



## Review Article

# Effectiveness of Communication Actions on the Reduction of Road Traffic Accidents Among Motorcyclists: A Systematic Review

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**Abstract:** Vulnerable road users, including motorcyclists, account for more than half of all road traffic fatalities worldwide. Communication actions are an essential part of prevention both in Africa and in the world. This study aimed to review the available scientific studies on the effectiveness of communication actions for the reduction of road traffic accidents among motorcyclists. We carried out an automatic search on PubMed using an equation and a manual search on Google Scholar using keywords and the bibliographic references of the studies generated by the automatic search. Using this strategy, 155 articles were identified, 16 of which were eliminated as duplicates. Thus, 139 were screened by reading the titles, abstracts, and full-texts. In the end, 13 articles met the inclusion criteria. The included articles provided evidence of the effectiveness of communication actions on the reduction of risk factors for the occurrence or severity of road traffic accidents. However, communication actions alone seem insufficient to achieve a sustainable and significant reduction in road traffic accidents, road traffic injuries, or road traffic fatalities. This confirms the need to integrate all road safety promotion strategies to act simultaneously on the various risk factors for the occurrence or severity of road traffic accidents and thereby significantly reduce their incidence and associated consequences.

**Keywords:** Effectiveness, Communication, Prevention, Road Traffic Accidents, Benin

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## 1. Introduction

With 1.35 million deaths worldwide each year (more than 3,000 deaths per day), road traffic accidents (RTAs) are the eighth leading cause of death for all age groups and the leading cause of death for people aged between 5 and 29 years [1]. Thus, RTAs now claim more victims than HIV/AIDS, tuberculosis, or diarrhoeal diseases [1–4]. If no effective action is taken immediately, it is estimated that RTAs are

expected to cause 2.4 million deaths per year, making them the fifth leading cause of death worldwide [5]. Furthermore, differences in mortality rates are observed according to the types of road users. Vulnerable road users, including motorcyclists, account for more than half of all deaths from RTAs [5]. A study in 2013 showed that motorcyclists were at greater risk of dying from RTAs than users of four-wheeled vehicles [6]. It also is estimated that per vehicle mile travelled, motorcyclists are about 35 times more likely than passenger car occupants to die in an RTA [7].

In order to reduce the incidence of RTAs among road users, governments and international agencies, in partnership with the World Health Organization (WHO), have intensified their response to the road safety crisis through the Decade of Action for Road Safety 2011-2020 and the 2030 Agenda for Sustainable Development [8, 9]. As a result, certain approaches have been favoured to effectively address the burden of RTAs. Among these, communication actions are considered to be an important area of prevention both in Africa and globally. The idea behind this statement is based on the hypothesis that many health problems can be avoided through effective communication with risk groups. Road safety communication focuses on human-related factors by increasing knowledge, changing attitudes, and behaviour among road users. It is estimated that human factors are responsible for 95% of RTAs [10]. A meta-analysis of 18 observational studies indicated that driving under the influence of alcohol increases the risk of RTAs for motor vehicle drivers. A 1% increase in the average speed of a vehicle results in a 4% increase in the risk of a fatal crash [11]. A case-control study in 2016 suggested that not wearing a helmet doubles the risk of injuries after an RTA [12]. According to the WHO, a helmet can reduce the risk of death by up to 42% and the risk of serious injury by more than 69% [11]. Other human factors such as driving while fatigued, insufficient knowledge of traffic regulations, poor driving experience, or insufficient knowledge of pre-hospital care among passers-by have been reported in the literature as being associated with the occurrence or severity of RTAs [11–14]. Thus, communication actions to prevent RTAs are ultimately aimed at reducing the prevalence of these factors in order to influence the incidence and consequences of RTAs.

In the field of road safety, communication actions are varied: awareness-raising, media campaigns, interpersonal communication, road safety education, etc. It is now perceived by decision-makers as a solution to the problems posed by road safety, although the real effectiveness of these interventions is still poorly known.

This study is part of a comprehensive research effort to develop a communication model for the reduction of RTAs among road users and motorcyclists in particular. This study aimed to review the available scientific studies on the effectiveness of communication actions in reducing RTAs among motorcyclists.

## 2. Materials and Methods

### 2.1. Data Sources

We carried out electronic searches using the PubMed and Google Scholar databases from 1990 to 2020 (30 years). We started with an automatic search on PubMed using the following equation: *("Accidents, Traffic/prevention and control" [Mesh]) AND "Motorcycles" [Mesh] AND "Education" [Mesh]*. To this automatic search was added a manual search on Google Scholar using keywords and the bibliographic references of the studies generated by the

automatic search. This systematic review conforms to the PRISMA statement [15].

### 2.2. Selection Process

The identified articles through the bibliographic search have been screened for duplication and by reading titles, abstracts, and full-texts. Duplicates were not selected and articles with irrelevant titles and abstracts were not eligible for full-text examination. Original observational, experimental or quasi-experimental studies, published in peer-reviewed journals, on the effectiveness of an intervention involving communication actions directed at motorcyclists (drivers/passengers), and which were judged to be of sufficient methodological quality were included. Studies from the grey literature were not included. Grey literature was defined as "any document produced by government, administration, education, and research, commerce and industry, in paper or digital format, protected by copyright, of sufficient quality to be collected and preserved by a library or institutional archive, and not controlled by commercial publishing" [16].

### 2.3. Data Processing and Analysis

Data were extracted from the included articles and synthesized. Two researchers worked in parallel to assess the identified studies. They first examined the duplication and relevance of these articles based on their titles and abstracts. They then independently read the full-texts of all remaining articles to determine whether they met the inclusion criteria. The results were compared and any disagreements were resolved by consensus. Data were collected on the year the study was published, the location of the study (country), the study design, the intervention implemented and its content, and the key findings. The analysis examined whether or not significant changes in the prevalence of risk factors for the occurrence or severity of RTAs, the prevalence of RTAs, the prevalence of road traffic injuries, and the mortality of RTAs were observed as a result of the communication action.

## 3. Results

### 3.1. Description of the Selection of Included Articles

Figure 1 shows the flow chart of the article selection. Following the automatic and manual searches, 155 articles were identified, 16 of which were eliminated as duplicates. One hundred and twenty-one articles were ineligible because of their titles and abstracts. A full-text evaluation of 18 articles was carried out and resulted in the inclusion of 13 articles in the systematic review. Thus, five articles were not included for the following reasons:

- 1) we registered two review articles;
- 2) in one article, cyclists were included in the study population;
- 3) in one article, although the association between exposure to training and helmet use was analysed, the authors' objective was to study motorcyclists' attitudes, norms,

and behaviours towards helmet use; relevant given the objectives of this systematic review.  
 4) in one article, the primary outcome was not considered

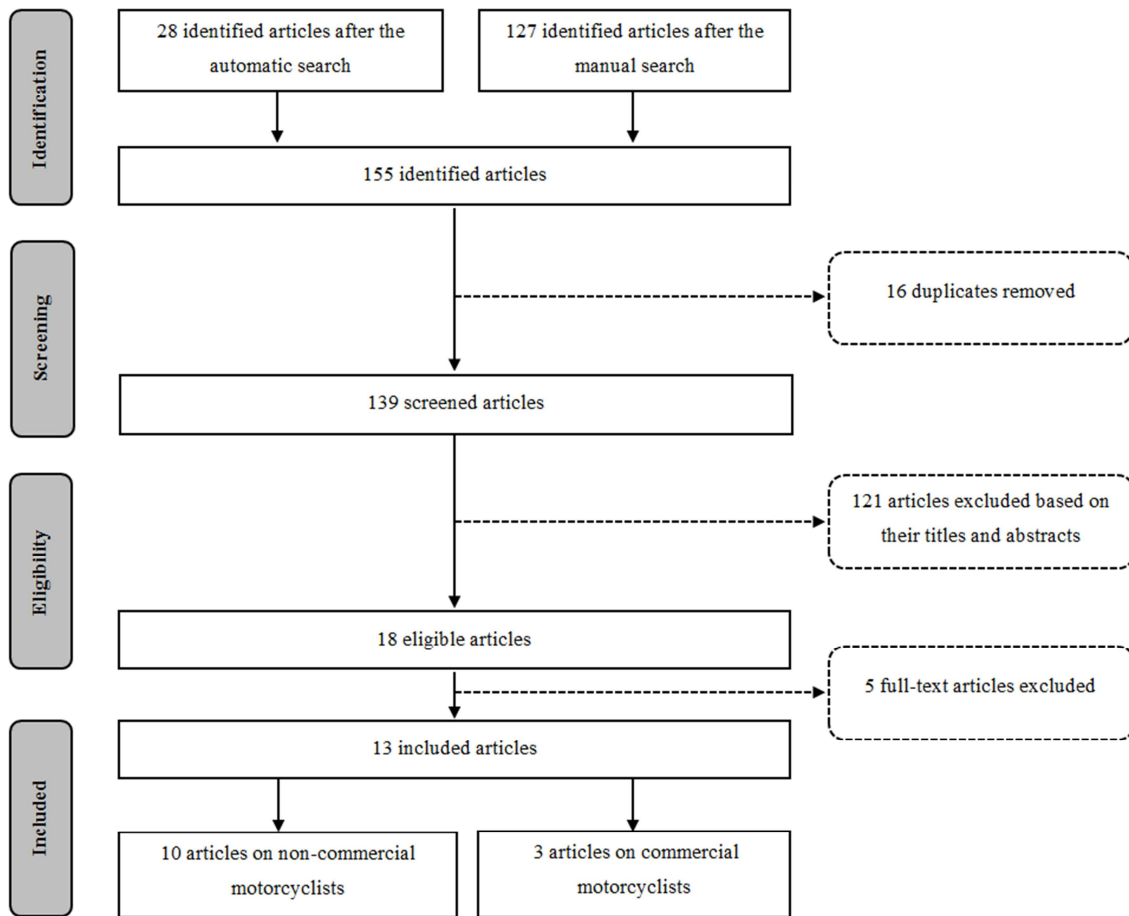


Figure 1. Flow chart of article selection.

### 3.2. Description of Included Articles in the Systematic Review

The included articles were published from 1998 to 2019. All studies opted for a quantitative approach. There are six quasi-experimental studies, three experimental studies

(randomized controlled trials), tree repeated cross-sectional surveys and one retrospective observational cohort study. Almost all of the studies (10 out of 13) were conducted in low- and middle-income countries. Table 1 provides a synthesis of the included articles in the systematic review.

Table 1. Synthesis of articles included in the systematic review.

Authors	Countries	Study design	Interventions	Contents	Key Findings
Adnan et al (2019) [26]	Pakistan	Repeated cross-sectional survey	Campaign for motorcycle helmet use	Motorcycles stopped and warned by police officers for not wearing a helmet Electronic and print media news about the legislation Strict enforcement at various points in the city	Non-significant change in helmet use after the intervention
Boele-Vos et al (2015) [22]	Netherlands	Randomized controlled trial	One-day advanced rider training course	Theoretical and a practical part Focus on timely perception and recognition of traffic hazards and no focus on acquiring skills	Higher rate on safe riding, positive effect on driver behaviour and better performance on the hazard perception test in the intervention group No effect on riders' assessment of their behaviour
Braver et al (2007) et al [20]	USA	Randomized controlled trial	Persuasive educational intervention	Mailing including: a letter (potential legal consequences while unlicensed), a brochure (attractive photographs and positive message about the benefits of licensure, negative consequences) explaining how to get licensed	Significantly higher licensure rate in the intervention group

Authors	Countries	Study design	Interventions	Contents	Key Findings
Foroutan <i>et al</i> (2019) [23]	Iran	Quasi-experimental design that uses a control group and pretest	Campaign for motorcycle helmets advocacy	Education and announcement Notifications and warnings to the riders Law enforcement	Significant increase in helmet use after the intervention Significant decrease in the rate of admission to the intensive care unit due to head trauma after the intervention Non-significant difference in mortality rate Non-significant effect on crash risk
Ivers <i>et al</i> (2016) [21]	Australia	Randomized controlled trial	On-road motorcycle coaching program	Discussions Practical Sessions	Significant increase in speeding behaviour and driver confidence in the intervention group
Johnson <i>et al</i> (2011) [17]	Nigeria	Quasi-experimental design that uses a control group and pretest	Safety education	Lecture Visual aids Interactive sessions	Significant increase in knowledge of and compliance with road traffic signs in the intervention group
Johnson <i>et al</i> (2012) [18]	Nigeria	Quasi-experimental design that uses a control group and pretest	Health education	Lecture (by the principal investigator in the local language of the respondents) Interactive session	Increase in the proportion of drivers complying with speed limits (significant) and having a valid driver's licence (not significant) in the intervention group Decrease in the proportion of drivers using psychoactive substances (not significant) in the intervention group Non-significant decrease in the prevalence of RTAs in the intervention group
Makota <i>et al</i> (2019) [28]	Tanzania	Quasi-experimental design without control group (single group)	Participatory training	Theoretical part: small group discussion, role play, simulation and case study Practical sessions: simulation	Significant increase in the knowledge and skills on basic life support after the intervention
Piyapong <i>et al</i> (2012) [27]	Thailand	Repeated cross-sectional survey	100% motorcycle helmet use campaign	A nationwide mass media campaign on the importance of wearing a helmet	Non-significant increase in helmet use after the campaign after the intervention Non-significant increase in helmet use among drivers after the intervention Significant increase in helmet use among passengers after the intervention
Ratanavara <i>et al</i> (2013) [24]	Thailand	Repeated cross-sectional survey	Community participation	Cooperative finding problems, causes, and acceptable solutions (participative decision making) Mutual decision-making in selecting approaches and problem-solving plans (Public meeting and Participative decision making) Collaborative implementation following planning activities (Public information) Cooperative evaluation of projects (Public meeting and Participative decision making)	Significant increase in helmet use among drivers and passengers
Swaddiwu <i>et al</i> (1998) [19]	Thailand	Quasi-experimental design that uses a control group and pretest	Community-based programme	Health education on the epidemiology of motorcycle crash injury, motorcycle-related risk, and the effective protection of helmet use Motorcycle rider education, including traffic laws, vehicle regulations, traffic signs, and written and skill tests for a driving licence	Motorcyclists were significantly more likely to have valid licences following the education programme Following the education programme, the proportion of motorcyclists who always or often wore helmets was significantly greater There was no significant difference in the alcohol consumption within 2 h before driving following the education programme The proportion of good motorcycles was not statistically different Following the education programme, the injury rates were significantly lower The annual number and rate of fatal motorcycle injuries decreased after the intervention although there was no significant difference
Slesak <i>et al</i> (2011) [25]	Laos	Quasi-experimental design that uses a control group and	Multisectoral road safety campaign	Motorcycle helmet distribution Two road safety days including: information about the increased road traffic injuries and risk factors, a motorcade	Severe road traffic injuries dropped, total road traffic injuries increased and helmet use increased significantly, following the intervention

Authors	Countries	Study design	Interventions	Contents	Key Findings
		pretest		through the provincial capital, helmet protectiveness demonstration	
Woratanarat et al (2013) [29]	Thailand	Retrospective cohort study	Safety riding program	30 h instruction (teaching abilities, first aid knowledge, and riding demonstration) 15 h license courses (knowledge, practical-skills)	The license course (significant) and the instruction course (non-significant) were associated with a reduction of motorcycle-related injuries

### 3.3. Effects of Communication Actions on Risk Factors for the Occurrence of RTAs

In a study conducted in 2011, Johnson et al [17] found that road safety education was significantly associated with a better knowledge of and compliance with road safety signs. Johnson et al in 2012 [18], also indicated that safety education significantly increases the proportion of motorcyclists complying with speed limits and non-significantly reduces the use of psychoactive substances (alcohol, tobacco, and drugs). Likewise, Swaddiwudhipong et al [19] found non-significant decrease in alcohol consumption following a community-based programme. Braver et al [20] and Swaddiwudhipong et al [19] found a significant increase in the proportion of motorcyclists who obtained a driver's license respectively following a persuasive educational intervention and a community-based programme, in contrast to Johnson et al [18]. Ivers et al [21] found an increase in young drivers' confidence following a coaching program. The other side of the coin was an increase in riding exposure and speeding behaviour [21]. In this study, the combination of greater confidence in their driving skills and possibly lower risk perceptions would have led young drivers to more risk-taking behaviour, such as speeding [21]. In 2015, Boele-Vos et al [22] carried out a study which aimed to assess the effects of the advanced rider training course. In this study, trained participants performed better on the hazard perception test and were rated higher on safe riding [22]. However, in contrast to Ivers et al [21], the training did not affect riders' assessment of their own riding behaviour [22].

About the vehicles used by motorcyclists, according to Swaddiwudhipong et al [19], a community-based programme did not seem to have a significant impact on the condition of these vehicles.

### 3.4. Effects of Communication Actions on Factors Associated with Severity of RTAs

This review included a body of evidence that shows a positive effect of certain communication actions on the adoption of protective behaviours such as helmet use by motorcyclists [19, 23–25]. Swaddiwudhipong et al showed that a community-based program can significantly improve the frequency of helmet use among motorcyclists [19]. A community participation approach also appeared to increase helmet use among both riders and passengers [24]. The study by Foroutan et al [23] also indicated an increase in helmet use following the implementation of a campaign for motorcycle helmets advocacy. Similar results were also observed among children or teenagers [23, 24]. Nevertheless, two studies

reported non-significant difference in helmet use among motorcycle riders after a national campaign, although in one of the two studies significant changes in helmet use were observed among passengers [26, 27].

In addition, Makota et al [28] studied the effectiveness of participative training in the acquisition of first aid knowledge and skills among commercial drivers. Indeed, commercial drivers are likely to be on-site at a road crash scene. The authors observed a significant increase in motorcycle riders' knowledge and skills with respect to pre-hospital care [28].

### 3.5. Effects of Communication Actions on Road Traffic Crashes, Road Traffic Injuries and Road Traffic Fatalities

Johnson et al [18] observed a non-significant association between health education and a reduction in the number of RTAs recorded among motorcyclists. Similar results were found by Ivers et al [21] who found no effect of an on-road coaching program on novice riders crashes. Woratanarat et al [29] reported that a license course and an instruction course were significantly associated with a reduction of motorcycle-related injuries. A significant decrease in severe road traffic injuries has also been reported by Slesak et al [25], following a multisectoral road safety campaign. In a study by Swaddiwudhipong et al [19], following a community-based program, the injury rates were significantly lower. Also, the annual number and rate of fatal motorcycle injuries decreased after the intervention although there was no significant difference [19]. Similarly, according to Foroutan et al [23], the mortality rate related to RTAs was not significantly changed after a campaign for motorcycle helmets advocacy.

## 4. Discussion

The objective of this study was to review the available scientific studies on the effectiveness of communication actions for the reduction of RTAs among motorcyclists. Applying the methodology described above, several trends were identified.

First, unlike "traditional" communication actions characterized by a directive style and the use of threat to increase risk perception, the interventions in the included articles for this review, overall and to varying degrees, were based on positive feedback and the use of a participatory or community-based approach. This approach is based on the principle that the close involvement of target groups in communication actions can create positive attitudes and bring about lasting changes in their knowledge, attitudes, and behaviour.

Secondly, road safety communication actions were effective in promoting the adoption of protective behaviours

such as helmet use by motorcyclists. It should be noted that two studies did not find a significant increase in helmet use as a result of communication actions. Behaviour change communication would also reduce the prevalence of certain behavioural risk factors for RTAs (substance use, speeding, not knowing, and not obeying traffic signs). However, the small number of studies that have shown this relationship does not allow us to generalize, especially since some authors have observed no significant change.

Thirdly, communication actions aimed at motorcyclists tend to reduce RTAs and their consequences (injuries and fatalities). However, this systematic review could not reveal a consensus as to the significance of this reduction. This could be explained by the fact that the studied interventions in this review only acted on a limited number of factors that could explain the occurrence or severity of RTAs. RTAs are a complex public health problem because of the multiplicity and interaction of their causes. In 1968, Haddon developed the first model for the analysis of RTAs and identified three groups of factors explaining their occurrence [30]. These were human-related, vehicle-related, and environmental factors [30]. Vehicle-related factors refer to the quality or capacity of the vehicles used by users of motorized two-wheelers, while environmental factors refer to weather, light, visibility, etc. [12, 31]. Developing and implementing communication actions to change motorcyclists' knowledge, attitudes, and behaviours can only act on human-related risk factors for RTAs. Thus, factors related to vehicles and those related to the road environment are only slightly affected. For example, in their study, Swaddiwudhipong *et al* found no significant changes in the condition of motorcycles used by motorcyclists as a result of a community education program [19]. This could explain the non-significant decrease in RTAs observed by Ivers *et al* or Johnson *et al*. Thus, interventions or communication actions must be coupled with projects to improve road infrastructure and the quality of vehicles on the road in order to be really effective in the long term.

Finally, we can distinguish two limitations to this systematic review. The first is related to the small number of studies that have looked at the effectiveness of road safety communication actions among motorcyclists. This limits the possibilities of making robust conclusions about the effectiveness of these interventions. The second limitation is that the majority of the studies we have included followed a quasi-experimental or observational design. These types of studies are subject to bias and have a limited ability to establish a causal relationship. In a quasi-experimental study, the lack of randomization limits the control of potential confounding variables. Under these conditions, differences observed between the intervention and control groups, or before and after the intervention, may not be justified solely by the intervention that was implemented [32].

## 5. Conclusion

The results of this review provide evidence of the effectiveness of communication actions on the reduction of risk factors for the occurrence or severity of RTAs.

Nevertheless, non-significant results observed in this review leads us to qualify the actual effectiveness of these actions. Many other studies are still needed to confirm or disprove the effectiveness of these interventions. However, it seems that communication actions alone are not sufficient to significantly and sustainably reduce RTAs. This confirms the need to integrate all strategies to combat RTAs in order to act simultaneously on the different risk factors for the occurrence or severity of this health problem.

## Conflict of Interest

The Authors has no conflict of interest

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