes is needed to make programs like STEP accessible to students as part of the school curriculum.

Study limitations

While this study provides important insights into attitudes and behaviours of young drivers, the focus of the study was male students. Although the ban on females being permitted to drive was lifted in 2018, the number of females with a driver's licence in Saudi Arabia remains low. It is not known if the insights from male students are shared by female students and future research is needed to understand more about the licensing and driving experiences for females in Saudi Arabia. The study was also limited due to the lack of a control group. This study only compared pre and post changes of one group who received STEP. The results related to commitment part of STEP were based on self-reported reactions and not on real observations of students' behaviours. Furthermore, the STEP was not evaluated against future crash risks or resulting deaths or injuries.

Conclusions

Among 18 year-old males, the Structured Traffic Education Program (STEP) demonstrated effectiveness in enhancing their understanding of safe and responsible driving and dedication to traffic rules pertaining to hazardous driving conduct. Our findings indicate a reduction in risky driving behaviours among program participants. However, we did not examine if this translates to a lower risk of road traffic crashes (RTCs). More research is needed to further establish the benefits of STEP.

Author contributions

Yahya A. Maslamani conceptualised this research and oversaw all stages of data collection and manuscript preparation. Yahya A. Maslamani, Anwar M. Makeen, and Majed A. Ryani conducted the systematic review and wrote the first draft of the manuscript. Yahya A. Maslamani developed the search strategy and supervised the systematic review. Ahmed Y. Abouelyazid and Mohammad A. Jareebi completed statistical analyses and prepared figures. Ahmad A. Bahri contributed data and critically reviewed the manuscript. All authors reviewed and approved the final version of the manuscript.

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Human Research Ethics Review

Ethical approval was obtained from the King Khalid University committee (HA06B001), record number (REC#20160304).

Data availability statement

The authors declare that no materials, data nor protocols were used.

Conflict of Interest Statement

The authors declare no conflict of interest.

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