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Are Adult Driver Education Programs Effective? A Systematic Review of Evaluations of Accident Prevention Training Courses

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Abstract

Road safety training programs are commonly used to raise awareness of risky attitudes and behaviours. The evaluation of road safety education courses aimed at children is carried out with some assiduity. However, this does not usually occur in courses aimed at young people and adults. The present systematic review aims to identify studies that evaluate the effectiveness of road safety training programs in this population group. This systematic review followed the PRISMA methodology, by which the relevant articles based on the research term were identified. A total number of 1,336 indexed articles were filtered, and a final selection of 22 articles directly addressing the issue was obtained. Search strategies were developed and conducted in WOS, Scopus, NCBI, Google Scholar and APA databases. The selected articles indicate that the effects of road safety training programs in adults are mild to moderate. Their effectiveness is substantially increased when they are aimed at improving risk perception and decision making rather than training in driving skills. In any case, more evaluations of these courses are needed to identify which tools are effective and which should be replaced by new behaviour modification methods in the design of future driver education programs.

Keywords: road education, training courses, road users, road traffic, behaviour.

¿Son Efectivos los Programas de Educación Vial para Adultos? Una Revisión Sistemática de las Evaluaciones de los Cursos de Formación en Prevención de Accidentes

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Resumen

Los programas de formación en seguridad vial se utilizan habitualmente para concienciar sobre las actitudes y comportamientos de riesgo. La evaluación de los cursos de educación vial dirigidos a niños se realiza con cierta asiduidad. Sin embargo, esto no suele ocurrir en cursos dirigidos a jóvenes y adultos. La presente revisión sistemática tiene como objetivo identificar estudios que evalúen la efectividad de los programas de capacitación en seguridad vial en este grupo de población. Esta revisión sistemática siguió la metodología PRISMA, mediante la cual se identificaron los artículos relevantes en función del término de investigación. Se filtraron un total de 1.336 artículos indexados y se obtuvo una selección final de 22 artículos que abordan directamente el tema. Las estrategias de búsqueda se desarrollaron y realizaron en las bases de datos WOS, Scopus, NCBI, Google Scholar y APA. Los artículos seleccionados indican que los efectos de los programas de formación en seguridad vial en adultos son de leves a moderados. Su eficacia aumenta sustancialmente cuando su objetivo es mejorar la percepción del riesgo y la toma de decisiones en lugar de la formación en habilidades de conducción. En cualquier caso, se necesitan más evaluaciones de estos cursos para identificar qué herramientas son efectivas y cuáles deberían ser reemplazadas por nuevos métodos de modificación del comportamiento en el diseño de futuros programas de educación vial.

Palabras clave: educación vial, cursos de formación, usuarios de la vía, tráfico vial, comportamiento

Traffic accidents are one of the public health problems of greatest concern in contemporary society (González et al., 2020; Apeagee & Haaor, 2020). This has led to an increase in the number and type of preventive measures aimed at promoting responsible behaviour on the road (Mansuri, et al., 2015). This endeavour brought about institutions and social awareness, which helped reduce the number of accidents in recent times. Despite this, every year, 1.35 million people die on the road as a result of traffic accidents (WHO, 2018).

In this line, with the aim of reducing road hazards, different activities are developed (Alecú & Tudor, 2019). Mainly such measures are focused on the field of infrastructure care on the road (DiGioia et al., 2017; Alonso et al., 2021a), the improvement of vehicle conditions (Linder & Svensson, 2019) and, the increase of road awareness and education (Faus et al., 2021). Initiatives related to the latter point are of particular importance as traffic accidents mostly reside in the human factor (Bucsuházy et al., 2020). This is an issue of great concern for institutions working on prevention (Paricio et al., 2018). Thus, traffic regulations and sanctions (Zhang et al., 2019) or communication campaigns and advertisements (Staton et al., 2016) are some of the most important measures developed in this area.

In this sense, road safety training stands out as one of the most reproduced measures worldwide, both from government agencies and private companies (Assailly, 2017). The principal aim of such programs is to influence the population, trying to positively affect their behaviours and attitudes as road users (Goniewicz et al., 2016).

The typology of training programs varies greatly depending on the target audience. Road safety education is necessary for the entire population because traffic accidents are a public health problem in which all members of a society are involved (Dai et al., 2018). Therefore, road safety education focuses on children, youth and adults, as well as drivers, pedestrians, cyclists, motorcyclists and other road users (Fausto et al., 2021; Koekemoer et al., 2017; Treviño-Siller et al., 2017), always adapting the communication strategy and the methodology and content of the programs to the characteristics of the population group to be addressed.

The variability of road safety education programs is enormous. Usually, the subject matter of road safety education programs focuses on the prevention of risk behaviours such as speeding, distractions or alcohol and drug

consumption while driving (Daniels et al., 2019). In other words, they are preventive initiatives aimed at preventing the accident from occurring (Garzón et al., 2017). However, there are also programs designed to know how to act in the presence of an accident and, therefore, are aimed at minimising the consequences derived from it (Manso & Castaño, 2008). In this sense, one of the key elements in the effectiveness of the programs is to understand the target audience and adapt the communication strategy, the activities to be carried out, and the subject matter to be addressed accordingly, focusing on the accident risk factors of the target group (Poó et al., 2015).

Are road safety training programs effective?

Since it was hypothesised that user training would contribute to accident reduction, thousands of road safety education programs have been developed around the world (Assailly, 2017). The design and implementation of this type of awareness campaigns require the investment of many material, economic and social efforts (Shuey, 2019). Therefore, it is surprising that there are so few evaluations of the degree of effectiveness of such programs (Hoekstra & Wegman, 2011). The fact that there is no information on the consequences and effects of road safety training programs makes it difficult to determine whether their effectiveness could be improved and, if so, in what ways. In addition, certain types of communication strategies or activities may achieve better results than others. Therefore, evaluating different ways of delivering road safety education is an essential resource for identifying the elements that should be maintained in future programs and those that should be replaced by others that are more effective in changing the attitudes and behaviours of road users.

It should be noted that among the few evaluations that have been conducted, most have been aimed at training programs in children (Alonso et al., 2016). These investigations, for the most part, conclude that positive effects are observed after the delivery of the courses (Ben-Bassat & Avnieli, 2016), which are modulated depending on the social environment of the children, increasing or reducing their benefits depending on the observed behaviour (Alonso et al., 2020). In this sense, children learn from an early age the basic road rules, traffic signs and road behaviour in order to avoid accidents. This information increases their independence to know how to manage and defend themselves in a traffic context. Moreover, some studies indicate that, if parents reinforce the information learned in training

programmes, children will develop habits that they can maintain throughout their lives ([Muir et al., 2017](#)).

This situation leads to considering that the rest of the people will also benefit from road safety training programs. However, conclusions should not be extrapolated to other population groups without performing the corresponding evaluations. Young people and adults have different cognitive characteristics than children, so the effectiveness of programs may not be the same for them ([Friedman et al., 2009](#)). This is why there is such a need for systematic and comprehensive evaluations of these population groups. However, the reality is that this has been far from common, having been carried out in a very small group of programs.

The present systematic review aims to examine the scientific articles in which an evaluation of a road safety training program aimed at young people and/or adults has been carried out in order to find common elements (and discrepancies) that can provide generalisable conclusions and that can be used to improve the development of future training courses.

Methods

Approach

Systematic reviews are usually described as a process of mapping the existing literature on a specific topic. It seeks to answer a research question through the search for studies and the synthesis of their main findings ([Armstrong et al., 2011](#)).

We used the [Arksey and O'Malley \(2005\)](#) methodology, which has five stages that are:

1. Identifying the Research Question,
2. Finding Relevant Studies,
3. Selecting the Studies,
4. Charting the Data and Collating,
5. Summarising, and Reporting the Results.

Step 1: Identifying the Research Question. As previously mentioned, the aim of this systematic review is to identify the number and type of studies that evaluate the effectiveness of road safety education programs aimed at young people and adults. This will collect and identify the communication strategies,

activities and actions carried out in such programs as well as their potential benefits.

No comparisons were made. The results included a summary and a topic analysis of all the chosen articles.

Step 2: Finding Relevant Studies. The present review was carried out following the PRISMA guidelines for the systematic reviews (Moher et al., 2011). The databases used for the preliminary literature search of the literature were the Web of Science, American Psychological Association (APA), Scopus and Google Scholar. Also, we reviewed other lists of references of systematic and scope reviews of articles potentially eligible and not captured by our search strategies.

The search included literature published from the beginning of the database and included the first week of July 2021. The terms we searched for included: "road education programs", "formation", "accidents", "evaluation", "effectiveness", "effects", and "road users". These terms were identified after reviewing the titles and keywords of the articles we found during our preliminary search.

Step 3: Selecting the Studies. Articles were excluded during this stage if they did not refer to our research objective. Thus, articles on driver education programs that were not evaluated and driver education courses aimed only at children were excluded. Publications in the form of editorials, protocols, summaries, conferences, letters, case reports or case series were not selected either. We also restricted our eligibility criteria to articles publicly available or possibly requestable from the library system that was being used and published in English and Spanish.

All authors evaluated the articles with the potential to be selected for review independently and subsequently met to discuss and resolve any discrepancies in the selection process.

Step 4: Charting the Data. The articles that fitted the inclusion criteria were critically reviewed using the descriptive-analytic Arksey & O'Malley (2005) method.

For each eligible article that was included, the following data were extracted and registered: title of the article, author(s), year of publication, country of the study, study design, group of users that were analysed, sample size, main findings and highlight results.

Step 5. Collating, Summarising, and Reporting the Results

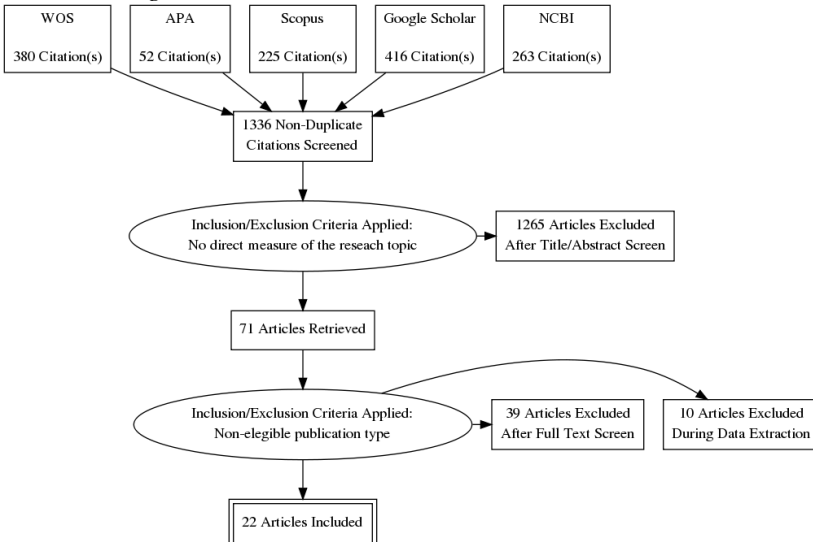
The graphed data were summarised in table 1, followed by the descriptive data, analysed through a thematic-based organisation strategy (Caldwell et al., 2005).

Results

Search results

The searched words identified a total number of 1,336 possible articles once the doubled or non-accessible elements were ruled out. A manual selection of the articles that adjusted to the objective of the present review was performed, which left us with 22 eligible articles. Figure 1 shows the data source searching and selection process.

Figure 1
PRISMA diagram



Notes: WOS (Web of Science); APA (American Psychological Association)

Characteristics of eligible research articles

Since we did not put time limits to our search, there were 22 studies complying with the inclusion criteria, published in Spanish and English between 2002 and 2021. This indicates that the study topic is a recent one. Moreover, the studies were conducted in geographically different countries. Thus, there are 13 countries from four continents: United States (n=4), Australia (n=3), Spain (n=3), Belgium (n=2), United Kingdom (n=2), Germany (n=1), Sweden (n=1), Ireland (n=1), Slovenia (n=1), Israel (n=1), Thailand (n=1), Iran (n=1) and Indonesia (n=1).

The methodology used in the evaluations was quite variable. Half of the studies carried out longitudinal evaluations (n=10), in which the effectiveness of the program was measured at different points in time in order to determine its short- and long-term consequences. The other half were cross-sectional (n=12), measuring the possible benefits obtained after the course was completed. In addition, most of the evaluations were observational (n=13), i.e., after exposure to the road safety training program, all participants assessed different circumstances and perceptions that provided information on the possible changes produced. On the other hand, the rest of the studies used an experimental methodology (n=9), where at least two groups of participants were distinguished, thus forming the control group (to which the training course was not applied) and the experimental group (which was exposed to the training course). In this way, it was possible to compare the differences between those to whom the driver education program had been given and those who had not, checking whether there really had been different effects in both groups.

Another important element is the type of evaluation technique or tool used. In some cases, a single instrument is used, while in others, two or more are used to obtain more information. In this sense, the most frequently used technique was the questionnaire (n=14), followed by focus groups (n=3), semi-structured interviews (n=3), simulators (n=2) and actual data on regulatory violations submitted to the authorities (n=1). Furthermore, regardless of the instrument, there were differences between the aspects evaluated, which are usually linked to the type and content of the training program. In other words, there were cases where the degree of behavioural change (n=5) or attitudinal change (n=6) was measured, but in others, the increase in knowledge about the subject dealt with in the course (n=5). The rest of the studies did not report the content of the evaluation (n=6).

Finally, it should be noted that the vast majority of the studies showed the benefits of the course (n=19), although the effects are mild to moderate and in the short term in the majority of cases.

Table 1
General characteristics of Eligible Studies

Author and year	Title	Country	Study aim(s) and setting	Method	Results (main outcomes)
Jaensirisa k & Luathep, 2020	Evaluation of unsafe driving behaviour change by road safety education	Thailand	This study applied the Behaviour Based Safety (BBS) approach to managing behaviour change. Various safety interventions were designed based on reviewed experiences. The evaluation was based on the Transtheoretical Model (TTM), which aims to explain a change in risky behaviour. Data collection was based on focus groups and questionnaire surveys (pre- and post-tests).	Observational and longitudinal	The interventions used in this study are related mainly to instructional and supportive interventions. These tend to instruct youngsters to transition from unknowingly risk behaviour to knowingly risk behaviour, and then deliberately safe behaviour. In order to be fluently safe behaviour, motivational interventions should be useful
Aghdam et al., 2020	Developing a national road traffic safety education program in Iran	Iran	Through semi-structured interviews with authorities in the field of road safety and focus groups with road groups representing society, a road safety training program was developed and evaluated.	Observational and cross-sectional	The content of the program consisted of 27 items, including traffic laws and regulations, first aid, and medical emergencies. Educational practices and authorities were determined based on the target group and educational content.

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Riaz et al., 2019	Evaluation of a Road Safety Education Program Based on Driving Under Influence and Traffic Risks for Higher Secondary School Students in Belgium	Belgium	This study aims to evaluate the road safety education program “Traffic Weeks” among higher secondary school students. The program focuses on driving under the influence (DUI) and traffic risks.	Observational and longitudinal	The DUI workshop had a positive effect on most socio-cognitive variables (attitude, subjective norm-friends, and intention) of female students in general education, while the traffic risks workshop only affected the perceived behavioural control of female students.
Topolšek, Babić, & Fiolić, 2019	The effect of road safety education on the relationship between Driver’s errors, violations and accidents: Slovenian case study	Slovenia	Evaluation of the "I still drive, but I cannot walk" program. Application of DBQ questionnaire on safe driving behaviours and common errors to a group that took the training program and another group that did not, with a sample of 183 people.	Experimental and cross-sectional	Drivers in the first group became more aware and responsible after the program, which can lead to safer driving and, consequently, fewer accidents.
Istiyanto, 2019	The Evaluation of Road Safety Programs District Level at Banyumas and Pasuruan	Indonesia	With a five-pillar safety instrument from the decade of action for road safety, data collection is conducted to determine the implementation of the program.	Observational and cross-sectional	The results of the data collection show the success of the action programs conducted by the Government of Banyumas and Pasuruan Regency.

<p>Hawley, Smith & Goodwin , 2018</p>	<p>Road safety education for older drivers: Evaluation of a classroom-based training initiative</p>	<p>United Kingdom</p>	<p>Evaluation of a driver education program conducted on 142 drivers aged 75 and over. Participants' driving ability and confidence were measured before and after the training, using questionnaires and focus groups.</p>	<p>Observational and cross-sectional</p>	<p>After the course, self-assessments of confidence and skill remained unchanged for 60% of drivers. However, two-thirds reported improved knowledge, and 80% said they would change their driving behaviour as a result of the course.</p>
<p>López, 2016</p>	<p>Evaluation of the effectiveness of a road safety course based on attitude change in driving schools.</p>	<p>Spain</p>	<p>Evaluation of the efficacy of road safety courses based on attitude change for the reduction of risk factors involved in traffic accidents, applied to driver training school students. To do so, a pretest-posttest quasi-experimental design with a control group was used, and a questionnaire was applied to collect the main risk factors.</p>	<p>Experimental and longitudinal</p>	<p>The experiment group obtained a greater improvement than the control group in all risk factors, especially in alcohol consumption, speed, and risk tendency, which have a higher incidence in young people.</p>
<p>Cuenen et al., 2016</p>	<p>Effect evaluation of a road safety education program based on victim testimonials in</p>	<p>Belgium</p>	<p>The study investigated the effect of a large-scale program with victim testimonials for high schools on five socio-cognitive and behavioural variables drawn from the Theory of Planned Behaviour</p>	<p>Observational and longitudinal</p>	<p>The program positively affected socio-cognitive and behavioural variables among students of general and occupational education, albeit the effects were small.</p>

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	high schools in Belgium		(i.e., attitude, subjective norm, perceived behavioural control, behavioural intention and behaviour). Moreover, this study investigated program effects on participants' cognitive and emotional estate. The sample included 1362 students.	
Baker et al., 2015	Evaluation of Light-Vehicle Driver Education Programs Targeting the Road with Heavy Vehicles: A Case Study Analysis	United States	Two components were introduced in different driver education classrooms and evaluated in comparison to the basic textbook-based component. It was evaluated through focus groups and a survey two months later, and knowledge retention of key learning points was measured.	Experimental and cross-sectional The mean percentage of correct answers for all survey questions was calculated and compared across the three conditions and did not show a statistically significant difference in knowledge retention of one condition over another.
Twisk et al., 2014	Five road safety education programmes for young adolescents pedestrians and cyclists: A multi-	United States	A practical approach was developed to evaluate and compare the effects of five brief road safety education (RSE) programs for young adolescents based on self-reported behaviours. Questionnaires were administered just before	Experimental and longitudinal Three out of five CSR programs resulted in significantly improved self-reported safety behaviour. However, the proportions of participants who changed their behaviour relative to the reference group were

	programme evaluation in a field setting		and approximately one month after participation in the RSE programs to both the intervention and reference groups.		small. Cognitive approaches did not differ in effect from programs using fear-appeal approaches.
Freeman et al., 2013	Evaluation of an automotive simulator based driver safety training program for run-off-the-road and recovery	United States	Evaluation with a score developed specifically for the automotive simulator-based training program to instruct drivers on how to perform a safe and effective recovery.	Observational and cross-sectional	Participants' recovery skills increased after the training. Drivers improved their recovery scores by an average of 78%.
Weiss et al., 2013	Calibration as side effect? Computer-based learning in driver education and the adequacy of driving-task-related self-assessments	Germany	To examine the effects of computer-based learning in driver education on drivers' calibration skills, they provided drivers with two different types of learning material (computer-based or paper-based). Two days later, they were presented with a driving simulator task.	Observational and cross-sectional	Drivers who used computer-based learning material would not only detect situation-specific danger signals earlier but would also demonstrate a better understanding of the information they perceived.
Wahlberg, 2011	Re-education of young driving offenders: Effects on recorded offences and	Sweden	Evaluation of an e-learning course for offending young drivers in terms of its effects on offending and self-reported crash rates.	Experimental and cross-sectional	Significant reductions in the number of violations and penalty points are observed, in addition to a greater reduction in collision involvement than a

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	self-reported collisions				randomised control group. Thus, there is a positive effect of the e-learning course for young offenders.
Sabatés & Capdevila, 2010.	Road safety education and attitudinal change: some results and future lines of action	Spain	Application of attitude change programs on different training levels (children, novice drivers, professional drivers and offending drivers). Subsequently, a small sample of subjects was followed up through questionnaires and semi-structured interviews.	Observational and longitudinal	Positive effects are observed in initial and refresher training. The need to improve evaluation to optimise pre-driver and driver training is recognised.
Murray et al., 2009	Effective Occupational Road Safety Programs: A Case Study of Wolseley	United Kingdom	Development and evaluation of an effective process for improving road safety at work.	Observational and longitudinal	Positive effects have been observed that have been maintained over the years during which the road safety training program has been implemented.
Rosenblom et al., 2009	Effectiveness of road safety workshop for young adults	Israel	Evaluation of the effectiveness of the Road Safety Workshop at the Loewenstein Hospital Rehabilitation Center based on emotional experience. For the purposes of the study, a survey questionnaire was created based on Ajzen and Fishbein's Theory of Planned Behaviour.	Experimental and cross-sectional	The results of the study suggest that vocational school students who attended the workshop have a more road safety-oriented view than students who did not attend the workshop.

<p>Senserrick et al., 2009</p>	<p>Young driver education programs that build resilience have potential to reduce road crashes</p>	<p>Australia</p>	<p>Prospective study of 20822 novice drivers among whom two specific road training programs were performed apart: a workshop focused on the driver and the risks of driving, and another focused on decision making and resilience development. These were then linked to accident data reported by the authorities.</p>	<p>Experimental and longitudinal</p>	<p>The resilience-focused program was associated with a reduction in relative crash risk (44%), while no effects were observed for the driver-focused program.</p>
<p>Garcia & Capdevila, 2009.</p>	<p>Attitudes and speed in young people. Application of a road safety education program.</p>	<p>Spain</p>	<p>Application of a road safety education program to improve safety based on self-control of speed in young people. The effectiveness of the program was evaluated based on the QAR questionnaire that measures risk in pre-drivers, and was applied in driving schools to people who had received traditional training and to others who had attended the specific program.</p>	<p>Experimental and cross-sectional</p>	<p>Young people who underwent traditional training did not manage to improve their level of safety in relation to speed; moreover, these drivers showed a high level of risk in speed, which was maintained after the training process was completed. On the other hand, the specific program was effective in changing attitudes.</p>

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King et al., 2008	Teaching adolescents safe driving and passenger behaviours: Effectiveness of the You Hold the Key Teen Driving Countermeasure	United States	This study evaluated the short- and long-term efficacy of the You Hold the Key (YHTK) Teen Driving Countermeasure. A two-page survey was completed by high school students at pretest, post-test, and long-term (6-month) post-test.	Observational and cross-sectional	YHTK was associated with significant immediate and long-term improvements in teen seatbelt use, safe driving, and perceived confidence in preventing drunk driving.
Elkington, 2005	Evaluation of the RYDA road safety education program	Australia	Seventeen schools participated in an evaluation of the one-day Rotary Youth Driver Awareness (RYDA) road safety education program. Pre, post and three-month follow-up surveys of over 1,200 students.	Observational and longitudinal	Results indicated a significant immediate impact on knowledge and attitudes, although, like many singular road safety education programs, most gains were lost after three months. So, the program is an appropriate educational tool if the messages are repeated at regular intervals.
Clapham et al., 2005	An Evaluation of the Lismore Driver Education Program 'On the Road'	Australia	This report provides an evaluation of Lismore's driver education program, On the Road. It was created to help members of the Aboriginal community obtain a Class C license, provide support to	Observational and cross-sectional	Interviews and focus groups indicate positive results, although there is room for improvement of the program administered.

			learner drivers and qualified drivers with license problems.	
O'Brien et al., 2002	Evaluation of the effectiveness of a dramatic presentation on attitudes to road safety	Ireland	The classroom group watched a play aimed at raising road safety awareness, while the control group did not. All participants completed a Likert questionnaire before the play, immediately after the play and ten weeks later.	Experimental and longitudinal
				The main finding was that exposure to the drama led to greater awareness of the potentially negative consequences of traffic accidents in the experimental group. A consistent gender effect also emerged, with females expressing more positive attitudes toward safety issues than males.

Discussion

Educational programs represent one of the main road safety measures in most countries around the world (Goniewicz et al., 2016). However, few efforts have been made so far to evaluate the effectiveness of these programs. Therefore, their actual benefits are unknown to some extent (Assailly, 2017). The present systematic review provides a synthesis of the number and type of scientific articles that evaluated the effectiveness of driver education programs for youth and adults, as well as their main findings.

The selected articles state that training programs can achieve a change in the attitude and behaviour of users, although the impact is mild to moderate and short-lived in most cases (Cuenen et al., 2016; Baker et al., 2015; Freeman et al., 2013). In this sense, early driver education is particularly important because, as has been shown, adult training has more difficulties in modifying behaviours or establishing new behaviours (Masuri et al., 2012). In fact, several investigations show that there is no relationship between post-licensing driver training and crash rates, which can be interpreted to mean that driver training does not influence safe driving (Ker et al., 2005; Mayhew & Simpson, 2002). However, this is not entirely true. Many of these programs aim to improve driving skills without including enabling elements such as risk perception and risk awareness directly linked to road safety (Cutello, 2020). For this reason, it is positive that more than half of the evaluations of training programs analysed are based on behavioural and/or attitudinal changes and not only on the knowledge acquired. The intention to modify a behaviour is essential for this change to finally occur. It is a factor that does not necessarily have to be related to knowledge about the risks of a behaviour. Therefore, improving the effectiveness of programs must take into account all these elements so that users understand that safe driving involves many more things than just vehicle operation and knowledge of regulations (Beanland et al., 2013).

It should be emphasised that evaluations of selected items are usually based on self-reported behaviour, which may be biased by various factors (Gonyea, 2005). Some studies find that, although virtually all attendees improved their knowledge and skills, only a few changed their behavioural habits while driving (Hawley et al., 2018; Twisk et al., 2014). Social desirability is one of the cognitive biases that can be influenced, to some extent, by participants' responses (Bowman & Hill, 2011). These may suggest the expected behaviour

or attitude, and lead to tailoring their responses based on these beliefs rather than their actual behaviours (Caputo, 2017). This is why it is so important to make respondents aware that there are no right or wrong answers, as well as to emphasise the importance of answering honestly. Another cognitive bias that can act is the overestimation of one's own abilities or behaviours, i.e., the belief that one's own behaviour is better than it objectively is (Cuenen et al., 2015).

In this sense, it would be ideal to know the reduction in road accidents that is directly influenced by attendance at training programs. Unfortunately, this is impossible because traffic accident data are modulated by both road safety education and many other factors such as traffic regulations, sanctions, communication campaigns and advertisements, among others (Al-Tit et al., 2020; Faus et al., 2021; Alonso et al., 2021b). In fact, many researchers conclude that the combination of several of these measures has the best effect on accident reduction (Ditsuwan et al., 2013).

However, in order to try to understand the benefits of road safety training programs in isolation, experimental evaluations are particularly important. In these, two (or more) groups of subjects are exposed to the same social context, in which the differential element is the road safety training program (Ross & Morrison, 2013). Undoubtedly, the findings of these investigations provide very relevant information that we infer is largely due to said training course and not so much to other factors. In this sense, the articles analysed that expose the results of this type of evaluations manifest an increase in the awareness and responsibility of the participants who attended the courses compared to the control group (Topolšek et al., 2019; López, 2016). In addition, the research conducted by Senserrick et al. (2009) also provides much knowledge in this area because it makes use of real data on offences sanctioned by the authorities in a particular driving program, and therefore, it is data that cannot be falsified. This research contrasts the effects of a program focused on driver skills and one focused on resilience and decision making while driving, concluding that it is the latter that significantly reduces driving risks (Senserrick et al., 2009). These cases support the previous point, and make it clear that more specific programs, and specifically those focused on attitudes, risk perception and decision making, obtain better results than other more generic ones (Cutello, 2020).

Following this line, it is important to note that road safety education programs and international campaigns are very useful for knowing the risk factors to address and the communication strategies that can be employed

(Bonnet et al., 2018). However, such "standard" programs should not be applied identically but used as a tool to design specific programs and courses for different cities, thus adapting to the road particularities of each location and, therefore, being more effective (Obregón-Biosca et al., 2018; Mirzaei et al., 2014).

Limitations of the study

Systematic reviews have some limitations that are characteristic of this type of study and should be discussed. Firstly, it is necessary to take into account the publication bias whereby some research is not published or is published in lower impact journals due to negative or non-significant results. Consequently, this situation directly affects the articles that can be selected for the review. Secondly, selection bias may have occurred whereby some relevant studies may have been excluded due to overly strict criteria. And finally, observer bias may have occurred. In any case, a specific and defined methodology has been followed for the selection of articles in order to minimise the biases that could occur in this process.

Conclusion

The results of this systematic review, apart from remarking the problematic scarcity of literature in this field, make it clear that road safety training courses for young people and adults should be aimed at raising awareness and changing the attitudes of their participants. For this, on the one hand, the communication strategy and adaptation to the audience is fundamental (Poó et al., 2015). In addition, the age and experience of the attendees show that they are probably already knowledgeable about certain know-how and skills as road users. Therefore, what must be achieved is to influence their intention to change their behaviours towards more appropriate and less risky ones (Cutello, 2020). Therefore, what must be achieved is to influence their intention to change their behaviours towards more appropriate and less risky ones (Cutello, 2020). In this sense, and having analysed the evaluations carried out on different types of programs, the specific courses focused on resilience, risk detection and decision making have proven to be the most useful for these objectives.

This systematic review gathers together the factors that have been shown to be most effective in road safety training programmes for adults and young

people. Therefore, this study has practical implications that would be of interest to various local and national governmental authorities, as well as public and private institutions and organisations that develop actions for the prevention of road crashes, and specifically, that design and implement road safety training programmes targeted at this population group.

Availability of data and material

The data used to support the findings of this study are available from the corresponding author upon request.

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Conflicts of Interest

The authors declare no conflict of interest.

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