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The Impact of Behavioral Training Interventions on Motorcycle Accident Prevalence: A 6-Month Pre-Post Study among Motorcycle Riders in Kiambu County, Kenya

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Abstract

Motorcycle accidents have become a leading cause of fatalities and injuries in Kenya, with a significant impact on families, communities, and the healthcare system. This study aimed to establish the impact of behavioral training interventions on motorcycle accident prevalence among motorcycle riders in Kiambu County over a 6-month period. The study employed the Epidemiological Model for Non-infectious Diseases as its theoretical framework. A quasi-experimental research design was adopted, with a sample of 140 motorcycle riders randomly selected from Kiambu County. The participants were divided into a control group and an experimental group, with the latter undergoing a 2-week behavioral training intervention conducted by a Cognitive Behavioral Therapist (CBT). The Motorcycle Rider Behavior Questionnaire (MRBQ) was used to assess the effectiveness of the intervention. The findings revealed that during the post-training period, the experimental group experienced a reduced prevalence of motorcycle accidents at 23% (16 out of 70 observations), compared to the control group's prevalence rate of 48% (34 out of 70 observations). A paired sample t-test showed a significant difference between pre-training and post-training periods (p=0.000), and a Chi-square test indicated a significant association between behavioral training interventions and motorcycle safety (X^2^=22.308, df=15, p<0.010). The study concludes that behavioral training interventions have a statistically significant impact on improving motorcycle safety among riders in Kiambu County. It is recommended that the National Transport and Safety Authority (NTSA) incorporates behavioral training as a standard component of the motorcycle licensing process and that policymakers, road safety organizations, and motorcycle rider training programs prioritize the implementation and expansion of these interventions to promote motorcycle safety in Kenya.

1. Introduction

Motorcycles have emerged as a preferred means of transportation in Kenya, especially in rural regions where they offer an economical and practical solution for navigating difficult terrain (NTSA, 2018). The growing popularity of motorcycles over the last ten years has led to a substantial increase in their numbers on Kenyan roads. This growth has also been accompanied by a surge in deadly motorcycle accidents, which have become a leading cause of fatalities and injuries, claiming the lives of thousands of Kenyans each year (NTSA, 2018). Compared to closed vehicles, motorcycles are inherently less crashworthy, less visible to other drivers and pedestrians, and less stable (Nyameino & Akama, 2018). Operating a motorcycle requires a different set of physical and mental skills than those used in driving four-wheel vehicles, and motorcyclists and their passengers are more vulnerable to the hazards of weather and road conditions (Sisimwo & Onchiri, 2018). The risk of a fatal accident per mile travelled is 35 times higher for motorcyclists than for car drivers (NHTSA, 2018).

In Kenya, data from the National Transport and Safety Authority (NTSA) in 2018 indicated that motorcycles had the highest rising cause of death on Kenyan roads. Deaths resulting from motorcycle crashes increased by 17.7% in 2018 compared to 2017, while passenger deaths increased by 13% (NTSA, 2018). These numbers could be even higher, as many road crashes in rural areas go unreported (MOH, 2018). A study by the World Health Organization (2019) found that 36% of patients in emergency departments at Kenyan hospitals were victims of traffic crashes involving motorcycles, and 75% of them were not wearing helmets at the time of the accident. Road traffic crashes, injuries, and deaths involving motorcycles have increased noticeably in Kenya and are placing a heavy burden on families, communities, and the health system (WHO, 2019). There are significant gaps in data availability and quality that limit the development of effective safety solutions. When crash data is available, it may be inaccurate, incomplete, and ultimately uninformative with respect to understanding overall health outcomes. Therefore, this study on motorcycle safety was proposed with the intention of building upon the wealth of road safety practices based on training behavioral interventions to promote motorcycle transport safety, with an emphasis on rural areas.

Motorcycle accidents have become a major contributor to the increasing number of patients admitted to accident wards across Kenya, particularly in Kiambu County (Ngunu, 2015). A preliminary study by the World Health Organization (2018) in Kiambu level 4 hospitals revealed that 36% of patients who presented to the emergency department due to a road traffic crash were motorcyclists, and 75% of these patients admitted to not wearing a helmet at the time of the crash. This alarming statistic highlights the need for effective interventions to reduce motorcycle accidents and fatalities in the area. Riding motorcycles carries a higher risk of being involved in a fatal road crash compared to other modes of transport, and motorcyclists are more likely to suffer serious and multiple injuries (Nyameino, Butt, Guthua, Macigo & Akama, 2018). Inadequate training, failure to wear helmets, and carrying excess passengers are among the key contributors to the rising number of accidents caused by motorcycle riders (Odiwuor, Nyamusi & Odero, 2015). To address this growing concern, it is crucial to implement effective intervention measures that enhance safety for both riders and passengers.

The National Transport and Safety Authority (NTSA) motorcycle licensing process in Kenya does not include mandatory behavioral training. The existing NTSA manual primarily focuses on the technical aspects of riding, such as vehicle control, traffic rules, and road signs (NTSA, 2023).

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However, it does not adequately address the critical role that riders' attitudes, risk perceptions, and decision-making processes play in preventing accidents. The absence of behavioral training in the NTSA manual leaves a significant gap in the preparation of new riders, as they may lack the psychological and cognitive tools necessary to navigate the complex and often unpredictable road environment safely. Given the rising statistics of motorcycle injuries in Kiambu level 4 hospitals, this study sought to establish the impact of behavioral training interventions on motorcycle accident prevalence among motorcycle riders in Kiambu County over a 6-month period. By comparing the prevalence of accidents before and after the implementation of behavioral training interventions, this study aims to provide valuable insights into the effectiveness of such interventions in promoting motorcycle transportation safety among rural motorists.

1.1 Research Objective

To establish the prevalence of motorcycle accidents before and after in 6 months behavioral training interventions among the motorcycle riders in Kiambu County

1.2 Research Question

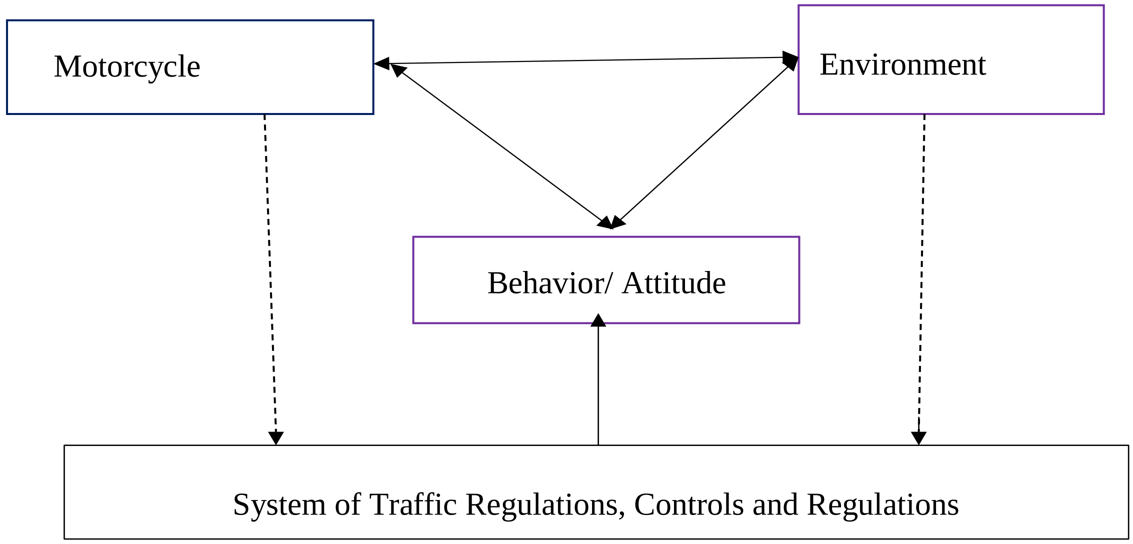
What is the prevalence of motorcycle accidents before and after in 6 months behavioral training interventions among the motorcycle riders in Kiambu County?

2. Literature review

2.1 Theoretical Review

The Epidemiological Model for Noninfectious Diseases

This Epidemiological model for non-infectious diseases such as accidents is adapted from Jorgensen Abane (1999). The model is a sub of system theory and it will be used with its key components of system of traffic laws, control regulation and as well as looking at aspects of behavior, vehicle and the environment. Traffic laws and regulations will help to highlight on the countermeasures. This is as shown in Figure 1.



Source: Adapted from Jorgensen and Abane (1999)

Figure 1: Epidemiological Model

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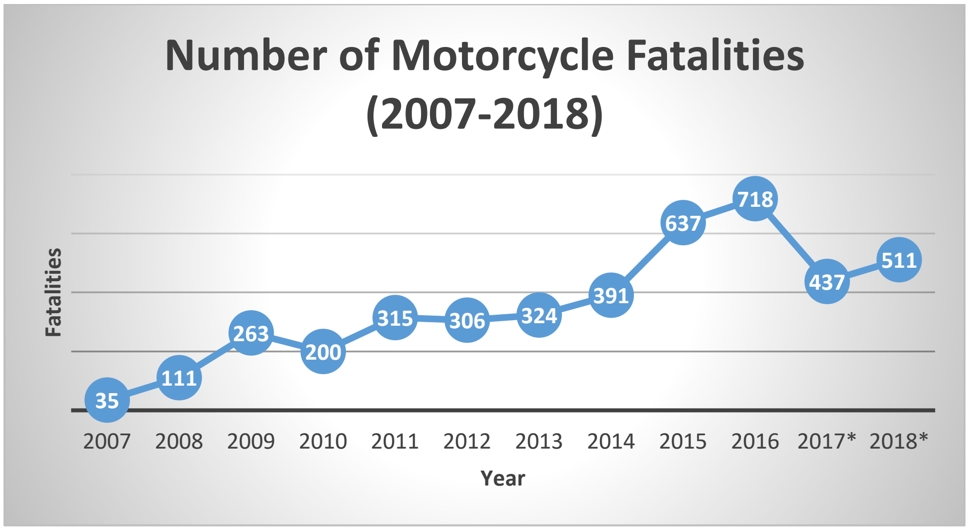
The model proposes that dealing with risk factors and prevention measures, four aspects should all be considered. These are the vehicle, behavior, physical environment and traffic regulations and control. The strength of this model is in its holistic approach to road traffic accident causation. All categories of road users are covered and it adds the policy making and implementation aspect. The path line arrows in the Figure 2.1 show direction of influence and nature of relationship among the different elements of the model. Odero et.al (2003) studying road traffic injuries in Kenya, identified major causes of road crashes as being human factors (85%), vehicle factors (5.1 %), road environment (2.9%) and other factors (6.4 %). On the other hand, Vitalis, Runyoro and Selemani (2021) found road design deficiencies, human factors and lack of proper enforcement as contributing factors to unsafe roadways in Tanzania.

2.2 Empirical Review

A study conducted by Kardamanidis (2020) evaluated the motorcycle rider training for the prevention of road traffic crashes. The study reviewed 23 studies: three randomised trials, two non-randomised trials, 14 cohort studies and four case-control studies. Five examined mandatory pre-licence training, 14 assessed non-mandatory training, three of the case-control studies assessed 'any' type of rider training, and one case-control study assessed mandatory pre-licence training and non-mandatory training. The types of assessed rider training varied in duration and content. However due to the poor quality of studies identified, we were unable to draw any conclusions about the effectiveness of rider training on crash, injury, or offence rates. The findings suggest that mandatory pre-licence training may be an impediment to completing a motorcycle licensing process, possibly indirectly reducing crashes through a reduction in exposure. Therefore, this study sought to fill this research gap.

Similarly, a study by Zulkipli et al (2018) evaluated the impact of a behavioral training program on the driving behavior of motorcycle riders. The training program included lectures, practical demonstrations, and on-road training, and was found to significantly improve the driving behavior of participants. Another study by Bao et al (2018) evaluated the effectiveness of a motorcycle safety training program that incorporated both behavioral and technical skills training. The program was found to significantly reduce the incidence of accidents among participants and improve their driving skills. A review article by De Rome et al (2017) examined the effectiveness of different types of motorcycle training programs. The review found that behavioral training programs that incorporated both classroom and on-road training were effective in improving driving behavior and reducing the incidence of accidents.

In Kenya, young people have been attracted into *boda boda* taxi business even without the necessary basic training which has also turned to be recipe to many accidents as well as violation of traffic rules (Nyachieo, 2015). In terms of training, many of the riders do not have formal training. Big percentage of the riders acquire riding skills through fellow riders at a fee of between 50 and 200 shillings. A study that was conducted in Kisumu found that only 39% of the riders had formal training from the driving schools (Nyachieo, 2015). Studying road traffic accidents in developing countries, Odero et al. (2003), observed that between 60 and 80 % of casualties were injured during the day and only one-third of traffic injuries occurred during the night between 18:00 and 24:00 hours. During the day, there is usually traffic congestion during 'rush hours' and more risk exposure to pedestrians' hence higher probability of collisions. Drivers force their way to cover up open spaces in the congestion disregarding breaking distance. But day accidents on the other hand are less severe due to low speed of vehicles move to those that occur at night when drivers over speed. The night create scope for risk taking behavior than day time because there is less presence of traffic police hence rule violation is common especially drink and drive and speed limit violation. According to the NTSA, the rate of motorcycle fatalities in the country has been on a high trend. In 2018, motorcycle fatalities were 511 compared to 437 in 2017 as shown in Figure 1.



(NTSA, 2018)

Figure 1: Motorcycle Fatalities

Motorcycles can additionally extra conveniently traverse and steer over all sort of roads. Registered motorcycles in Kenya have in fact boosted through over 600 percent surge in 6 years (Kenya National Bureau of Statistics, 2018). There has been arise in motorcycle fatalities divulged in Kenya (WHO, 2018).

2.3 Conceptual Framework

The conceptual framework presents the organization of the study objectives. The knowledge on risk behaviors, causes and prevalence of motorcycle accidents, prevalence of motorcycle fatalities, regulatory compliance and awareness on training behavioral interventions formed the inputs. The outcome was motorcycle safety where it was evaluated using number of fatal accidents, number of minor accidents, accident emergency response, and compliance to road safety and ease of reporting on accidents. The conceptual framework is as shown in Figure 2.

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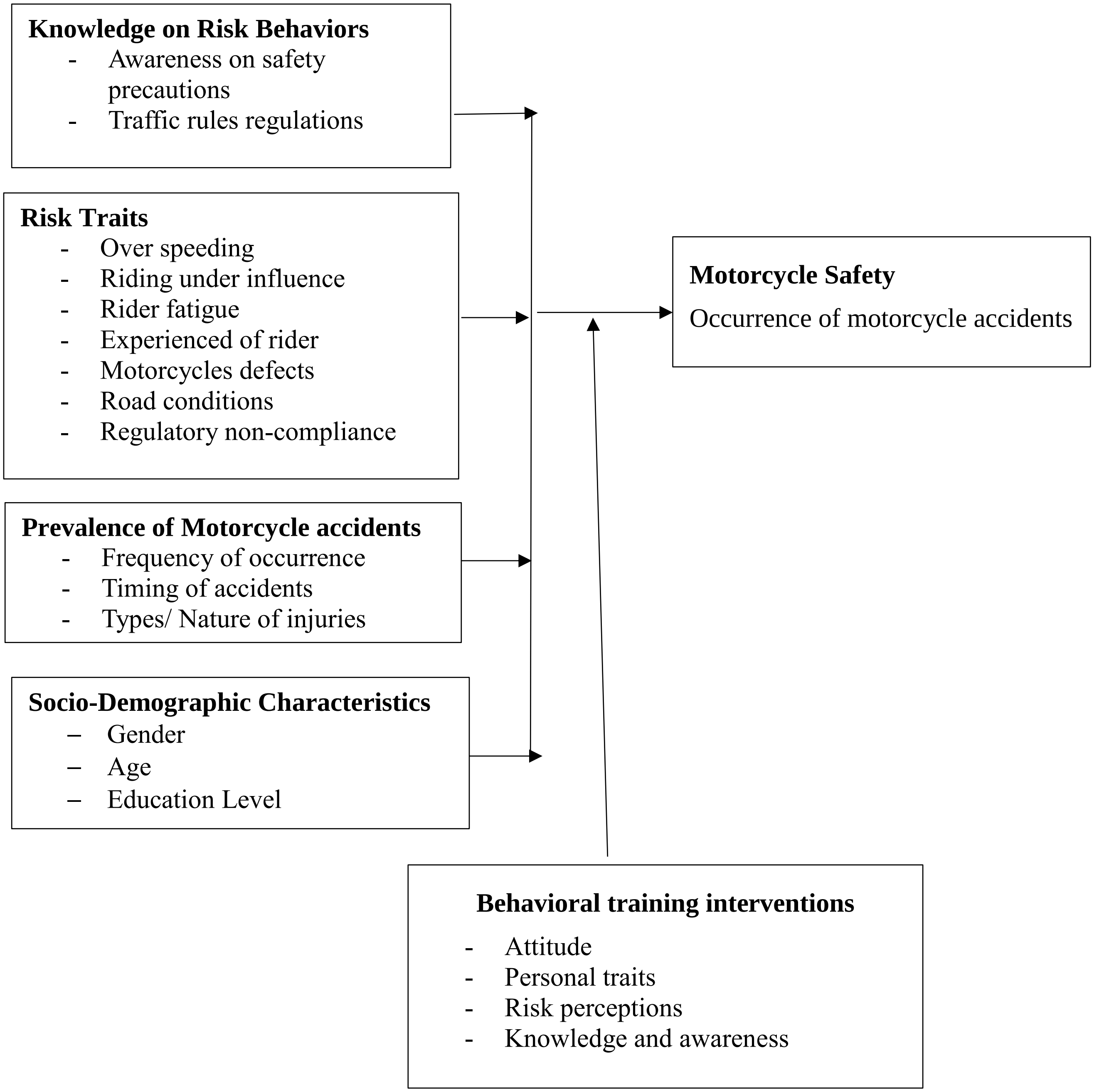

Figure 2: Conceptual Framework

3. Materials and Methods

The study adopted a quasi-experimental research design which establishes a relationship between the cause and effect of a situation. Motorcycle taxi riders in Kiambu County formed the target population for this study. These includes the motorcycle taxi riders in Kikuyu, Githunguri, Gatundu South, Thika and Kiambu Sub Counties for objective representation of the entire Kiambu County The county, comprising 12 sub-counties, served as the study area, with a focus on Kikuyu,

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Githunguri, Gatundu South, Thika, and Kiambu Sub Counties for diverse representation. A simple random sampling approach was utilized to ensure each individual had an equal chance of selection, promoting fairness and reducing biases in the sampling process. Using the Altman‘s nomogram a sample size of 140 was achieved. Therefore, motorcycle riders were randomly selected from the riders Sacco.

The training behavioral interventions for motorcycle safety, which formed the intervening variable in this study, focused on key indicators such as attitude, personal traits, risk perceptions, and knowledge and awareness. Attitude refers to individuals' predispositions to respond positively or negatively towards certain ideas or behaviors, influencing how they absorb and respond to training. Personal traits, including resilience, adaptability, and openness, significantly dictate how individuals process and implement learned behaviors. Risk perceptions involve an individual's understanding and evaluation of potential risks, impacting their decision-making and behavior following training. Knowledge and awareness pertain to the level of understanding about the behaviors and practices being targeted by the training, which is crucial for the effectiveness of the interventions. The training was conducted using a field study experiment for 2 weeks, with assessments before and after a 6-month period, to determine the impact on motorcycle accident outcomes among the riders.

A Cognitive Behavioral Therapist (CBT) was responsible for conducting the training, focusing on behavioral aspects of risk, consequences, attitude, personal traits, risk perceptions, and knowledge and awareness. The CBT utilized manuals and materials sourced from an NTSA authorized motorcycle-training agency to ensure the training was contextually relevant. The Motorcycle Rider Behavior Questionnaire (MRBQ), a validated tool developed by Elliott, Baughan, and Sexton (2007), was adopted in this study to assess the effectiveness of the behavioral training intervention. The MRBQ has been widely used in motorcycle safety research across different countries and contexts, such as in the United Kingdom, Australia, and Iran. It consists of several subscales that evaluate traffic errors, speed violations, use of safety equipment, engagement in stunts, control errors, and attitudes toward safety. By incorporating the MRBQ into the training package, the CBT can assess riders' behaviors and attitudes before and after the intervention, providing a standardized and validated measure of the training's effectiveness and identifying specific areas where riders may need additional support or targeted training.

Using the Altman‘s nomogram (Appendix 6) the number of motorcycle riders required in order to have an 80% power of detecting a motorcycle accidents difference in success rates of 25% between the two groups of the trained and untrained groups at the 5% level of significance; assuming a success rate of 30% in the group having the least successful treatment was; P_1 = 0.30 and P_2 =0.50, so,

0. $\frac{30 + 0.50}{2}$

$p == 0.4$

Therefore, the standardized difference,

$$= \frac{p_1 - p_2}{\sqrt{\overline{p}(1 - \overline{p})}}$$

$$= \frac{0.30 - 0.50}{\sqrt{0.40(1 - 0.40)}}$$

Standard difference = 0.4082

The line linking a standardized distinction of 0.4082 and also an electrical power of 80% reduces the sample measurements center at 140. Hence, 70 people were called for in each group. Atman's nomogram for example size computation was used. The 140 motorcycle riders were randomly selected from the riders Sacco.

The data was cleaned then coded by grouping data into responses on independent variables and measures of the dependent variable. Statistical Package for Social Sciences (SPSS) was used to analyze the data. Ethical clearance was sought from Kenyatta University Graduate School and consequently a research authorization was acquired from NACOSTI. Further, Ministry of Transport & Infrastructure officials and health officials in Kiambu County were informed. The research study took into consideration confidentiality, privacy and personal privacy of the respondents along with guaranteeing that the communities in the research place are actually not adversely had an effect on by the study. All data acquired was confidential and made use of for the main function of the research.

Both control and experimental groups underwent pre-training assessment and post-training assessment. This is as illustrated in the intervention and experimental chart in Figure 3.

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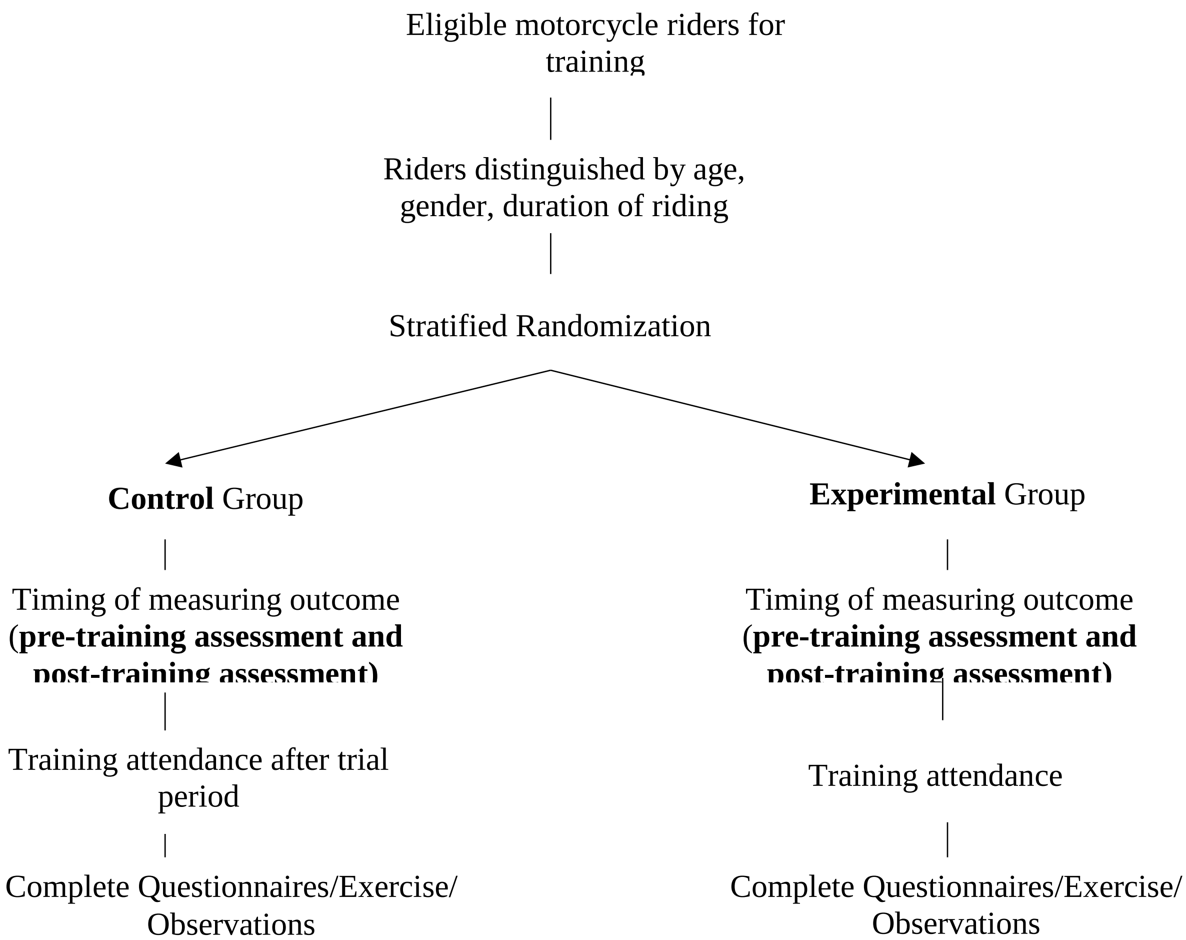

Figure 2: Behavioral Intervention and Experimental Chart

4. Results

The data was analyzed in three groups; main riders (before any intervention), control group and the experiment group). The study utilized three distinct groups to ensure a comprehensive and accurate analysis. The first group, 'main riders', served as a baseline. They did not participate in any intervention, allowing us to understand the natural characteristics and behaviors of riders without external influences. The second group, the 'control group', was crucial for establishing a comparative standard. Just like the main riders, they did not receive any training, ensuring that any observed changes in the third group could be attributed to the intervention rather than external factors. The third group, the 'experiment group', underwent the behavioral intervention training for a period of 6 months. The inclusion of this group was vital to directly assess the impact of the intervention on rider behavior. The distinct data from each group was essential to isolate the effects of the intervention and validate its efficacy, ensuring that any observed behavioral changes could be confidently attributed to the training provided.

4.1 Prevalence of Motorcycle Accidents for Control Group

The control group was crucial for establishing a comparative standard. The control group did not receive any training, ensuring that any observed changes in the third group could be attributed to the intervention rather than external factors. A total of 70 motorcycle riders participated in the study for 6 months. The prevalence of motorcycle accidents among motorcycle riders results are as shown in Table 1. The results show that during the period, 34 motorcycle accidents were recorded from a total of 70 observation and prevalence rate of 48%.

Table 1: Prevalence of Motorcycle Accidents for Control Group

Period	Total participants	Occurrence of Motorcycle Accidents	Percentage
Control group	70	34	48%

4.2 Training Intervention of Motorcycle Accidents among Riders

The trained group underwent the behavioral intervention training. The inclusion of this group was vital to directly assess the impact of the intervention on rider behavior. Formal behavioral training was conducted focusing on riding skills enhancement, riding skills, riding attitude, personal traits, risk perceptions, knowledge and awareness. After the training period, the statistics on motorcycle incidents, minor accidents and major accidents were assessed to determine the effect of the training behavioral interventions.

A total of 70 motorcycle riders participated in the behavioral training on motorcycle safety during the 6 months training period. The prevalence of motorcycle accidents among motorcycle riders results are as shown in Table 2. The results show that during the post- training, 16 motorcycle accidents were recorded from a total of 70 observation and prevalence rate of 23%.

Table 2: Prevalence of Motorcycle Accidents among Motorcycle Riders

Period	Total participants	Occurrence of Motorcycle Accidents	Percentage
Trained group	70	16	23%

4.3 Training and Occurrence of Accidents

The training behavioral intervention was conducted using a field study experiment before and after in 6 months to determine the motorcycle accidents outcome among the motorcycle riders. A paired sample t-test procedure was used to determine whether the mean difference between the pre-training and post training period. The paired sample t-test output indicates that the mean for the pre-training is 5.52, and for the post-training, it is 1.87. The average difference between the paired pretest and posttest scores is -3.65. The p-value (0.000) is less than the significance level (0.05) and the difference does not equal zero. Since the p-value (0.000) for the paired sample t-test is less than the standard significance level of 0.05, we reject the null hypothesis. The data support the notion that the average paired difference does not equal zero. The pre-training and post-training outputs are as shown in Table 3.

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Table 3: Pre-training and Post-training Outputs

Paired Samples Statistics

	Mean	Std. Deviation	Std. Error Mean
Control Group	5.52	2.994	0.377
Trained Group	1.87	0.833	0.105

Paired Samples Correlations

	Correlation	Sig.
Control Group-Trained Group	0.63	0.202

Paired Samples Test

	Paired Differences			t	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean		
Control Group-Trained Group	3.651	2.974	0.375	9.74	0.000

In addition, a Chi-square was conducted to determine if there was a statistical significant effect of behavioral training intervention on motorcycle safety. Phi and Cramer's V was used a measure of substantive significance between behavioral training intervention and motorcycle safety. Chi-square test of independence reported a significant association between behavioral training intervention on motorcycle safety (X^2 =22.308, df =15, p* <.0.010). The Phi coefficient of correlation was associated with the chi-square test of significance. The Phi coefficient was used to quantify the strength of the association between behavioral training intervention on motorcycle safety (Phi = .399, p=0.011). The Cramer's V coefficient was 0.230 and the probability was less than .001. Behavioral training intervention and motorcycle safety are thus significantly related. The results are as shown in Table 4.

Table 4: Chi-square and Phi and Cramer's V

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	22.308a	15	0.010
Likelihood Ratio	23.713	15	0.030
Linear-by-Linear Association	2.49	1	0.015
N of Valid Cases	70		

Symmetric Measures

		Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Nominal by Nominal	Phi	0.399			0.011
	Cramer's V	0.230			0.011
Interval by Interval	Pearson's R	0.134	0.0083	16.1446	0.015[c]
Ordinal by Ordinal	Spearman Correlation	0.132	0.0083	15.9036	0.019[c]

4.4 Hypothesis Testing

The study was stated in null hypothesis that;

Ho: Behavioral training intervention does not have a statistical significance on motorcycle safety among motorist of Kiambu County.

The p-value was 0.000, which is less than the significance level of 0.05. Since the p-value 0.000<0.05, we reject the null hypothesis that behavioral training intervention does not have a statistical significance on motorcycle safety among motorist of Kiambu County. Therefore, the study adopted the alternative hypothesis that behavioral training intervention has a statistical significance on motorcycle safety among motorist of Kiambu County.

In addition, the Chi-square test reported a significant association between behavioral training intervention on motorcycle safety (X2 =22.308, df =15, p* <.0.010). The Phi coefficient (Phi = .399, p=0.011) and the Cramer's V coefficient (0.230 p= .001>0.05. The null hypothesis was rejected. The alternative hypothesis was adopted that behavioral training intervention has a statistical significance on motorcycle safety among motorist of Kiambu County.

4.5 Discussion of findings

The objective was to establish the prevalence of motorcycle accidents before and after in 6 months behavioral training interventions among the motorcycle riders in Kiambu County. The findings showed that during the post- training, 16 motorcycle accidents were recorded from a total of 70 observation and prevalence rate of 23%.

The paired sample t-test procedure was used to determine whether the mean difference between the pre-training and post-training period. The p-value was 0.000, which is less than the significance level of 0.05. Since the p-value 0.000<0.05, we reject the null hypothesis behavioral training intervention does not have a statistical significance on motorcycle safety among motorist of Kiambu County. Further, the Chi-square test reported a significant association between behavioral training intervention on motorcycle safety (X2 =22.308, df =15, p* <.0.010). The Phi coefficient (Phi = .399, p=0.011) and the Cramer's V coefficient (0.230 p= .001>0.05. The null hypothesis was rejected. Therefore, the study adopted the alternative hypothesis that behavioral training intervention has a statistical significance on motorcycle safety among motorist of Kiambu County.

This is an important finding for this study because these results may mean that formal training is necessary for motorcycle safety. Findings from related studies clearly indicate that training is a serious issue in commercial motorcycle business. The 2015 survey by Ngim and Udosen (2017) evaluating the attitude of *Alalok* riders to road safety indicated that of 247 interviewed commercial motorcyclists, less than half, that is (41.3% had received formal training on motorcycle riding, and only 88 or 35.6% had a motorcycle riders' license. One important way to reduce the risk of motorcycle accidents and fatalities is through motorcycle behavioral training for riders. Motorcycle behavioral training can teach riders how to operate their motorcycles safely and defensively, how to avoid common causes of motorcycle accidents, and how to respond in emergency situations. Training can also help riders develop the necessary skills to navigate through traffic, make quick and precise turns, and handle their motorcycles in difficult conditions such as rain or gravel.

In addition to learning these technical skills, safety training can also teach riders how to be more aware of their surroundings and anticipate potential hazards. For example, riders can learn how to

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identify and react to the cues of other drivers, such as turning signals or changing lanes. They can also learn how to adjust their riding style to suit different road conditions and environments. Motorcycle behavioral training can be especially important for new riders, who may not have had the opportunity to develop the experience and judgement of more experienced riders. However, even experienced riders can benefit from safety training, as it can help them refresh and improve their skills, and learn about new developments in motorcycle safety technology. Safety training is an essential aspect of motorcycle riding, and can greatly reduce the risk of accidents and injuries.

5. Conclusions

The study concludes that behavioral training interventions have a statistically significant impact on improving motorcycle safety among riders in Kiambu County. This conclusion is drawn from the observed decrease in motorcycle accidents post-training, with a prevalence rate of 23% based on 16 accidents out of 70 observations. The statistical analysis, employing a paired sample t-test, demonstrated a meaningful difference between pre-training and post-training periods, as evidenced by a p-value of 0.000, which is substantially lower than the significance level of 0.05. Additionally, the Chi-square test further supported this finding, indicating a significant association between behavioral training interventions and motorcycle safety. The results, including the Phi coefficient and Cramer's V coefficient, decisively reject the null hypothesis, thereby affirming the effectiveness of behavioral training in enhancing road safety for motorcyclists.

6. Recommendations

The study recommends that the National Transport and Safety Authority (NTSA) incorporates behavioral training as a standard component of the motorcycle licensing process in its manual. The findings demonstrate that well-designed behavioral training programs significantly reduce accident rates and promote safe riding practices among motorcycle riders. By making behavioral training a prerequisite for obtaining a motorcycle license, the NTSA can ensure that all new riders are equipped with the necessary knowledge, skills, and attitudes to make responsible decisions on the road. This proactive approach to accident prevention will help address critical risk behaviors, such as speeding, impaired riding, and helmet use, which are major contributors to motorcycle accidents in Kenya. Furthermore, policymakers, road safety organizations, and motorcycle rider training programs should prioritize the implementation and expansion of behavioral training interventions, incorporating specific components that address the most critical risk behaviors identified in the study. Sufficient resources should be allocated to support the development, implementation, and evaluation of these training programs, as well as to enforce existing traffic laws and regulations related to motorcycle safety.

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