Original Article

Effect of First Aid Training on Motorcyclists and Cyclists' Knowledge, Skills, Attitude, and Self-Efficacy in Managing Road Traffic Accident Victims in Rwanda: A Quasi-Experimental Study

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Abstract

Background
Road traffic deaths are a leading global concern, especially for those aged 5–29. Brain damage can occur within five minutes without first aid, yet ambulances often take longer to arrive. In Rwanda, delays may be worse, motorcyclists and bicyclists who are often the first witnesses to road traffic crashes, often lack the knowledge and confidence to provide immediate assistance.

Objective
To assess the effect of first aid training on motorcyclists and cyclists' knowledge, skills, attitudes, and self-efficacy in Rwanda.

Methods
A quasi-experimental study involved 95 motorcyclists and cyclists, conveniently selected from two Rwandan districts. A self-administered questionnaire and observational checklists were used in a one-group pre-post test design.

Results
Participants had a mean age of 33 years (SD = 7.45) and 6.56 years of driving experience (SD = 4.50). Cyclists made up 52.08%, and 38.30% had secondary or tertiary education. While 52.38% had witnessed accidents, 75.00% had no prior first aid training. Post-training, significant improvements were seen in knowledge (6.11 to 11.29), attitude (28.50 to 37.59), self-efficacy (113.25 to 157.08), and skills (22.03 to 31.78) (all $p < 0.001$).

Conclusion
First aid training may significantly improve motorcyclists' and cyclists' capacity to respond to road traffic accidents while waiting formal prehospital emergency care services to arrive on the scene of accident.

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Keywords: Road traffic accident, motorcyclists, cyclists, first aid training

Background

Road traffic fatalities continue to pose a major global public health challenge, claiming approximately 1.19 million lives annually and alarmingly, about 90% of these deaths occur in low- and middle-income countries (LMICs).[1] Africa reports the highest mortality rate from road traffic injuries (RTIs), with 26.6 deaths per 100,000 population, and pedestrians account for 38% of these fatalities.[2] In Rwanda, studies revealed that road traffic accidents (RTAs) were responsible for 75% of all trauma-related injuries, with a significant proportion involving motorcycles.[3, 4]

RTIs remain one of the leading causes of death across all age groups and are the primary cause of mortality among children and young adults aged 5 to 29 years.[1] According to the International Federation of Red Cross and Red Crescent Societies (IFRC), more than half of traffic-related deaths occur within minutes of the incident, primarily due to irreversible brain damage caused by oxygen deprivation. Each minute without timely intervention reduces the chance of survival by approximately 10%.[5] Beyond the human toll, RTAs impose a substantial economic burden, with costs estimated between 1% and 3% of a country's Gross Domestic Product (GDP), reaching up to 6% in some cases, and moreover, despite global commitments to reduce road traffic deaths, progress remains limited.[1]

Timely first aid plays a critical role in preventing fatalities by stabilizing victims before the arrival of emergency medical services. The IFRC defines first aid as a cost-effective, life-saving intervention and advocates for widespread training to empower bystanders to act promptly during emergencies.[6,7] Evidence shows that faster response by trained individuals increases survival rates and improves neurological outcomes.[5] A study further reveals that 96% of participants recognize the importance of immediate first aid and express willingness to receive training.[2] Moreover, individuals with adequate first aid training are five times more likely to assist injured persons confidently and effectively.[8,9] However, untrained bystanders may unintentionally worsen injuries due to inappropriate or harmful interventions.[2]

In Rwanda, the Ministry of Health has introduced a prehospital emergency service, Service d'Aide Médicale d'Urgence (SAMU), to address prehospital emergencies, including road traffic injuries. Yet, SAMU faces persistent challenges, including poor infrastructure, limited ambulance availability, and a shortage of skilled personnel, which hinder rapid response.[10] As supported by different studies, training first responders significantly reduced mortality.[11,12]

However, there is currently no documented evidence on the impact of first aid training among motorcyclists and cyclists in Rwanda. Therefore, this study aims to evaluate the effects of a first aid training intervention targeting this key population.

Methods

Study design and settings

This study employed a quasi-experimental design with a one-group pretest-posttest approach. The intervention was conducted in two of the country's 30 districts, Nyarugenge and Nyagatare. Nyarugenge was selected guided by a previously conducted study in Rwanda, which mentioned it as the busiest area in Kigali, which mostly has a high number of road traffic accidents.[13] Nyagatare, the largest district in Rwanda and one of the country's secondary cities, is the busiest area among rural districts of Rwanda.[14]

Study participants and sampling strategy

This study involved a single group made of motorcyclists and cyclists who were operating in Nyarugenge or Nyagatare districts during the period of data collection. Motorcyclists and cyclists are mostly victims of road traffic accidents.[15]

These participants are organised in well-known cooperatives which facilitated the way to reach them through their cooperatives' leaders. Convenient sampling strategy. A total of 100 participants were initially invited, with 50 from each district, and 95 participants completed the study. Participants aged between 18 and 65 years who were operating in these two districts during the period of the study were eligible to participate. Below 18 years participants were excluded as they could not sign the consent for participation.

Sample size

The sample size was calculated using G*Power 3.1.[16] An alpha level of .05, a power of .95, and a moderate effect size of 0.4 were used to determine the required sample size. The G*Power calculation indicated a required minimum sample size of 70 participants. However, to account for potential attrition, 100 participants were initially recruited. Ultimately, 95 participants completed the study and were included in the final analysis.

Intervention: First Aid Training Process

This study aimed to evaluate the effectiveness of a first aid training intervention for motorcyclists and cyclists in Rwanda. After identifying and contacting potential participants, those who agreed to join were consulted to schedule a suitable training date. In each district, the training was conducted over two days, with eight hours of theoretical and practical instruction per day. Each session began with the signing of informed consent forms, followed by a pre-assessment test. Participants then received theoretical instruction on first aid for road traffic accidents, which was followed by practical demonstrations. Trainers guided participants through essential first aid techniques, and each participant was given time to practice the demonstrated skills. At the end of the second day, a post-test was administered to assess participants' achievement of the learning outcomes. In total, 95 motorcyclists and cyclists received the training across the Nyagatare and Nyarugenge districts.

Training manual and assessment tool

The training was conducted using a manual developed by the research team and validated by experts in emergency and critical care. It covered essential first aid topics, including the definition and principles of first aid, victim prioritization, cardiopulmonary resuscitation (CPR), rescue breathing, hemorrhage control, the recovery position, injury immobilization, and the safe transport of road traffic accident victims. Originally written in English, both the manual and the study questionnaire were translated into Kinyarwanda to ensure accessibility for a lay audience.

To evaluate the effectiveness of the training, the research team developed a structured questionnaire aimed at assessing participants' knowledge, skills, attitudes, and self-efficacy related to first aid in road traffic accidents. This process was iterative and collaborative, involving physicians specialized in emergency and critical care, critical care nurses, and nurse educators. The initial draft was based on the study objectives and aligned with the content in the training manual. A validation workshop with first aid experts ensured the questionnaire addressed the key domains relevant to non-healthcare providers, such as motorcyclists and cyclists.

Following the workshop, the draft questionnaire was piloted with five commercial motorcyclists and five commercial cyclists. Feedback from the pilot led to further refinements to enhance clarity and relevance. The finalized questionnaire comprised four sections: knowledge multiple-choice questions, each with one correct answer. Attitudes: 8 items measuring attitudes toward first aid in road traffic accidents, rated on a 5-point Likert scale. Self-efficacy: 37 items assessing participants' confidence in providing first aid, rated on a 5-point Likert scale (from 5 = fully able to 1 = not able at all). Practice: An observational checklist of 37 first aid skills. Each correctly performed skill was scored as "yes" (1 point),

while incorrect or poorly performed skills were scored as "no" (0 points). To ensure the tool's reliability, Cronbach's alpha was calculated for the attitude, self-efficacy, and practice sections, yielding values of 0.784, 0.956, and 0.963, respectively.

Data analysis

Descriptive statistics were presented in the table, using the mean and standard deviation for continuous variables and frequency and percentage for nominal variables.

The total score for each domain (knowledge, skills, attitudes, and self-efficacy) was calculated by summing the individual item scores within each domain. We assessed the distribution of the differences in mean scores before and after the training and found them to be approximately normally distributed. Given that the same group was evaluated before and after the intervention, paired sample t-tests were employed to examine changes in scores. Additionally, we used Pearson correlation tests for continuous independent variables, independent samples t-tests for binary independent variables, and one-way ANOVA tests for nominal independent variables to examine the participants' characteristics associated with knowledge, attitudes, self-efficacy, and practice before and after the intervention. A p-value less than 0.05 was considered statistically significant. Stata version 18.0 (Stata Corp LLC, College Station, TX) for all analyses.

Ethical considerations

An ethical clearance was obtained from the Institutional Review Board of the College of Medicine and Health Science at the University of Rwanda with reference number 344/ CMHS IRB/2024. Permission to conduct the study was also granted by Nyarugenge and Nyagatare districts, with reference numbers 3155/07.01.01.09.24 and 0159/07/06/02/01, respectively. Before participating in this study, respondents received information about the objectives and procedures of the study. Any questions from the participants were answered, and any concerns were addressed. They were also informed that their participation was voluntary and that they were free to drop out of the study at any given time. They also signed a consent form before starting their participation.

Results

Characteristics of motorcyclists and cyclists who participated in the study

Table 1. Characteristics of the participants

Characteristics	Frequency	Percentage
Age in years, mean (standard deviation)	33 (7.45)	
Profession		
Motorcyclist	46	47.92
Cyclist	50	52.08
Experience in years, mean (standard deviation)	6.56 (4.50)	
Education		
Did not complete primary	25	26.6
Completed primary	33	35.11
Secondary and tertiary	36	38.30
Witnessed accident		
Never	5	5.95
Once	32	38.10
Twice	3	3.57
Several times	44	52.38
Ever had first aid training		
Yes	23	25.00
No	69	75.00
Consider first aid knowledge and skills as important		
Yes	73	79.35
No	19	20.65

Table 1 shows the characteristics of the participants in the study. The average age of the participants was 33 years (SD= 7.45 years). Regarding profession, 47.92% of the participants were motorcyclists, while 52.08% were cyclists. Participants reported an average of 6.56 years of experience (SD= 4.50 years). In terms of education, 26.6% of the participants did not complete primary education,

while 35.11% completed primary education. A notable 38.30% had pursued education up to the secondary or tertiary levels. When questioned about witnessing accidents as soon as they occurred, 5.95% of participants reported never having witnessed one, 38.10% reported witnessing an accident once, 3.57% twice, and 52.38% several times. Regarding first aid training, only 25.00% of the participants had received training, whereas 75.00% had not. Despite this, 79.35% of the respondents believed that first aid knowledge and skills are important, while 20.65% did not believe that.

The Impact of First Aid Training on Participants' Knowledge, Attitudes, Self-Efficacy, and Practice Related to Responding to Road Traffic Accidents

Table 2 reports the results of a paired-samples t-test assessing the impact of first aid training on participants' knowledge, attitudes, self-efficacy, and skills related to responding to road traffic accidents. The findings indicate significant improvements across all evaluated domains following the training intervention.

The mean score for first aid knowledge increased from 6.11 (SD = 1.76) before the training to 11.29 (SD = 1.43) after the training, with a mean difference of 5.18 (SD = 1.95). This improvement was statistically significant ($p < 0.001$). Similarly, attitudes regarding the provision of first aid during road traffic accidents showed a notable increase, with mean scores rising from 28.5 (SD = 6.99) before to 37.59 (SD = 2.17) after the training. The mean difference of 9.09 (SD = 6.93) was also statistically significant ($p < 0.001$).

Furthermore, participants' self-efficacy scores related to providing first aid in road traffic accidents increased significantly, with scores improving from 113.25 (SD = 32.70) before the intervention to 157.08 (SD = 18.01) afterward. The mean difference was 43.83 (SD = 33.65), and this change was statistically significant ($p < 0.001$). Lastly, the scores for practice and skills associated with first aid in road traffic accidents also exhibited significant enhancement, increasing from 22.03 (SD = 7.67) before the training to 31.78 (SD = 4.18) after the training. The mean difference of 9.76 (SD = 7.64) was statistically significant ($p < 0.001$).

Table 2. Paired Sample t-Test Results for Pre- and Post-First Aid Training: Impact on Knowledge, Skills, Attitude, and Self-Efficacy in Road Traffic Accident Response

Variable	First Aid Training	Mean (SD)	Mean difference (SD)	P-value
First aid knowledge scores	Before	6.11(1.76)	5.18 (1.95)	<0.001
	After	11.29 (1.43)		
Attitude Scores Regarding the Provision of First Aid During Road Traffic Accidents	Before	28.5 (6.99)	9.09 (6.93)	<.001
	After	37.59 (2.17)		
Self-Efficacy Scores Regarding the Provision of First Aid for Road Traffic Accidents	Before	113.25 (32.70)	43.83 (33.65)	<0.001
	After	157.08 (18.01)		
Skills Scores Related to First Aid for Road Traffic Accidents	Before	22.03 (7.67)	9.76 (7.64)	<0.001
	After	31.78 (4.18)		

Analysis of participants' characteristics associated with knowledge, attitudes, self-efficacy, and practice related to first aid for road traffic accidents before and after training

Table 3. Participants' Characteristics Associated with Knowledge, Skills, Attitude, and Self-Efficacy regarding First Aid post Road Traffic Accidents

Variable	Knowledge				Attitude				Self-efficacy				Skills			
	Pretest	P-value	Post-test	P-value	Pretest	P-value	Post-test	P-value	Pretest	P-Value	Post-test	P-value	Pretest	P-Value	Post-test	P-value
*Age, r	0.10	0.30	-0.05	0.63	-0.16	0.12	0.03	0.79	-0.17	0.17	-0.01	0.96	0.10	0.37	-0.01	0.94
+Profession, mean (SD)																
Motor cyclist	6.67 (1.46)	0.002	11.37 (1.18)	0.61	27.54 (6.93)	0.20	37.26 (2.14)	0.15	108.06 (29.16)	0.12	160.36 (15.62)	0.31	22.05 (7.05)	0.56	32.45 (3.87)	0.15
Bicyle cyclist	5.6 (1.87)		11.22 (1.63)		29.38 (6.99)		37.9 (2.18)		119.82 (33.62)		156.44 (18.89)		21.05 (8.35)		31.15 (4.47)	
*Experience, r	-0.02	0.88	-0.08	0.46	-0.04	0.68	0.07	0.51	-0.03	0.84	0.06	0.57	0.04	0.73	0.16	0.14
++Education, mean (SD)																
Did not complete primary	5.36 (2.14)	0.04	10.92 (1.98)	0.27	28.88 (7.74)	0.77	37.76 (2.01)	0.49	97.74 (26.40)	0.003	155.05 (19.80)	0.49	18.7 (7.58)	0.10	31.8 (4.63)	0.94
Completed primary	6.24 (1.62)		11.39 (1.25)		29 (7.17)		37.88 (2.30)		131.4 (31.49)		160.97 (16.04)		23.31 (7.20)		31.52 (3.51)	
Secondary and tertiary	6.5 (1.52)		11.5 (1.06)		27.86 (6.56)		37.28 (2.20)		114.31 (29.28)		157.38 (17.80)		22.32 (7.78)		31.82 (4.68)	
++Accident witnessed as soon as it happened, mean (SD)																
Never	5 (3)	0.001	11 (0.71)	0.93	22 (6.44)	0.07	35.4 (2.07)	0.05	97 (34.77)	0.77	157.6 (25.75)	0.06	21(6.32)	0.42	34.4 (3.21)	0.32
Once	5.66 (1.62)		11.25 (1.32)		29.88 (7.28)		38.06 (2.04)		114.05 (32.14)		160.34 (15.40)		23.59 (6.83)		31.14 (3.66)	
Twice	4 (1)		11.33 (0.58)		25.33 (4.04)		36.33 (3.06)		110.5 (3.54)		131.67 (9.61)		21.33 (4.04)		29 (1.73)	
Several times	6.82 (1.53)		11.36 (1.31)		29.27 (6.15)		37.32 (2.16)		117.05 (32.55)		155.45 (17.24)		20.61 (7.47)		31.58(4.82)	
+Ever had first aid training, mean (SD)																
Yes	6.13 (1.69)	0.92	11.09 (1.70)	0.4	30.70 (5.83)	0.08	37.74 (1.71)	0.62	113.85 (27.43)	0.82	161.83 (14.23)	0.29	21.38 (7.88)	0.75	32.10 (3.95)	0.71
No	6.17 (1.81)		11.34 (1.36)		27.79 (7.05)		37.48 (2.34)		115.79 (32.65)		156.86 (18.48)		22 (7.51)		31.69 (4.37)	
+Do you think first aid knowledge and skills are important to you?, mean (SD)																
Yes	6.07 (1.78)	0.45	11.48 (1.27)	0.02	28.92 (6.88)	0.24	37.53 (2.12)	0.84	116.58 (32.05)	0.55	156.33 (18.79)		21.77 (7.62)	0.88	31.41 (4.39)	0.25
No	6.42 (1.87)		10.68 (1.63)		26.79 (7.11)		37.42 (2.46)		111.44 (28.45)		163.76 (12.00)		22.05 (7.58)		32.76 (3.75)	

*Note: Abbreviation: r: the Pearson correlation coefficient, SD: Standard deviation. * Correlation tests were used ,+ independent samples t-tests were used and ++ a one-way ANOVA were used*

Before the first aid training, several participant characteristics were associated with variations in knowledge scores. Profession was significantly associated with pretest knowledge, with motorcyclists achieving higher scores (mean = 6.67) than bicycle cyclists (mean = 5.6, p = 0.002). Similarly, education level was associated with knowledge, participants who did not complete primary education had lower knowledge (mean = 5.36, p = 0.04). The number of accidents witnessed was also significant, with those who had witnessed accidents twice had lower knowledge scores (mean = 4.00, p=0.001). Other characteristics were not significantly associated with pretest Knowledge scores. Moreover, no participant' characteristics associated with attitude and practice scores. The education level was the only participant characteristic associated with self-efficacy scores; those who had not completed primary education had lower scores (mean = 97.74, p = 0.003).

After the first aid training intervention, there was significant improvement across all domains. The belief that first aid knowledge and skills are important was the only participant characteristic significantly associated with higher post-test knowledge scores (mean= 11.48, p = 0.02). No other participant characteristics were significantly associated with knowledge, attitude, self-efficacy, or practice scores after the intervention (Table 3).

Discussion

This study assessed the effect of first aid training on motorcyclists and cyclists' knowledge, skills, attitude, and self-efficacy in managing road traffic accident victims. The findings reveal key insights into the baseline knowledge, attitude, self-efficacy, and practice of road users to respond to road traffic accidents (RTAs), as well as the effectiveness of first aid training programs.

Effects of first aid training on participants' knowledge

Our study found a significant increase in first aid knowledge scores following the training intervention (mean difference = 5.18, p < 0.001). Although differences in knowledge were observed before the intervention across participant characteristics such as profession, education level, and prior experience of witnessing accidents, these differences disappeared after the training. This indicates that the educational session was highly effective. This finding aligns with previous studies that have highlighted the positive impact of short-term training on knowledge acquisition among lay responders and road users.[17,18] The high post-test scores suggest that even brief training sessions can substantially enhance participants' understanding of basic first aid principles, which could play a crucial role in reducing the severity of injuries in road traffic accidents (RTAs) when emergency medical services are delayed. Consequently, this improvement might increase the chances of survival among RTA victims, as [19], affirms that if bystanders fail to recognize a serious injury or do not know how to call for help, even the most sophisticated emergency care system is ineffective.

Effects of first aid training on participants' attitude

We also found an increase in attitude scores (mean difference = 9.09, p < 0.001) suggests that the intervention positively influenced participants' perceptions of their role in providing first aid. This is consistent with Bandura's Social Cognitive Theory [20] which posits that knowledge, perception of risk, and self-efficacy are essential drivers of behavior. Shaping attitudes is especially important in low-resource settings, where bystander intervention can significantly impact victim outcomes before professional care arrives. This is also evidenced in a previous study where bystanders provided first aid in 20% of road traffic crashes,[17] fostering positive attitudes toward first aid can lead to a cultural shift where laypersons feel both responsible and empowered to intervene during emergencies.

Effects of first aid training on participants' self efficacy

Our study revealed a significant improvement in self-efficacy scores following the first aid training (mean difference = 43.83, $p < 0.001$). These findings are consistent with those of study, reported a significant increase in self-efficacy from pre-course to post-course assessments ($p < 0.001$), with an overall mean (SD) increase of 2.8 (2.1). [21] Similarly, self-efficacy increased greatly immediately after the first training, where simulated patients were used as a training method.[22] These consistent findings across studies underscore the effectiveness of structured first aid training particularly when practical, simulation-based methods are used, in enhancing participants' confidence to respond effectively in emergencies.

Effects of first aid training on participants' skills

The significant gains in practice and skill scores (mean difference = 9.76, $p < 0.001$) further demonstrate the practical utility of the training. This outcome is especially relevant in environments where formal emergency response systems may be limited or delayed. The improvement in skills emphasizes the value of including scenario-based exercises in training programs, which allow participants to move from theory to action. Empowering laypersons such as motorcyclists and cyclists with practical first aid skills can contribute to a stronger community-based emergency response system, reduce pre-hospital mortality, and alleviate the burden on overstretched healthcare services, particularly in low-resource settings.[17–19]

Study limitation

Despite the valuable insights gained from this study, several limitations should be acknowledged. First, the study employed a quasi-experimental design without a control group, limiting the ability to attribute changes solely to the intervention. Second, the evaluation relied partially on self-reported measures, which may be subject to response bias, particularly in assessing attitudes and self-efficacy. Third, the sample was limited to motorcyclists and cyclists in a specific geographic area, which may restrict the generalizability of the findings to other populations or regions. Lastly, practical skill assessments were conducted in a simulated setting, which may not fully reflect participants' real-world performance in actual emergencies.

Conclusion

This study highlights significant improvements in knowledge, skills, attitude, and self-efficacy following first aid training among motorcyclists and cyclists in both rural and urban areas of Rwanda. These findings provide evidence that such training can be effective in equipping laypersons with the knowledge and skills needed to respond quickly after road traffic accidents. Trained individuals may be more likely to activate prehospital emergency services and notify the police, while also providing basic first aid as they wait for emergency responders to arrive at the scene. The researchers recommend scaling up such training nationwide by integrating mandatory first aid instruction into the driving license examination process for motorcyclists and cyclists and developing community-based first aid training programs. Future researches will be needed to scale up the same studies to more laypersons across the country and to explore the impact of trained laypersons on saving lives following road traffic accidents.

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Conflict of interest

None

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Authors' contributions
RL, GN, MMGS, and UP contributed to the proposal writing, data collection, analysis, and manuscript writing; MM, UP, and RD contributed to the proposal writing, data analysis, and manuscript writing; and EN contributed to the manuscript writing.

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