

**OCCUPATIONAL HEALTH HAZARDS AND SAFETY NEEDS OF
COMMERCIAL MOTORCYCLISTS IN, KAPSERET SUB COUNTY, UASIN GISHU
COUNTY, KENYA**

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**A Thesis Submitted to the Graduate School in Partial Fulfilment of the
Requirements for the Master of Science Degree in Environmental and Occupational
Health of Egerton University**


EGERTON UNIVERSITY

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DECLARATION AND RECOMMENDATION

Declaration

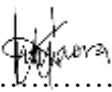
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DEDICATION

I wholeheartedly dedicate this thesis to my loving parents, Mr. Dominic Menjo and Mrs. Milcah Bore for their endless love, support, encouragement and prayers throughout my study. Thank you for being my source of inspiration and guidance and for instilling in me the value of perseverance and diligence. Special dedication goes to my dear siblings Peter Lagat, Betty Bore and Sosten Maritim for being my best cheerleaders.

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ABSTRACT

In Kenya, the commercial motorcycle (*boda boda*) industry is one of the largest informal sector employing over 2 million riders and is a source of livelihood to 5 million Kenyans. Unprecedented levels of youth unemployment in Uasin Gishu County have driven novice riders to venture into the *boda boda* business with minimal recourse of the occupational hazards and risks they will be exposed to. Escalating cases of *boda boda* related accidents and fatalities in the region prompted the Moi Teaching and Referral Hospital to set aside wards that cater for injured riders. The broad objective of this study was to assess occupational health hazards and safety needs of commercial motorcyclists in Kapseret Sub-County, Uasin Gishu County. The study used a cross-sectional research design. A two-stage cluster sampling technique was used to select study participants to the desired sample size of 368. Qualitative and quantitative data was collected using questionnaires, key informant interviews and focus group discussions. Descriptive and inferential (chi-square) analysis was executed using SPSS software Version 20. From the findings, psychosocial, physical and ergonomic hazards featured as the predominant occupational hazards among commercial riders in Kapseret Sub-County with stress being categorized as high risk factor (55.4 %). The level of compliance to recommended Occupational Health and Safety practices among the riders was low, a factor that was attributed to lack of formal training whereby, 47.6 % were novice riders with no formal training. The study established a prevalence of 57.5% of road traffic crashes in Kapseret –Sub-County mainly attributed to alcohol abuse, over speeding and poor visibility. The chi –square test results revealed that there was a significant relationship between rider training and accident involvement ($\chi^2=151.7$; $df = 4$; $p= 0.000$). Socio-demographic factors significantly associated with *boda boda* accidents in the study area included age ($p=0.000$), education level ($p=0.016$) and motorcycle ownership ($p= 0.018$). This study therefore demonstrates that commercial riding is an inherently risky occupation and the risk is exacerbated by precarious behavioural factors that increase the likelihood of fatal crash involvement. This study recommends for interventions aimed at enhancing capacity and behaviour change in the *boda boda* sector through refinement of the training curriculum, concerted sensitization on statutory requirements and strict enforcement of safety laws to enhance occupational safety in Kenya during the 2nd UN Decade of Action for Road Safety 2021-2030.

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LIST OF ABBREVIATIONS AND ACRONYMS

HIRAC	Hazard Identification, Risk Assessment and Control measures
ILO	International Labor Organization
LMICs	Lower and Middle Income Countries
MCI	Motorcycle Related Injuries
NHTSA	Nation Highway Traffic Safety Administration
NTSA	National Transport and Safety Authority
NYS	National Youth Service
OSHA	Occupational Safety and Health Act
PPE	Personal Protective Equipment
RTAs	Road Traffic Accidents
RTC	Road Traffic Crash
RTDs	Road Traffic Deaths
RTIs	Road Traffic Injuries
UNGA	United Nations General Assembly
UN	United Nations
VRUs	Vulnerable Road Users
WBV	Whole Body Vibration
WHO	World Health Organization

CHAPTER ONE

INTRODUCTION

1.1 Background of the study

World Health Organization (WHO) in 2018 revealed that approximately 1.35 million people die each year due to road accidents. Despite considerable road safety progress made during the previous Decade of Action for Road Safety 2011-2020, the number of road traffic deaths remains unacceptably high with 90% of the fatalities occurring in developing countries. According to projected trends, fatalities related to road traffic accidents will be the fifth leading cause of reported deaths by 2030 (WHO, 2018). Based on the aforementioned statistics, appropriate precautionary measures need to be put in place in order to realize UN Sustainable Development Goal (SDG) target 3.6 which seeks to achieve a 50% reduction in the number of reported road traffic injuries and deaths during the Second Decade of Action for Road Safety 2021-2030 (World Health Organization, 2020).

Motorcyclists are categorized as vulnerable road users (inclusive of cyclists and pedestrians) and account for more than 50% of deaths globally among different road user categories (WHO, 2018). Commercial riding is an inherently risky occupation as an effect of exposure to physical, psychosocial, chemical, biological and ergonomic related hazards. The USA federal government comprehensive data indicates that 4,985 motorcycle related fatalities were reported in 2019; 29% of the motorcyclists did not have valid license (Centers for Disease Control and Prevention, 2020). Motorcyclists are often exposed to the following physical hazards excessive heat, deafening noise levels, vibrations, lacerations and cuts resulting from physical injuries (International Labour Organization, 2019). The risk of noise-induced hearing loss among professional commercial riders is significantly high prompting the United States to make external structural modifications on aerodynamic features of modern helmets (NHTSA, 2017).

In India, motorcycle related deaths account for 30.9% of all road fatalities and this is estimated to be 69% higher than the global average. The higher death rate in India is mainly attributed to poor infrastructure, poor enforcement of speed limits, motorcycle helmet use and minimal involvement of vulnerable road users in designing and operation of roads (Pal *et al.*, 2019). Depending on the nature of the accident, motorcycle crashes often result in heavy economic implications mainly as an effect of: high treatment costs, property and motorcycle damage, litigation costs, burial related expenses in the event of death and the loss of manpower (Chen *et al.*, 2019). The seated posture and static working position adopted by commercial

motorcyclists is an ergonomic risk and is associated with the development of spinal injury and extensive musculoskeletal disorders (Carvalho *et al.*, 2018).

In Africa the use of commercial motorcycles as a conventional public transport means is highly patronized with the two-wheeler market projected to cross 9 billion dollars by the end of 2024. The growth is partly due to increased urbanization, easy financing, unreliable public transportation systems and the fact that there is an influx of motorcycles from India which are favourably cheap. In Nigeria, The Highway Code statistics reveal that in the event of a crash, motorcyclists are six times more likely to die when compared to other motor vehicles that are enclosed (Yunusa *et al.*, 2014). Riders are often exposed to chemical hazards like flammable liquids, corrosives, degreasers, welding fumes, diesel fuel and petrol. Long-term occupational exposure to toxic chemicals through dermal contact, dietary intake and by breathing toxic fumes often leads to adverse health effects since the chemicals contain toxic compounds like carcinogens, irritants and corrosives (Chernyshev *et al.*, 2018). Understanding *boda boda* rider hazard awareness on chemical exposure is vital to ensure riders are fortified with relevant information on risks of combined exposure to multiple chemicals.

In Uganda, more than 41% of the reported cases of road traffic injuries and fatalities are linked to motorcyclists. Psychosocial and behavioural aspects play a critical role in motorcycle accidents. Perceived psychosocial hazards associated with accidents in the *boda boda* industry include violence, stress, fatigue, aggression, bullying, harassment and job strain (Haworth *et al.*, 2005). Consequentially, the economic burden resulting from the treatment of road traffic injuries (RTIs) is estimated to be between 300-369 USD per case. Cited risk factors for motorcycle accident included non-adherence to road signs, excessive speed, carrying in excess of one passenger, unlicensed riding, alcohol and drug use (Kimuli *et al.*, 2017). Additionally, modifiable behaviours like rider experience, risk taking, riding speed, control errors and traffic errors also contribute to (RTIs).

Kenya is ranked as the third largest most lucrative market for motorcycles in Africa. The number of registered motorcycles in Kenya increased from 53,508 units in 2004 to an astounding 1,147,403 registered units in 2016 (KNBS, 2016). Motorcycles (*boda boda*) have become a vital mode of transport in Kenya due to poor organization of public transport systems, ease of manoeuvrability, demand responsiveness, minimal regulation from authorities, zero-rated import duty and the fact that motorcycles can be used in all-weather roads (WHO, 2017). Despite the numerous advantages associated with the commercial motorcycles, the observed rapid growth has resulted in increased fatalities, adverse traffic management complexities, extensive air pollution mainly as an effect of emission of greenhouse gases and local noise

pollution. Key *boda boda* safety policies that govern the *sector* include; training requirements, licencing, non-compliance penalties, drugs and substance abuse and third-party insurance specifications. National Transport and Safety Authority (NTSA) trend analysis indicate that motorcycle related fatalities and injuries increased from 26% in 2015 to 46.5% in January 2020 (National Transport and Safety Authority, 2020). *Boda boda* riding was one of the high-risk professions during the COVID-19 coronavirus pandemic. The risk of rider exposure to the Coronavirus (a biological hazard) was significantly high due to close contact with varied passengers and flouting of Covid-19 safety protocols (Ministry of Health -Kenya, 2020).

Kapseret Sub-County hosts Eldoret town which is the fifth densely populated urban area in Kenya as per the 2019 census. Unprecedented levels of youth unemployment in the Sub-County has driven novice riders to venture into the *boda boda* business with minimal recourse of the occupational hazards and risks they will be exposed to. Data from the department of Co-operative and Enterprise Development reveal that Uasin Gishu County has 26 registered *boda boda* Sacco's with at least 9,000 members. Escalating cases of *boda boda* related traffic crashes prompted the Moi Teaching and Referral Hospital to set aside wards that caters for traumatic injuries occasioned by motorcycle related traffic accidents. The County Assembly passed a motion in 2019 directing the department of roads in collaboration with NTSA to carry out extensive *boda boda* training in a bid to curb road traffic menace and related accidents (National Transport and Safety Authority, 2020). The objective of this study was to assess occupational health hazards and safety needs of commercial motorcyclists in Kapseret Sub-County, Uasin Gishu County Kenya.

1.2 Statement of the problem

Motorcyclists are among the most vulnerable road users (VRUs) globally, accounting for nearly a quarter of global road traffic mortality annually. In Kenya, the severe economic hardship in the country coupled with high rate of unemployment has necessitated continuous increase in the number of people riding commercial motor-cycles for their livelihood. According to NTSA statistics, in 2021, *boda boda* rider death rose by 7% to stand at 1,154 from 1,075 in 2020 and 1,209 motor-cycle related fatalities had been reported as of 31st December, 2022. Motorcyclists are predisposed to a number of hazards which increases the risk of injuries and related fatalities in cases of fatal road accidents. The increased popularity of *boda boda* as a mode of transport in Uasin Gishu County has resulted in escalating cases of occupational injuries and fatalities. Cases of motorcycle related road traffic accidents in Kapseret Sub-County have continued to rise and has thus put an enormous burden on the health care sector. The Moi Teaching and Referral Hospital, Eldoret, had to set aside Orthopaedics

and Trauma Wards to specifically cater for traumatic injuries occasioned by motorcycle related traffic accidents in the County. The high prevalence of traffic crashes and injuries make *boda boda* riding an inherently risky occupation. Therefore, the objective of this study was to establish underlying factors which influence on-road riding behaviour, safety practices and severity of motorcycle related road traffic accidents amongst *boda boda* riders in Uasin Gishu County. The study aimed to provide more insight on appropriate target actions that would help to reduce high crash rates and related fatalities among commercial motorcyclists during the 2nd UN Decade of Action for Road Safety 2021-2030.

1.3: Objective of the Study

1.3.1: Broad Objective:

To enhance traffic safety among commercial motorcyclists in Kapseret Sub-County by identifying occupational health hazards and safety risks.

1.3.2: Specific Objectives

The study was guided by the following specific objectives;

- (i) To assess occupational hazards among commercial motorcyclists in Kapseret Sub-County.
- (ii) To establish knowledge, perception and extent of compliance to recommended OSH practices among commercial motorcyclists in Kapseret Sub-County.
- (iii) To determine the prevalence of commercial motor cycle related road traffic accidents in Kapseret Sub-County.
- (iv) To establish the relationship between socio demographic characteristics of *boda boda* riders and occurrence of road traffic accidents in Kapseret Sub-County.

1.4: Research Questions

The study sought answers to the following questions;

- (i) What are key occupational hazards affecting commercial motorcyclists in Kapseret Sub-County?
- (ii) How does knowledge and perception influence the extent of compliance to recommended OSH practices among commercial motorcyclists in Kapseret Sub-County?
- (iii) What is the prevalence of commercial motor cycle related road traffic accidents in Kapseret Sub-County?
- (iv) What is the relationship between the socio demographic profiles of *boda boda* riders and the occurrence of road traffic accidents in Kapseret Sub-County?

1.5: Justification of the Study

The scarcity of existing data on occupational health hazards and safety habits among commercial motorcyclists in Uasin Gishu County necessitated a further look into the causative factors influencing the occurrence of such hazards. According to research, vulnerable road users (motorcyclists, pedestrians, cyclists and passengers) account for 46% of global road traffic deaths. In order to improve on road safety at the global level, the United Nations General Assembly adopted Sustainable Development Goals: target 3.6, to halve the number of road injuries and deaths by 2030; and target 11.2, to provide access to safe, affordable, accessible and sustainable transport systems for all by 2030 (World Health Organization, 2011). The government of Kenya recognizes the *boda boda* informal sector as one of the critical enablers in achieving the Vision 2030 development blueprint.

The study therefore contributes evidence that could help policy makers take action on improving road safety performance records and implementing United Nations road safety legal instruments during the 2nd UN Decade of Action for Road Safety (2021-2030). The findings from this research provides additional insight on on how to curb the menace of commercial motorcycle accidents helping researchers, authorities and policy makers figure out which occupational hazard is most rampant in Uasin Gishu County and appropriate target actions that should be adopted in order to caution the most VRUs categories (motorcyclists). These actions are as envisioned by the Uasin Gishu County Integrated Development Plan (CIDP) 2023-2027. Understanding the aforementioned influences on rider intentions and behaviour may facilitate the refinement of training interventions and would inform proper policy formulation, appropriate public sensitization as well as road infrastructural development. Establishing a dynamic, vibrant and sustainable *boda boda* industry that is responsive to the transport and safety needs of all road users will accelerate economic and social growth in Kenya as envisioned in Vision 2030.

1.6: Scope and limitations of the Study.

The study was carried out in Kapseret Sub-County which hosts Eldoret town, the largest administrative and commercial centre in the region and the fifth densely populated urban area in Kenya as per the 2019 census. The study focused on occupational health hazards and safety needs of commercial motorcyclists in Kapseret Sub-County. Commercial motorcyclists (*boda boda* riders) in Kapseret Sub-County were the target population during the study. The study used a cross-sectional research design and confined itself to a sample size of 368 riders drawn from registered assembly points and 30 key informants from the following groups; health care officers, county officials, *boda boda* association stakeholders and traffic officers. The study

was carried out from March 2023 to August 2023 where primary data was captured using self-administered questionnaires. Secondary data with special focus on *boda boda* accidents and related fatalities was obtained from the County Police Traffic Department.

The key limitation of the study was high mobility of *boda boda* riders in the urban set-up in response to customer demand and thus made it difficult to complete an interview. The study prevailed over the aforementioned limitation by administering questionnaires during off-peak hours. There was also a lot of bureaucracy in obtaining accident records from the traffic department and this was dealt with by obtaining a written approval from the traffic commandant, Uasin Gishu County.

1.6.1: Assumptions of the Study

The study was conducted based on the following assumptions;

- i. The respondents were honest and truthful in their responses
- ii. The information given was a true reflection of the entire population of riders in the region.

1.7: Definitions and operationalization of Terms

Boda boda: For this study *boda boda* refers to a motorcycle used for transporting passengers or goods.

Chemical hazards: Chemical substances that have properties with the potential to cause adverse health effects to human health and can be categorized as toxic chemicals, irritants, corrosives, explosives and flammable products.

Commercial motorcycle Accident: The unintended collision of one motorcycle with another motor vehicle, a stationary object, or person, resulting in injuries, deaths and/or loss of property.

Motorcycle safety: it has to do with aspects that reduce vulnerability to accidents. It entails equipment design, operator training, skills and knowledge

Occupational hazards: Immediate and long-term risks associated with a specific work environment subsequently affecting the health and safety of workers and can be categorized as ergonomic stressors, physical, biological, psychosocial and chemical hazards

Physical hazards: Factors within the environment (environmental hazards) that can cause physical harm or intense stress and include deafening noise levels, radiation, temperature extremes and vibration.

Psychosocial hazards: Aspects of the work environment that can have an impact on the psychological health and mental well-being of a worker and include exposure to violence, stress, bullying, fatigue, job strain and long working hours.

CHAPTER TWO

LITERATURE REVIEW

2.1: Introduction

Commercial motorcyclists operate in a complex economic, organizational and multi-cultural environment thus requiring an in-depth analysis and understanding of this unregulated environment in a bid to curb the escalating public transport crisis. Economic complexities coupled with unemployment amongst the youth result in varied forms of occupational injuries and accidents despite commendable developments designed to eradicate road traffic crashes and fatalities. The relinquishment of supervisory functions by key transport authorities especially in developing countries has resulted in numerous road traffic injuries with extensive fatalities among the VRUs like motorcyclists. Capacity building of stakeholders drawn from a wide spectrum is essential in developing counter measures for motor-cycle related fatalities and accidents.

2.2 History and growth of motorcycling in the global context

The earliest motorcycle power invention that gained global acceptance was made by a Gottlieb Daimler (a German engineer) in 1886 and the prototype has gradually evolved over the years (Fujita, 2013). Trends in developing countries indicate that ownership of individual modes of transport has gained popularity especially in peri-urban areas as an effect of poor organization of the public transportation system. According to a research conducted Japan, Italy and France, the break out of the Covid -19 pandemic fueled the need for individual mobility options considering most public transport systems did not guarantee hygienic conditions and it was hard to maintain substantive social distance (Fact.MR, 2021). Subsequently, the global sales of motorcycles increased significantly considering that two-wheelers are quite affordable and have high fuel efficiency with an estimated 56.9million units being sold in the year 2020. In America, motorcycle ownership increased by a margin of 2 million in 2018 to 12,231,000 with California recording the highest number of registered units in 2019 (808,377) (Research and Markets, 2021)

In Africa, a significant number of countries like Nigeria, Uganda, Kenya, Cameroon and Togo have recorded exponential rise in motorbike taxis since the mid-1980s. Commercial motorcycles are commonly referred to as *boda boda* in Tanzania, Kenya and Uganda, *bendskin* in Cameroon, *zemidjan* in Togo while the local name adopted in Nigeria and Ghana is *Okada* (Kumar, 2011). In Africa, privatization of the public transport system and adoption of non-conventional mobility options has been largely attributed to governance and technical failure from regulatory institutions. Technical and financial constraints of varied highway authorities

in Africa has resulted in poor regulation of externalities like fare structures, management of intersections, peak periods, road traffic, safety standards and traffic rules (Olvera *et al.*, 2012). Research by TechSci reveals that the market and sales of motorcycles in Africa will double to \$9 billion in 2021 compared to the \$4 billion sales recorded in 2015 (Dahir, 2016).

In Nigeria motorcycles commonly referred to as *Okada* are highly patronized owing to the failure of policy instruments that govern public transport systems and influx of low- budget motorcycles from countries like India. According to statistics the number of Okada riders in Nigeria is approximated to be at 8 million (Kumar, 2011). A study in Akure Township by Joseph *et al.* (2016) revealed that commercial motorcyclists earn N1,600 (\$5.3) on average on a daily basis and the daily income is heavily dependent on duration of operation, efficiency of an individual and aggressiveness at 42%,32% and 16% consecutively.

Table 2.1: Factors contributing to the growth of motorcycles in African cities.

Positive		Negative	Pull	Push
Demand	Supply			
Time savings	Easy	Congestion	Urban sprawl	Inexpensive
Easy access	availability	Pollution	Poor road quality	Easy credit
Improved mobility	Limited street space	Accidents	and network	High unemployment
Demand responsive		Safety/unregulated crime	Low density	Low car ownership
Easy manoeuvrability			Uncontrolled growth	
Employment generation/increase in income			Absence of safe and secure alternatives	

Source: Kumar, A. (2011). *Understanding the emerging role of motorcycles in African cities: A political economy perspective*. Sub-Saharan African Transport Policy Program (SSATP).

2.2.1 Expansion of commercial motorcycle transport in Kenya

In Kenya, commercial motorcycles are commonly referred to as *boda boda* a term coined in the late 1980s by riders in Busia town who used to ferry passengers to the border of Malaba from Busia town and would shout *boda boda* (border-to-border) (Olvera *et al.*, 2012). Mobility needs have become highly diversified in Kenya owing to rapid urbanization,

exponential population growth and economic growth. In a bid to stimulate economic growth through job creation, Kenya zero-rated the import duties of motorcycles in 2008 subsequently resulting in an upsurge of motorcycles registered in the country.

According to the NTSA, motorcycle sales significantly increased by a margin of 183% in 2017 when the 10,000-excise duty per *boda boda* unit was eliminated with the number of registered motorcycles increasing from 18,032 in 2016 to 51,139 in 2017 (National Transport and Safety Authority, 2018). According to a study carried out in Kajiado County, 50.7% of motorcyclists in the county agreed that zero tax rates on motorcycles and access to favorable financing significantly contributed to the growth of *boda boda* business (Kariuki *et al.*, 2019). In 2020 the number of registered *boda boda* units rose by 22,172 despite the turbulent economic times; with over 2 million motorcycles reported to be in Kenya as of May 2020 (National Transport and Safety Authority, 2020).

2.3 Occupational hazards and risks among commercial motorcyclist

Occupational hazards refer to long-term and short immediate risks associated with a specific work environment subsequently affecting the health and safety of workers and can be categorized as ergonomic stressors, physical, biological, psychosocial and chemical hazards (Mehrdad, 2020). The nature of hazards tends to vary depending on the working environment and appropriate laws and safety procedures need to be in place to help avert potential injuries and fatalities linked to risky behaviour. According to the International Labor Organization, approximately 2.3million deaths are recorded annually resulting from work-related injuries (International Labour Organization, 2019). The National Institute for Occupational Safety and Health (NIOSH) is in charge of enforcing health and safety standards at the workplace in the United States while in Kenya the Directorate of Occupational Safety and Health Services is the mandated body. Extensive economic complexities coupled with soaring numbers of unemployment has driven many youths in developing countries to venture into the *boda boda* industry with minimal recourse of the occupational hazards and risks they will be exposed to.

2.3.1 Physical hazards

Motorcyclists are often exposed to the following physical hazards excessive heat, deafening noise levels, vibrations, lacerations and cuts resulting from physical injuries (International Labour Organization, 2019). A study revealed that modern helmets sound attenuation properties are quite poor offering low frequency attenuation which is not effective considering that at 60 km/h the noise resulting from wind around the helmet is reported to be at about 90 dB(A) (McCombe, 2003). Subsequently, riders often experience hearing impairment due to prolonged exposure to traffic noise prompting countries like US to make

external structural modifications on aerodynamic features of helmets but it only resulted in a 5 dB gain (NHTSA, 2017).

A research in Spain during the winter revealed that the lowest temperature recorded among the different subjects was in the foot, 14.7 (30.6 ± 0.93) while the highest body temperature was at the forearm, 28.8 (33.8±0.19 revealing that the feet of rider cools at a significantly higher rate (3°C hour⁻¹) (Hankey & Oxley, 2010). During hot weather conditions, motorcyclists experience extensive thermal discomfort since most of the protective equipment do not enhance heat dissipation. A study in Australia revealed that when riding in hot climates with a body temperature of 37 °C and while wearing appropriate PPE, a rider within 190 minutes will exhibit a profound hyperthermia greater than 40°C and possible strain in the central cardiovascular system (de Rome et al., 2015).

Prolonged exposure to Whole–Body Vibration (WBV) among commercial motorcyclists often results in lower back pain and shoulder stiffness. WBV is often as a factor of rider experience, speed levels, motor vehicle maintenance, weight of the rider, automobile manufacturer, age of the motorcyclist and cushion seat design (Mehrdad, 2020). The highest exposure to vibration among the riders is from the handle bar to the upper limbs while the foot rest to lower limb has the lowest exposure time. A study on WBV comparison between cars and motorcycles revealed that exposure levels to WBV among riders was significantly higher when compared to car drivers (Moreno *et al.*, 2011). The health risk among motorcyclists is exacerbated by the lack of a back support system while riding increasing exposure to vertical vibrations.

Poor road infrastructure in terms of rough roads, stagnant water, and debris on the road, poor road alignment and stalled construction activities are other major physical hazards motorcyclists are exposed to making it hard for them to manoeuvre. Haworth *et al.* (2005) revealed that the most significant environmental factor contributing to traffic crashes is obstruction of the crash site impairing the motorcyclist or car driver individuals view of each other accounting for a third of the prior collusion causal factors. A study in Kirinyaga County established that collision accounted for 36.8 % of the accidents and 24% of the collisions were as a result of poor road conditions. Road surface conditions were vital contributor factors to motorcycle crashes with over 55% of motorcyclists citing that loss of traction as an effect of slippery roads, potholes and loose gravel as key underlying factors (Ndwiga *et al.*, 2019)

2.3.2 Chemical Hazards

Chemical hazards are risks resulting from exposure to chemicals in the work environment often resulting in acute toxicity, carcinogenicity, aspiration toxicity, skin

corrosion and irritation, reproductive toxicity and eye effects. There is minimal emphasis and awareness of risks with regards to exposure to toxic chemicals in the *boda boda* industry. Motorcyclists are often exposed to chemical hazards like compressed gases, combustible liquids like diesel, organic peroxides and flammable products. In Brazil, a study by Carvalho *et al.* (2018) found that genetic damage and oxidative stress factors is significantly high among professional motorcyclists as an effect of exposure to NO₂ and O₃ and other trace elements ($p < 0.05$). Additionally, there was a strong positive correlation between plasmatic lipid peroxidation and exposure to NO₂ and O₃ ($p < 0.001$ and $r = 0.8849$ and 0.8995).

Chemical hazards often predispose the riders to significant health risks since the chemicals contain toxic compounds like carcinogens, irritants and corrosives. During oil change commercial riders often experience contact dermatitis and eye irritation. The major routes of exposure among riders include inhalation of smoke dust and fumes, direct eye and skin contact causing extensive irritation and ingestion of chemicals. Exhaust particulates from motorcycles contain significantly higher amounts of polycyclic aromatic hydrocarbons (PAHs) acting as a major contributor of air pollution as an effect of their ease of dispersal. (PAHs) constitute hazardous chemical compounds which are carcinogenic, teratogenic and mutagenic with research indicating that by 2020 the highest emitter of PAHs in Europe will be scooters (2-stroke engine types) (Chernyshev *et al.*, 2018).

2.3.3. Biological hazards

Biological hazards often result from exposure to biological elements posing a significant threat to the health and well-being of humans at the work place and include viruses, bacteria, infectious plant materials, stinging insects and other airborne pathogens. Since the declaration that COVID-19 is a global pandemic by WHO in March 2020, maintaining 2-metre physical social distancing was one of the vital safety measures advisories that would help curb the spread of the virus (Ministry of Health -Kenya, 2020). Subsequently citizens in developing countries were reluctant to use public transit systems and preferred to use *boda bodas* increasing the risks of corona virus infections amongst riders due to close contact with different passengers.

In Kenya, the Ministry of Health issued a directive that all commercial motorcyclists should only carry one passenger and each of them should wear a mask in order to minimize community transmissions. A study in Nairobi revealed that commercial motorcyclists believed that they were highly susceptible to Covid-19 and that the government should avail free sanitizers and face masks to the riders (Kigatiira, 2020). With respect to personal hygiene, *boda boda* riders could not easily access designated areas to wash their hands frequently

predisposing the riders to virus exposure since they came into contact with fuel pumps, money and door handles. In Homa Bay County, a report on Tuberculosis data assessment among underserved population revealed that *boda boda* drivers are one of the emerging vulnerable drivers of Tuberculosis in Kenya (KELIN, 2018).

2.3.4 Psychosocial hazards

Psychosocial hazards are elements of the work environment which can impact on the mental health and well-being of a worker and can cause psychological harm or emotional torture subsequently affecting work-related operations. Common psychosocial hazards in the *boda boda* industry include violence, stress, fatigue, aggression, bullying, harassment, job strain as an effect of long working hours and customer aggression (Haworth *et al.*, 2005). Prolonged exposure to work stressors like harassment, unstable income, debt, irregular work hours often results in debilitating effects resulting in extensive “burnout” and subsequent health complications like psychological disorders, cardiovascular diseases, musculoskeletal disorders, suicide, cancer and ulcers. According to research in China, time pressure often triggers psychological tension stressors predisposing the riders to extensive musculoskeletal disorders as an effect of muscle tension (Li *et al.*, 2008). Understanding psychosocial influence on rider intentions is essential in the development of training interventions that will help in addressing psychological and social aspects of a rider and subsequent influence on the behaviour of a motorcyclist.

A study in Pakistan, revealed that psychosocial variables like work stressors, aggressive behaviour and mood fluctuation exacerbates risky driving behaviour among motorcyclists; 80 % of the patients admitted that their speed of driving fluctuated with emotional moods; while financial constraints influenced 80% of the aggressive riding behaviour among motorcyclists (Zehra *et al.*, 2019). Psychological determinants influencing the risky behaviour among *boda boda* riders include desire to speed, danger perception, attitude, behavioural perception and the risk of being caught by law enforcers. According to Watson *et al.* (2007) ,three vital psychosocial elements that impact on rider behaviour include normative influences such as a sense of responsibility to family and friends, employment consideration thus fearing to lose the rider license and the other riders operations; attitudinal and control factors influencing perception to risky behaviours; Personal related factors influencing tendency to engage in aggressive riding behaviour, and risky stunts, with aggression and frustration largely influencing rider intentions and safety habits.

2.3.5 Ergonomics/ machine factor

Ergonomics refer to optimizing human safety and appropriate system interactions in the design of a tool or engineering of the work environment to eliminate discomfort and meet the needs of the worker. Commercial motorcyclists are often required to sustain a specific sitting position for extensive hours performing repetitive movements resulting in repetitive strain injuries (European Agency for Safety and Health at Work, 2007). Riding for extensive hours often result in musculoskeletal disorders. A study in India revealed that driving related musculoskeletal disorders among motorbike riders is mainly caused by riding stress, improper driving posture and repeated body motions depending on the road infrastructure with spinal injury and lower back pain being the most prevalent riding-related musculoskeletal disorders (Ramasamy *et al.*, 2016).

Ergonomic modification of the hand grip and motorcycle seat can help improve the posture while riding and extensively reduce body vibrations. The seated posture adopted by motorcyclists is an important ergonomic risk factor often increasing the risk of musculoskeletal disorders. Varied brands of motorcycles used by commercial riders often impose awkward sitting postures resulting in significant body strain and the problem is compounded by long riding hours which exposes the riders to frequent postural damage and subsequent back pains (Kourouma, 2020). The lower back pain is due to the fact that the lower back supports the weight of the upper arm, head, neck, the thoracic region and the surrounding tissues coupled with maintaining a static posture for extensive hours (Szeto & Lam, 2007).

A significant proportion of second hand *boda bodas* do not have antilock brakes and yet studies indicate that the aforementioned brakes reduce the likelihood of fatal crash among riders by 37% (National Highway Traffic Safety Administration, 2007). In the European Union, it is mandatory for all motorcycles to have anti-lock braking systems since it significantly reduces the risk of skidding and subsequent fatalities among riders by a third (Chen *et al.*, 2009). Mounted air bags on the fuel tanks are reported to minimize fatality cases in the event of a frontal collision and this is a vital ergonomic feature considering that in America frontal collisions account for 62% of the motorcycle accidents (Fujita, 2013). In Kenya, very few *boda bodas* have turn signal indicators increasing the risk of fatal accidents while in the US all motorcycles should be fitted with the indicator as a standard feature to enhance road safety.

2.4. Global Burden of Road Traffic Crashes

2.4.1 Motorcycle Accident Rates in the World

According to the global status report by WHO, 1.3 million RTAs are reported annually and as per the projections, the fifth cause of death globally by 2030 will be as a result of road traffic injuries (RTIs) with youths between the age of 15-29 being the most vulnerable group. Motorcyclists, pedestrians and cyclists (VRUs) account for the significant portion of the 3,400 global daily road traffic fatalities with low- and middle-income countries bearing the largest burden of injury related costs (approximately 100 billion US\$ annually) and accounting for 93% of the fatalities (WHO, 2018). Motorcyclists account for 23% of road fatalities exhibiting a 34-fold increased risk to head injuries, spine and lower-extremity deformations, fractures and minor abrasions with 50% of the fatalities being reported in urban areas (Centers for Disease Control and Prevention, 2020). Risk factors influencing crash causation include vehicle factors such as braking and maintenance, over speeding, alcohol abuse, road defect due to poor design, limited visibility as an effect of environmental factors and human tolerance factors.

Motorcycle accidents in India are a major concern, with a disproportionate number of fatalities compared to other nations. This is primarily attributed to factors such as inadequate road infrastructure, lack of enforcement of traffic regulations, and a culture of reckless driving among motorcycle riders. A study in India revealed that between 1990 -2017 road traffic injuries increased significantly by 58.7% significantly higher than the 8% global increase during the same period; with 30.9 % of the fatalities registered among motorcyclists predominantly affecting males between the ages of 15-39 (India State-Level Disease Burden Initiative Road Injury Collaborators, 2019). Statistics by the Nation Highway Traffic Safety Administration (NHTSA) in the US indicate that when compared to car owners, the likelihood of crash occurrence is 27 times among motorcyclists with 4,985 fatalities being recorded in 2017 (NHTSA, 2017).

2.4.2 Motorcycle Accidents in Africa

The highest road traffic fatality rate is recorded in Africa (26 per 100,000 population) with 10 African nations; Kenya, Uganda, Ghana, South Africa, Nigeria, Mozambique, Tanzania, Madagascar, Ethiopia and Republic of Congo contributing to 70% of all the traffic fatalities (World Health Organization, 2011). According to a research in Sub-Saharan Africa, RTIs accounted for 2.8% of all fatalities in region with the West African nations accounting for more than half of the injury related deaths with the southern region having the least non-fatal injuries (Joseph *et al.*, 2016). A study in Kampala city revealed that vital underlying factors that contribute to road traffic crashes among the motorcyclists include; minimal

experience in riding (OR = 2.04, 95% CI: 1.19–3.52), sharing and swapping of motorcycles (OR = 8.25, 95% CI: 2.62–25.9) and alcohol consumption among the younger riders with an odds ratio of 2.30 (Galukande *et al.*, 2009). In Nigeria, statistics indicate that 82% of fatal and non-fatal injuries are as an effect of human behaviour with a retrospective study in a hospital in Lagos indicating that 23.4% of RTA involved motorcyclists with the head being the most susceptible anatomical injury region (Faduyile *et al.*, 2016). In Guinea, statistics from victims from health facilities revealed that 58.3% of the RTAs involved motorcyclists with 43.8% of the patients sustaining serious injuries (predominantly younger males) and 54% of the victims succumbing to death (Kourouma, 2020).

2.4.3 Motorcycle Accident Rates in Kenya

In Kenya NTSA daily reports reveal that RTIs among motorcyclists registered a massive increase from 698 in 2018 to 1337 in 2019 with fatalities increasing from 589-724 during the same period. As of December 2019, 6938 RTIs and 3572 fatalities were recorded in the country with more than 85% of the accidents being attributed to reckless driving (National Transport and Safety Authority, 2020). A study in Mwea town, Kirinyaga County revealed that 38% of motorcyclists were involved in a crash during the survey period with brake failure, poor visibility, risky motorist behaviour and over speeding contributing to 41.2%, 23.5%, 8.8% and 13.2% of the accidents respectively (Ndwiga *et al.*, 2019). The relentless high numbers of motorcycle fatalities are largely attributed to rogue riders and poor enforcement of the Motorcycle Regulations of 2015. According to Ngari *et al.* (2020) 24% of *boda boda* riders were involved in an accident during the three-month research period in Embu with alcohol influence and chewing of khat being independent causative factors.

Uasin Gishu County has recorded a significant increase in fatalities and injuries related commercial motorcycle accidents prompting the county assembly to endorse a motion that seeks to ensure all *boda boda* riders are trained. In 2016, 36.8% of the fatalities on the Northern corridor were recorded in Uasin Gishu County while Busia County accounted for only 3.5% of the RTDs (National Transport and Safety Authority, 2018). Kapseret's Sub-County significant population of commercial motorcyclists makes it an ideal area for investigating occupational risks prevalent in the sector. Additionally, the high incidence of *boda boda* accidents in the region as per the traffic safety reports affirms the critical need for research to provide guidance on effective safety measures. In collaboration with the NTSA, the department of roads seeks to create awareness on relevant traffic regulations and subsequently minimize reckless driving considering the sector employs a significant percentage of youths. The County government of Uasin Gishu acknowledges the fact that the *boda boda* sector contributes a substantial amount

of revenue and that the county is therefore obligated to intervene and provide relevant training on speed limit, helmet and reflector jacket use among other safety regulations (Uasin Gishu County Transport Act, 2015).

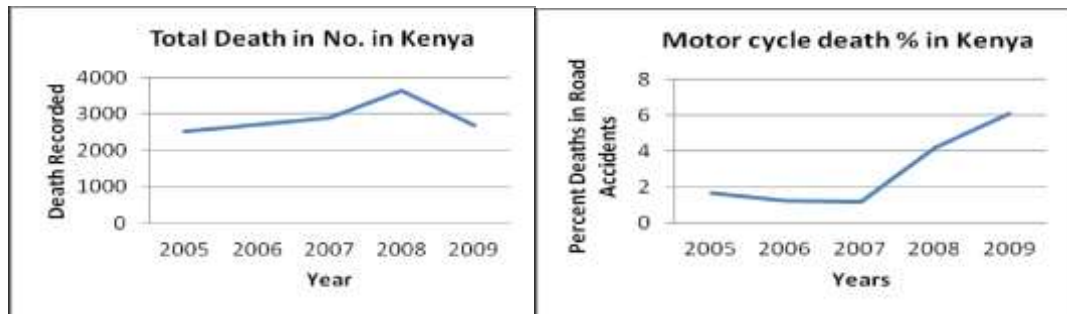


Figure 2.1: 1970-2006 Trends in Road traffic deaths in Kenya (National Transport and Safety Authority, 2018)

2.4.4 Rider Attitude and Behaviour antecedents of motorcycling accidents

Environmental factors, riding patterns and characteristics and the complexity of vehicular interactions strongly influence the behaviour of a *boda boda* rider. According to Cheng *et al.* (2015) novel motorcyclists have a fatalistic notion and attitude towards risks with a number of them disregarding safety laws resulting in fatal injuries like breakage of joints, facial disfigurement and extensive brain concussion. Over speeding, suddenly braking, alcohol consumption, overtaking during a lane change, operating a phone while riding, disregard of PPEs and riding on prohibited lanes are some of the risky behaviours linked to motorcyclists. Enormous pressure as an effect of the remuneration system in the *boda boda* industry has been cited as vital contributor to aberrant driving behaviours exhibited by motorcyclists (Olvera *et al.*, 2012). A study by Moskal *et al.* (2012) in France found that alcohol is the largest risk factor for accidents with significant dose effect relationship and the estimated odds ratio being over 10 for drunk operators (2g/l of alcohol consumption).

A research by Goh *et al.* (2020) in Malaysia found that risky riding patterns and behaviour is less prevalent among older motorcyclists with a negative relationship (estimate coefficient = -0.032). The potential severity of a hazard is greatly impacted by hazard perception of novel riders and is often influenced by the behaviour of other road users. In order to minimize the risk of accidents and fatalities training among motorcyclists should encompass hazard perception and appropriate response mechanisms. In Kenya a research in Kakamega County revealed that the relationship between caution-rider years of experience and accident involvement was significant ($\chi^2= 3.299$, $df= 3$, $p < 0.05$) with over speeding and lack of training significantly contributing to the accidents (Luchidio, 2013)

2.5. Legal requirements and policies

2.5.1 Global Policy level

Globally, non- fatal and fatal road traffic injuries claim 1.35 million lives annually with middle income and developing nations recording the highest crash rates (WHO, 2018). Convention on Road Traffic, of 8 November 1968 is a vital international road safety legal instrument with 75 countries including 30 developing countries (inclusive of Kenya) being parties to the convention (UNTC, 2015). In the United States, the enactment of the first Universal Motorcycle Helmet law was in 1966 with the laws covering pillions and riders of all ages while in some states like Florida, riders above 21 years are exempted from the law. Subsequently, brain related injuries amongst riders that use helmets reduced by 41-69% while fatalities significantly reduced by 22-42%; significantly lowering medical related costs in intensive care unit (ICU) by an estimated \$32.5 million (Centers for Disease Control and Prevention, 2011)

2.5.2 Sustainable Development Goals (SDGs)

In March 2010, 2011-2020 was declared as the Decade for Action for Road Safety by the United Nations General Assembly (UNGA) in a bid to reduce reported incidences of road traffic injuries and fatalities estimated to be 50 million and 1.3 million respectively (WHO, 2018). Member states of the United Nations (UN) subsequently incorporated two targets on global road safety as part of the SDGs 2015.SDG target 3.6 sought to reduce the number of road traffic injuries and deaths globally by halve by 2020 and SDG target 11.2 seeks to provide and improve access to safe, affordable, accessible and sustainable systems of transport by 2030. In August 2020, the General Assembly expressed its concern that the number of road traffic crashes remained unacceptably high and that SDG target 3.6 would not be achieved by 2020.The United Nations General Assembly therefore proclaimed 2021-2030 as the 2nd Decade of Action for Road Safety placing prominence on preventing 50% of road traffic deaths and injuries.

The comprehensive global plan that targets to improve road safety during the 2nd Decade for Action has five key pillars; improving the capacity of road safety management, enhancing mobility and improving infrastructure for safer roads, empowering road users to adopt appropriate behavioural practices, enhancing the safety of vehicles through appropriate technologies and improving response in the event of a crash (World Health Organization, 2020) .United Nations Road Safety Collaboration acts as the coordination unit of extensive initiatives and coordinates the overall road safety framework during the aforementioned decade(World Health Organization, 2018) .

2.5.3 World Health Organization (WHO) guidelines on global road safety.

The first global road safety status report was released in 2009 by WHO and revealed that road traffic crashes claim approximately 1.23 million lives in 2007 and this prompted the UN to adopt the decade for action with WHO releasing regular reports to aid in monitoring progress during the decade (World Health Organization, 2011). Despite SDG target 3.6 and performance target 9 which seeks to reduce the number of RTIs by halve, the number of road traffic fatalities increased to 1.35 million in 2018 as per the global status report. In 2015, half-way through the Decade of Action, during the 2nd Global High-Level Conference on Road Safety co-sponsored by WHO, delegates present adopted the Brasilia Declaration on Road Safety. The declaration sought to advocate for appropriate mechanisms to halve the number of fatalities as per SDG target 3.6 through the adoption of sustainable transport systems and strengthening the management of road safety systems (UNTC, 2015).

According to WHO, the lowest road traffic fatality rate is at 9.3 in Europe while the fatality rate in Africa is at 26.6 which is highest globally and if the aforementioned trajectory is sustained by 2030, the 7th leading cause of mortality globally will be road traffic crashes (WHO, 2018). Global Mobility Report indicates that when compared to owners of cars, fatality risk among motorcyclists is 20 times higher (Centers for Disease Control and Prevention, 2020). As of 2015, WHO statistics indicate that only 5.7% of the global population (17 countries) had aligned or amended their road safety laws to be in synch with international practices and standards having incorporated the five critical risk factors that contribute to RTC (UNTC, 2015). Decade of Action for Road Safety Performance targets 6,7 ,8 and 10 emphasize on regulating speed limits, compulsory use of safety helmets mandatory use of safety belts and prohibits the use of mobile phones while driving respectively. Nonetheless, majority of countries globally have to not aligned their road safety practices to be at par with international legal instruments thus not cushioning children, women, persons with disabilities and vulnerable road users as stipulated in SDG target 11.2 (WHO, 2018).

2 .5.4 Legal Requirements in Kenya

In Kenya, laws that govern the motor vehicle industry and the wider transport and traffic control sector include: Traffic Act cap 403, the National Transport and Safety Authority Act, National Transport and Safety Authority (Operation of Motorcycles) Regulations (2015), National Police Service Act and County by laws (Uasin Gishu County Transport Act 2015) which is relevant to this study. In a bid to combat the culture of rogue riding and reduce cases of road traffic fatalities the NTSA listed the following regular traffic offences committed by *boda boda* riders in Kenya and fines to be incurred for each offence; operating a mobile phone

while riding (KES 2,000), operating a motorcycle without using appropriate PPEs (KES 1000), Passenger riding without a PPE (KES 1000), exceeding speed limit by 1-5kph (KES 500), and *boda boda* riders carrying more than one passenger earning a fine of KES 1000 (National Transport and Safety Authority, 2020). Escalating cases of *boda boda* related accidents contributing to 40% of the fatal crashes in the country compelled NTSA to stipulate stiffer penalties in a bid to streamline the industry by eliminating reckless behaviours thus compelling the riders to comply with traffic laws (National Transport and Safety Authority, 2018). Despite numerous police reforms cases of bribery among the NTSA officers and traffic officers have extensively affected enforcement and adherence to traffic laws with supremacy struggles between the two fractions compounding the corruption menace.

2.5.5 Traffic Act Cap 403

According to the Traffic Act, “motorcycle” means a motor vehicle with less than four wheels the weight of which unladen does not exceed eight hundred weights. Section 33(1) stipulates the age limit with respect to issuance of driving license and directs that no driving license or provisional license shall be granted to any person - (a) under the age of sixteen years; (b) under the age of eighteen years, except in respect of motor-cycles. With respect to Section 103(5) a person shall not ride a motorcycle unless that person has a valid driving license issued in accordance with the provisions of the Act. The registered owner of a motorcycle shall ensure that any person who rides the motorcycle has a valid driving license issued in accordance with the provisions of the Act (Traffic Act, 2012).

With respect to restrictions on passenger riding, section 60 (1) states that it shall not be lawful for more than one person in addition to the driver to be carried on any two-wheeled motor cycle, nor shall it be lawful for any such one person to be so carried otherwise than sitting astride the motor cycle and on a proper seat securely fixed to the motor cycle behind the driver’s seat. According to section 103B (1) (2) a person, including a passenger, shall not ride on a motor cycle of any kind, class or description without wearing a helmet and a jacket that has reflectors. Additionally, a person who rides a motor cycle shall provide a helmet and a jacket that has reflectors to be worn by the passenger, and shall carry only one passenger at a time (Traffic Act, 2012).

2.5.6 Occupational Safety and Health Act, 2007

OSHA, 2007 Section 12(1) stipulates that all self-employed persons should take all necessary precautions to ensure their own safety and health and that of any other person in their workplace or within the environs of his workplace; at all times use appropriate safe systems of

work, preventive and control measures and where not feasible, use suitable personal protective appliances and clothing required under the Act. With respect to operation and use of machinery inclusive of motorcycles, section 55 of the Act states that all plant, machinery and equipment whether fixed or mobile for use either at the workplace or as a workplace, shall only be used for work which they are designed for and be operated by a competent person (Office of the Attorney General and Department of Justice, 2007).

Section 76(1) highlights Ergonomics at the workplace and states that Machinery, equipment, personal protective equipment, appliances and hand tools used in all workplaces shall comply with the prescribed safety and health standards and be appropriately installed, maintained and safe guarded. The Act also gives specific guidelines with regards to Protective clothing and appliances.in section 101 (1) stipulating that every employer shall provide and maintain for the use of employees in any workplace where employees are employed in any process involving exposure to wet or to any injurious or offensive substance, adequate, effective and suitable protective clothing and appliances, including, where necessary, suitable gloves, footwear, goggles and head coverings (Office of the Attorney General and Department of Justice, 2007) .

2.5.7 National Transport and Safety Authority (Operation of Motorcycles) Regulations (2015)

According to section 4 (1) No motorcycle shall be sold or transferred by any person without the following protective gear, two helmets which comply with the standards established by the Kenya Bureau of Standards and two reflective jackets which shall have the registration number of the motorcycle indelibly printed in letters. (3) No supplier, distributor or person involved in the business of selling motorcycles in Kenya shall sell, distribute or otherwise convey a motorcycle without the protective gear described in regulation. With respect to ownership of a motorcycle Section 5 of the Act stipulates that every owner of a two wheeled motorcycle shall provide the rider and passenger with the protective gear as stipulated in regulation 4 (1) and ensure that the helmets provided under are yellow if the two wheeled motorcycle is a taxi. Additionally, the owner should not cause or permit any person to ride their motorcycle unless such person is the holder of a valid driving license and ensure no modifications to the exhaust system or any other noise abatement device of a motorcycle are done so as to cause the noise emitted by the motorcycle to be above that emitted by the motorcycle as originally manufactured (National Transport and Safety Authority, 2015).

Section 6 of the Act stipulates the responsibilities of a rider stating that all riders should have a valid driving license, should not carry more than one person at a time, passengers should not be carried without the prescribed protective gear properly fastened; all passengers are to be carried on a proper seat with foot rests securely fixed to the motor cycle behind the rider's seat; passengers should sit astride the motor cycle; motorcyclists should ensure that the headlights of the motorcycle are on at all times when riding. Additionally, riders should; ensure that loads and passengers are not carried at the same time; ensure that the rear number plates are visible at all times; overtake on the right-hand side and not to overtake in the same lane occupied by vehicle being overtaken; observe all traffic rules and they are not allowed to park in undesignated areas. Section 8 of the Act states that a motorcycle rider should not carry a load whose height is more than two meters from the ground; whose width projects more than fifteen centimetres beyond outside end of the handle bars and no part of the load carried should drag on the road (National Transport and Safety Authority, 2015)

2.6 Motorcycle Training and safety needs

Globally, programs targeting motorcycle training safety have been shown to be effective in minimizing cases of traffic violation and subsequent crash fatality rates. Galukande *et al.* (2009) found that human errors and poor road conditions were the leading causes of occupational hazards among motorcyclists in Uganda. Commercial motorcyclists have embraced the culture of contravening most safety and traffic rules in a bid to generate higher profits. Understanding the underlying factors that influence risky stunts and behaviours amongst riders is essential when designing appropriate interventions to curb road accidents.

2.6.1 Training and awareness among commercial motorcycle riders

Training is an essential variable in road safety since it empowers novice riders with relevant skills and off-road techniques that enhance hazard perception and appropriate response significantly reducing the killed or seriously injured rider statistics. In the past training has had minimal emphasis on behavioural and attitudinal training which subsequently impacting on the effectiveness of the training program. The Motorcycle Safety Foundation is the institution that provides cost-effective training to experienced and novice motorcyclists in USA as per the standardized curriculum adopted in different states while Canada Safety Council (CSC) is in charge of the same in Canada. Mandatory licensing in 19 states in USA has had a positive effect on rider training in the country (National Highway Traffic Safety Administration, 2007). A study in rural Nigeria revealed that while 60.7% of the riders had knowledge on appropriate road safety codes, only 15.7% and 23.3% of the riders adhered to the laws and understood more than half of the safety codes respectively (A Moran *et al.*, 2005)

Legislative framework governing training and certification in Kenya is governed by the NTSA with reference to the Traffic Act cap 403. The *boda boda* sector contributes approximately 27 billion to the Kenyan economy annually but sadly claimed 1,421 lives in 2019 (National Transport and Safety Authority, 2020). In order to minimize fatalities in the sector the NTSA has partnered with the National Youth Service (NYS) and the County governments to provide voluntary training to *boda boda* riders as from 2021. The NYS training curriculum mainly focuses on rider resilience, hygiene, first aid, and licensing and traffic laws adherence. According to a research in Kakamega County, only 33% of the *boda boda* operators had attended driving schools while 51% and 16% having trained through apprenticeship and personal practice with the statistical relationship between riders who had undergone training and road accidents being significant ($\chi^2=4.744$, $df=1$, $p<0.05$) (Luchidio, 2013). In Uasin Gishu, the County Assembly passed a motion in 2019 directing the department of roads in collaboration with NTSA to carry out extensive *boda boda* training in a bid to curb road traffic menace and related accidents (Uasin Gishu County Transport Act, 2015).

2.6.2 Personal Protective Equipment and safety of riders

Appropriate PPEs play a vital role in enhancing the safety of riders and crash prevention since they aid in abrasion resistance, minimizing the severity of an impact during a crash and protects from extreme weather elements. Essential protective gears used by riders include helmets, boots, safety goggles, protective vests, airbags and earplugs. Results of crash victims of motorcycle related accidents in rural areas of Kenya revealed that 74.8% of *boda boda* riders usually overload, with only 27.9 % admitting to using reflector jackets while 74.3% usually do not use helmets (Kariuki *et al.*, 2019). A research in Nigeria revealed that 100 % of the respondents did not wear protective helmets while riding with only 24.1 of the riders possessing a valid driving license in rural Nigeria (Labinjo *et al.*, 2009).

According to a study in Malaysia, the prevalence of RTCs among motorcycle postal delivery riders that do not have certified helmets was 76.6 % with helmet type and cost cited as predictor variable influencing helmet ownership (Yellappan *et al.*, 2019). Statistics indicate that 88% of the motorcycle related crash fatalities in low –income countries are linked to head injuries with helmets considered to be effective in minimizing the risk of death by 39% (Yellappan *et al.*, 2019). In America, NHTSA estimates indicate that helmets are 37% and 41% effective in preventing fatal injuries among riders and pillions respectively with approximately 1,872 lives being saved as an effect of helmet use in 2017 (NHTSA, 2017).

2.7 Research Gap

Despite several studies on occupational hazards related to commercial motorcyclists, there is insufficient information on factors associated with psychosocial, biological, chemical and ergonomic hazards. Previous research during the Decade of Action for Road Safety (2011-2020) mainly focused on exposure to physical hazards and related injuries and fatalities with minimal consideration to human and machine factors. Therefore, the objective of this study was to assess occupational hazards among *boda boda* riders and the appropriate risk rating with the aid of a Hazard Identification Risk Assessment and Control (HIRAC) tool. Appropriate control measures whether elimination, substitution, engineering control, administrative control or use of PPEs will therefore be based on the risk rating of each hazard. The risks of exposure to physical hazards like Whole-Body Vibration (WBV) among commercial motorcyclists and deafening noise levels due to poor helmet sound attenuation properties have not been adequately reported on.

There is limited literature on the relationship between exposure to psychosocial hazards like violence, stress, fatigue, aggression, harassment, job strain and the debilitating effects like psychological disorders, cardiovascular diseases and musculoskeletal disorders. It is important to address ergonomic risk factors like the sitting posture adopted by *boda boda* riders and hand grip modification which increases the risk of musculoskeletal disorders. Additionally, the question of the effectiveness of training and sensitization on road safety statutory regulations like National Transport and Safety Authority (Operation of Motorcycles) Regulations (2015) among riders need to be addressed. Despite the fact that the *boda boda* industry employs more than 2 million Kenyans, the informal sector is highly unregulated with regards to labour laws. There is an urgent need to formulate relevant policies that will incorporate aspects of the Employment Act 2007, Occupational Safety and Health Act 2007 and Work Injury Benefit Act 2007 in order to safeguard the health and safety of *boda boda* riders.

Table 2.2: Research gaps

Author(s) and year of study	Study Title	Research gaps
Galukande <i>et al.</i> (2009)	Boda-boda injuries: A health problem and a burden of disease in Uganda – A tertiary hospital survey. <i>East and Central African Journal of Surgery</i> , 14(2), 33-37.	The study mainly focused on exposure to physical hazards and related injuries with minimal consideration to human and machine factors

Yunusa <i>et al.</i> (2014)	Occupational health hazards among commercial motorcyclists in Ahmadu Bello University, Zaria. <i>Annals of Nigerian Medicine</i> , 8(1), 15-19.	The research did not address how psychosocial hazards like violence, stress, fatigue, aggression, harassment, job strain contributes to serious and fatal accidents.
Cheng <i>et al.</i> (2015)	Relationship between driving violation behaviors and risk perception in motorcycle accidents. <i>Accident Analysis & Prevention</i> , 77, 1-6.	The relationship between training, compliance and violation of road safety rules has not been clarified.
Luchidio (2013)	Impact of training boda boda operators and safety status in Kakamega County, Kenya. <i>International Journal of Advance Research</i> , 1(9), 1-15.	Lack of measurable indicators for vital aspects of <i>boda boda</i> rider training.
Olvera <i>et al.</i> (2012)	Motorcycle accident mortality in Nigeria: Impact of a traffic law. <i>Journal of Transport & Health</i> , 5(3), 217-226.	Subject on pattern of motorcyclist injuries following the enforcement of traffic laws has been scarcely dealt with.
Kariuki <i>et al.</i> (2019)	The influence of motorcycles/boda-boda on community development in rural Kenya: A study of the challenges facing motorcycle operators in Meru South Sub-County. <i>Journal of Education and Human Development</i> , 8(1), 86-92.	The key question remains on how to incorporate policies like the Employment Act 2007 and Work Injury Benefit Act 2007 in the <i>boda boda</i> industry to guarantee the safety of riders.
Ndwiga <i>et al.</i> (2019)	Factors associated with road traffic accidents involving motorcyclists in Mwea town,	The research did not address other major modifiable risk factors associated with

Kourouma (2020)	<p>Kirinyaga County, Kenya. motorcycle injuries like job strain, fatigue, physical exertion and stress.</p> <p><i>African Journal of Health Sciences</i>, 32(1), 74–81.</p> <p>Motorcycle accidents and their outcomes among victims admitted to health facilities in Guinea. <i>Hindawi Advances in Public Health</i>, 2020, Article ID 4768923.</p> <p>It is important to address musculoskeletal disorders (spinal injury and lower back pain) among riders since the research was conducted in a health facility setting and there is little empirical evidence on ergonomic risks.</p>
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2.8 Theoretical Framework

Several theoretical frameworks have been used to explain underlying variables that impact on road safety, accident causation, crash fatality and trauma severity with a heavy emphasis on situational factors, individual characteristics, situational dimensions and socio-ecological determinants influencing road safety globally. In accordance with the research focus of this study, the following theoretical perspectives and models will be used to elaborate the complex relationship between structural, personal factors, environmental externalities and human factors and the subsequent influence on human behavioural elements and risk perception among commercial motorcyclists: System theory, Human Factor Theory and the Social Cognitive Theory.

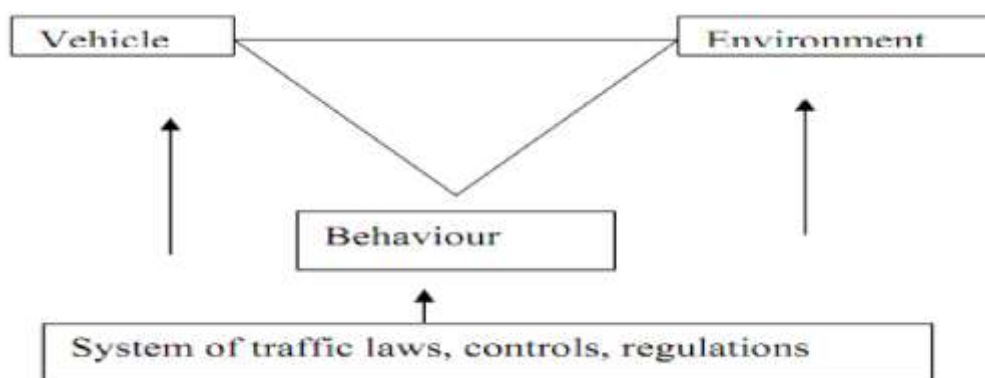


Figure 2.2: A model of road accident causation (International Labour Organization, 2012)

2.7.1 System Theory

The system theory as well known as the systems approach places emphasis on the fact that the road traffic system is a complex system and that road traffic fatalities are multidimensional problems that require analysis of multiple underlying factors in order to develop a comprehensive framework of causal factors, determinants and appropriate interventions (Naumann *et al.*,2020). The theory can be dated back to the early 1940s when during a study, Chepanis made a vital discovery that systems error in the design of airplanes often contribute to human errors subsequently resulting in fatal air crashes signifying that all aforementioned factors are interdependent (Cowlag & Saleh, 2007). Over the years the systems approach has been widely used by researchers in the field of safety, psychology, traffic management since road safety interventions require a complex system level technical intervention

A vital assumption of the theory is that malfunctioning of the varied transport system components and interactions often result in Road Traffic Crashes (RTCs) as an effect of physical, social, vehicle, environmental and human factors which are all inter-dependent (Lenne, 2012). In trying to understand accident causation and appropriate countermeasures, the technical team and different actors in crash prevention should analyse all causal factors since behavioural modification is influenced by motor vehicle design, infrastructure and technical modification of the road traffic system. The fallibility and vulnerability of humans should be accommodated in the design of a road traffic system subsequently reducing the risk of fatal crashes (Naumann *et al.*, 2020). The holistic approach of the theory has provided a vital blue print in the management of accidents with the development of the Vision Zero safety interventions in Norway and Sweden (Lenne, 2012). However, the theory does not incorporate elements of traffic law enforcement and yet it significantly contributes to accidents. The theory has inspired the development and conceptualization of Haddon Matrix Model which analyses the causal factors of accidents pre-crash, during the crash and after the crash.

Table 2.3: The Haddon matrix and pedestrian-vehicle crashes

PHASE		FACTORS		
		HUMAN	VEHICLES AND EQUIPMENT	ENVIRONMENT
Pre-crash	Crash prevention	Information Attitudes Impairment Police enforcement	Roadworthiness Lighting Braking Handling Speed Management	Road design and road layout Speed limits Pedestrian facilities
Crash	Injury prevention during the crash	Use of restraints impairment	Occupants’ restraints Other protective devices Crash protection Design	Crash protective road side objects.
Post –crash	Life sustaining	First Aid skill Access to medics	Ease of access Fire risk	Rescue facilities Congestion

Source: Daniel, J., Ran, D., & Jonathan, M. (2005). The application of Haddon Matrix to public health readiness and response planning. *Environmental Health Perspectives*, 113(5), 561–566.

2.7.2 Human factor theory

The human factor theory is premised on the notion that majority of the accidents are caused by human errors and often compounded by poor judgment of risk factors in the road. The human factor theory of accident causation places emphasis on inappropriate behavioural activities, overloading and poor response as the three essential human errors that contribute to RTAs mainly as an effect of system failure, poor decisions and ergonomic elements (Ranjan, 2018). Human errors are often as an effect of internal factors like stress, psychosocial and personal problems; environmental externalities inclusive of road distractions and excessive noise and situational factors impacting on risk perception. Contributing variables to poor perception include disregard of safety rules and ignoring safety guards. On the other hand, inappropriate activities are influenced by level of training and underestimating the degree of risk. Prominent models that have been used to elaborate on the accident causation chain include the Heinrich's Domino model and the Coopers Reciprocal Safety Culture Models which emphasize on the fact that behavioral and psychological precursors often trigger operational failure in the work flow system (Carayon, 2017). The human factor theory is vital in investigating exposure to hazards and safety habits among *boda boda* riders.

2.7.3 Social Cognitive Theory

The Social Cognitive Theory seeks to explain how individuals acquire specific behavioural traits as an effect of human functioning and appropriate interventions. Key assumptions of the theory are that environmental factors, behaviour and personal factors are vital determinants that impact on the behaviour of humans (Bandura, 2002). The theory analyses latent variables that influence crash causation with extra emphasis on attitude and behaviour. The Bandura's triadic reciprocal model exhibits the significance of human agency in behavioural influence as a vital element of the theory. With respect to personal factors, internal dispositions often influence the behaviour of a person characterized by biological events, mental and cognitive variables (Bandura, 2004). Behavioural, personal and environmental factors are interlinked since behaviour is acquired through observation of the environment and personality reinforcement through acquiring of vicarious societal traits. According to research, behaviour and cognition maybe inversely related since drivers still receive calls while driving despite knowing the risk factors associated with the same (Cheng *et al.*, 2015). The theory emphasizes that personal traits are extensively influenced by the environment with some motorcyclists adopting the culture of speeding by observing other riders over speeding with minimal repercussions from the traffic enforcement authorities.

2.9 Conceptual Framework

The conceptual framework below informed by the human factors, systems and social cognitive theory helps to elucidate the relationship between varied variables in the study in the form of a diagrammatical link and illustrates how varied motor-cycle accident causative factors interact. By incorporating the aforementioned theoretical perspectives in the conceptual framework we develop an in-depth view on how road safety is shaped by systems dynamics, rider behaviour, beliefs and attitudes. The independent variables in this study are predisposing factors for *boda boda* accidents while the dependent variable is occupational hazards in the *boda boda* industry. The independent variable is further subdivided into awareness and compliance to road traffic policies, training and personal demographic characteristics of riders. The framework demonstrates that the prevalence and severity of motorcycle –related road traffic crashes and fatalities among *boda boda* riders is heavily dependent on predisposing factors for accident causation like over speeding, alcohol abuse, training, compliance and rider attitude. Policy is an intervening variable since it alters the cause effect relationship and interactions between causative factors that influence crash involvement and related fatalities.

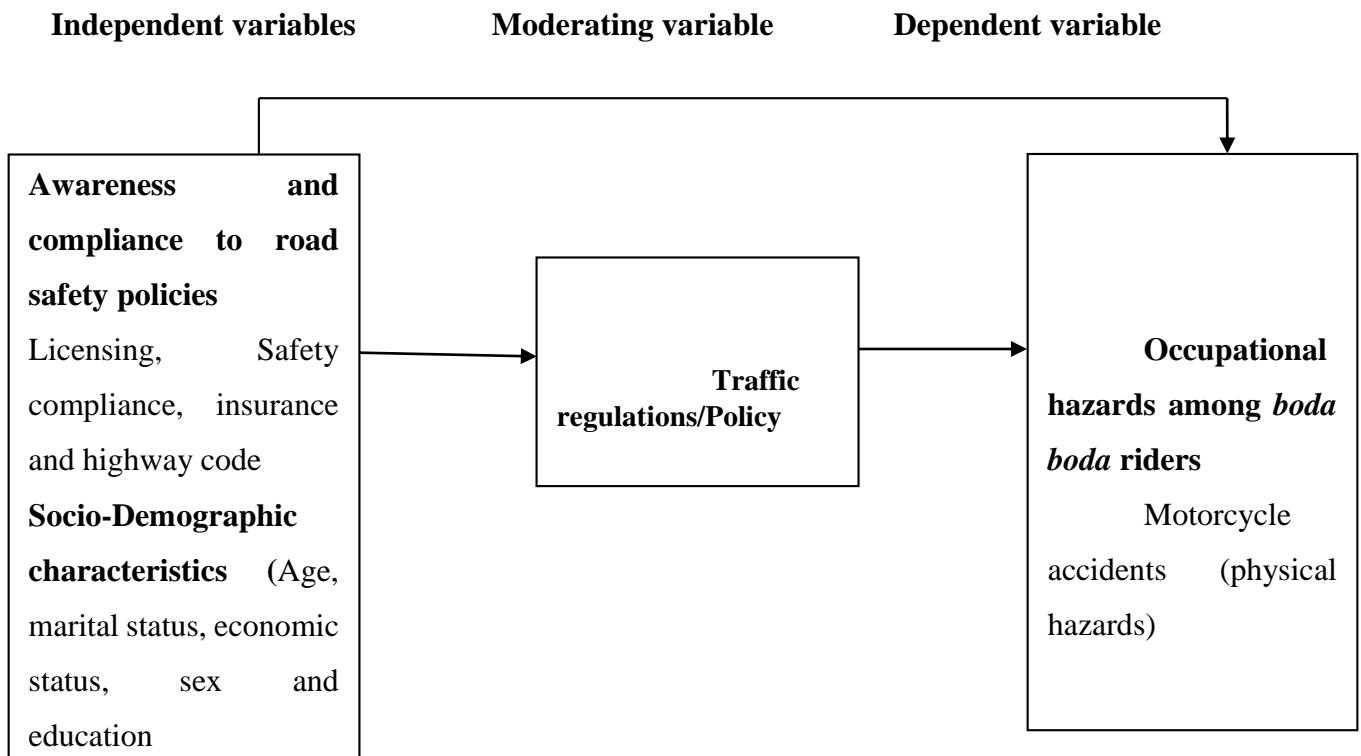


Figure 2.3: Conceptual Framework

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Study area.

The study was carried out in Kapseret Sub-County, Uasin Gishu County, located in the Rift Valley region and is one of the 47 counties in Kenya. The county has an area of 3,392 km^2 and borders the following six counties; Nandi, Trans Nzoia, Elgeyo Marakwet, Kericho, Bungoma and Baringo County. With respect to infrastructure, the County Road network comprises of; gravel (549 km), earth roads (377.2km) while bitumen surface covers approximately 309.6km. The County has six Sub-Counties namely Moiben, Kapseret, Soy, Ainabkoi, Turbo and Kesses and a population of 1,163,186 as per the 2019 census. Kapseret Sub-County hosts Eldoret town which is the largest administrative, commercial and population centre in the County and the fifth densely populated urban area in Kenya as per the 2019 census with a population of 475,716.

Kapseret Sub-County is the economic hub of the region and its headquarters is Kapseret Centre located along Eldoret-Kisumu Road; approximately 10Km from Eldoret town. Rapid urbanization and exponential population growth in the sub-County are attributed to availability of jobs, business opportunities, training institutions, health and recreational facilities. The poverty rates and unemployment rates in the County are estimated to be at 38.2 % and 14.5% respectively (UNDP, 2017). Subsequently, the *boda boda* enterprise has become a popular source of informal self-employment among the youth in Kapseret Sub-County significantly impacting rural-urban transportation in the region. Data from the department of Co-operative and Enterprise Development reveal that Uasin Gishu County has 26 registered *boda boda* Saccos with at least 9,000 members. Poor urban development has led to the mushrooming of informal settlements in Kapseret Sub-County like Langas, Huruma, Mwenderi and Kamkunji with more than 30% of the town's population living in the Langas settlement as per the 2019 census.

The sub-county also hosts the Moi Teaching and Referral Hospital (MTRH) which serves more than 23 Counties in Kenya. The government hospital located in Eldoret town has isolated wards for *boda boda* patients involved in motorcycle accidents; a clear indicator of escalating cases of reported *boda boda* related accidents and fatalities in the region. The main economic activities in the region are large scale wheat, maize and dairy farming, agro-processing, manufacturing and the county is considered the breadbasket of the country. However, there is a growing trend towards urbanization thus contributing to the growth of

informal sectors like the *boda boda* industry providing accessible and flexible mobility options for the residents.

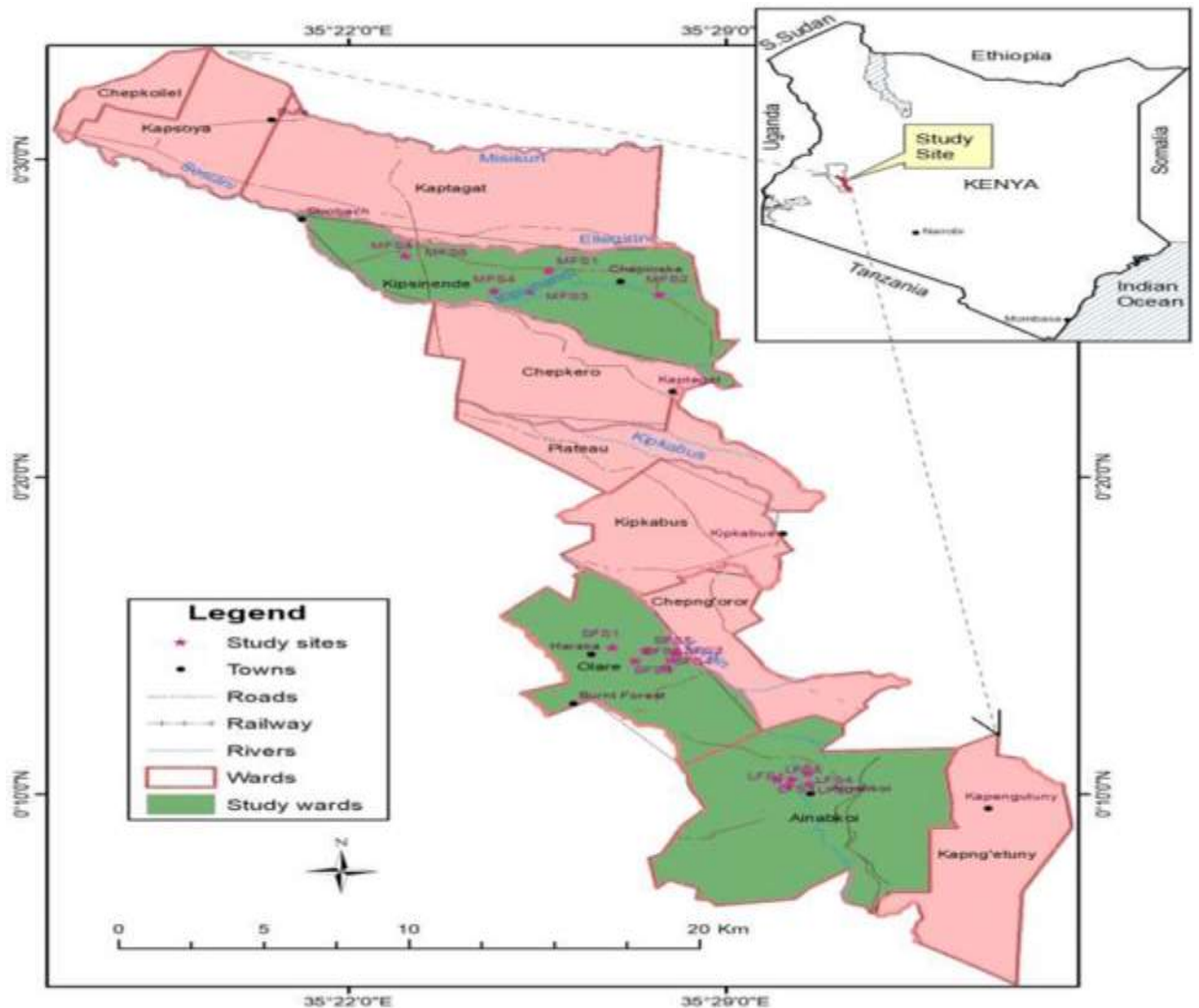


Figure 3.1: Map of Uasin Gishu County, Kenya (County Government of Uasin Gishu, 2018)

3.2: Research Design.

The study adopted the use of a cross-sectional research design that involved describing the nature and characteristics of the demographic segment without manipulating the behaviour of subjects and variables in the study. The design was relevant to the study since it had the potency to elicit a large amount of quantifiable data from the study population and it was considerably cost-effective. The cross-sectional study was vital in determining the characteristics of the study population through analysis of multiple variables at point in time. This design was essential in capturing valid cross-sectional data from the target population; thereafter generating insightful recommendations on occupational hazards and *boda boda*

accident predisposition factors since it incorporated the collection of both qualitative and quantitative data (Mugenda & Mugenda, 2003).

3.3 Target population

The target population for this research were *boda boda* riders who charge a fee to ferry passengers in Eldoret town, Kapseret Sub- County. Data from the department of Co-operative and Enterprise Development indicates that Uasin Gishu County has 26 registered *boda boda* Saccos with a membership of at least 9,000 operators. Commercial motorcyclists were sampled from selected *boda boda* assembly points (clusters) within Eldoret town since it was impractical to compile an exhaustive list of *boda boda* riders given the riders level of mobility. Additionally, key stakeholders in the county, selected medical officers and traffic officers also provided vital information on the safety dynamics of *boda boda* riders. The population of interest was inclusive of all age groups, gender, levels of income and accommodated diverse religious denominations. The study made inference from the commercial motorcyclist riders in region.

3.4 Sampling Techniques

3.4.1 Sample Size Determination

Sample size is the number of observation or replicate to include in the statistical population (sample unit drawn from sample frame). Vital factors that a researcher takes into consideration before determining the appropriate sample size include confidence level, acceptable level of precision, population variability within the cluster or stratum, cost considerations and the sampling method (Hale, 2011). When the study population size is less than 10,000 individuals, a sample size of 10-30% is considered acceptable when carrying out a descriptive research as long as the sampled elements are more than 30 (Mugenda & Mugenda, 2003). Estimation of the sample size was based on the formulae provided by Fisher *et al.* (1998).

$$n = \frac{Z^2 p(1-p)}{d^2}$$

n= the desired sample size (if the target population is more than 10,000)

z = the standard normal deviation which is equal to 1.96 at 95% confidence level.

p= Proportion of the target population estimated to have the desired characteristic.

d = degree of accuracy (the level of statistical significance set) which in this case will be 0.05

If there is no estimate available of the proportion in the target population assumed to have the same characteristics, the researcher may use 50% of the given sample as recommended by Fisher *et al.* (1998).

$$\frac{1.96^2 0.5(1-0.5)}{0.05^2} = 384$$

However, since the target population for this study was less than 10,000 the final sample size estimate was adjusted according to the recommendations by Mugenda and Mugenda

$$(2003). nf = \frac{n}{1 + \frac{n}{N}}$$

nf= desired sample size when the population is less than 10,000

n= desired sample when the population is more than 10,000

N= estimate of the population size.

$$\frac{384}{1 + \frac{384}{9000}} = 368$$

Therefore, the sample size used in this study was 368 *boda boda* operators from Kapseret Sub-County, Uasin Gishu County.

3.4.2 Sample size Selection

A multistage sampling technique was used to recruit the study participants. First, Kapseret Sub-County was purposefully selected because of the significant increase in fatalities and injuries related to commercial motorcycle accidents in the region. Secondly, *boda boda* assembly points, herein called clusters in the sub-county were selected at random. A total of 21 clusters (N) were chosen. Out of these, a Probability Proportional to Size cluster sampling technique was used to select the final study sample which comprised of 12 clusters(n). A simple random sampling technique was then used to select study participants from the 12 clusters using sample weight or proportion per cluster population (table 3.1). Individual *boda boda* riders who consented to the study were thus recruited until desired sample size of 368 was achieved. Sample unit was an individual commercial *boda boda* rider in Kapseret Sub-County. Purposive sampling, specifically expert sampling technique was used to select 30 key informants in Kapseret Sub-County. Targeted groups included; health care officers, county officials, *boda boda* association stakeholders and traffic officers. Informant selection was based on the hierarchy of the informant, their personal experience, knowledge and understanding of the target population (*boda boda* riders operating in Kapseret Sub-County). A diverse mix of informants from different groups of key stakeholders provided a broad range of perspectives.

Table 3.1: Number of selected riders per cluster.

Selected cluster	Cluster Population size	Proportion/sample weight %	Selected riders per cluster
Langas	103	13	49
Televiwe	38	5	18
Kibyoka	64	8	29
Pionner	111	14	52
Kipkenyo	56	7	26
Tai	21	3	11
Total	65	8	29.
Rivatex	87	11	40
Keelenget	50	6	22
Inter	43	5	18
Kibagenge	69	9	33
Naivas	84	11	41
Total	791	100	368

3.5 Data Collection Tools.

Data were collected using a face to face questionnaire (appendix 1). The questionnaire utilized both open and close ended questions in order to collect adequate qualitative and quantitative data on hazards and road safety issues among *boda boda* riders. Key Informant Interview schedules were used to collect qualitative data from identified experts (health care officers, county officials and traffic officers) thus yielding in-depth information on motorcycle safety. Secondary data on *boda boda* accidents and related fatalities were obtained from the Health Service Data, County Police Traffic Department, road Safety Manuals and County motorcycle association records. The Hazard Identification, Risk Assessment and Control measures (HIRAC), (appendix 2), was the standard data collection tool that was used to identify the most predominant occupational hazards among *boda boda* riders. The HIRAC tool was vital in evaluating the risks arising from exposure to psychosocial factors, physical, chemical, biological and ergonomic hazards and appropriate risk rating taking into account the adequacy of any existing controls. Two focus group discussions (FGDs) were also conducted and provided in-depth information on the general state of motorcycle road safety.

3.6 Validity and Reliability of Research Instruments

3.6.1 Validity

Validity of a data collection tool is the degree to which the findings of the research can be used to make accurate and meaningful generalization to other places and subject populations (Mugenda & Gitau, 2008). Content validity is one of the approaches used to assess validity of measuring tools. Content validity was achieved by careful and precise wording of the questionnaire items based on established theories, expert opinions, previously validated instruments and findings from previous studies. Validity was established by engaging a panel of content-familiar experts who examined variables in the study and determined vital characteristics should be included in the questionnaire (Denscombe, 2014). The researcher sought professional opinion from supervisors and other experts in the field of occupational safety and health. The experts used a four-point scale (1=not relevant, 2= somewhat relevant, 3=quite relevant, 4 = highly relevant) to score each question. The content experts assessed the relevance of each question in the instrument, suitability for the target population and thereafter provided recommendations for questions that had a low score. The suggestions from the experts facilitated necessary revisions and modifications with regards to wording and question content and thereby enhanced the validity of the research tool.

3.6.2 Reliability

Reliability refers to the extent to which the results of a data collection instrument can be replicated. That is the consistency of measurement of an instrument overtime (Kothari, 2004). A respondent driven pilot-test questionnaire was used to conduct a pre-study prior to the execution of the actual study. The pilot study was carried out in Kesses Sub- County, which is one of the six Sub-Counties in Uasin Gishu County with nearly similar characteristics with the study site. The developed data collection tools were pre-tested on 30 boda *boda* riders who were randomly selected and were exposed to the test-retest technique of reliability testing. The scores obtained from each test were correlated to get the coefficient of reliability and were used to determine the consistency, dependability and trustworthiness of the instruments. The questionnaires were to be considered reliable if the obtained Cronbach's alpha value was 0.70 or higher (Kumar 2005). The Cronbach's alpha value for the pilot study was 0.8612 making the questionnaires reliable tools to collect data.

3.7 Ethical Consideration

Ethical approval was sought and obtained from Egerton University Ethics Review Committee (EUREC) before embarking on the study (appendix 5). Additionally, a research permit was obtained from the National Commission for Science Technology and Innovation (NACOSTI) (appendix 4.) Permission was also sought from *boda boda* Sacco leaders in Uasin Gishu County prior to commencing the study. Consent was obtained from each of the riders before the questionnaires were administered. The confidentiality of each respondent was guaranteed throughout the data collection process. Additionally, the questionnaires were filled on voluntary basis and respondents were allowed to withdraw consent if they felt that their privacy was not guaranteed. The respondents were informed that there was no monetary reward attached to filling the questionnaires and that the study sought to generate relevant information that would improve road safety practices and minimize fatalities among *boda boda* riders in Kapseret Sub-County.

3.8 Data Analysis

Descriptive statistics such as frequencies, percentage and measures of central tendency were used to analyse of quantitative data generated from the study. The findings were presented using frequency distribution tables, graphs, pie and bar charts to enhance visualization and data interpretation. The qualitative information obtained from the study was subjected to thematic analysis, which involved discovering, exploring, and reporting overarching ideas or concepts. For extensive analysis, the data collected was cleaned, coded and analysed using Statistical Package for Social Sciences (SPSS) version 20. Pearson's chi-square test was used to test for the significance of association between categorical variables in the study. (Mugenda & Gitau, 2008).

Table 3.2: Statistical data analysis methods for each objective

Research Objectives	Variables	Statistical data analysis method
To asses' occupational hazards among commercial motorcyclists in Kapseret Sub-County	Psychosocial hazards Ergonomic factors Physical hazards Chemical hazards Biological hazards	Descriptive statistics (percentages and frequency distribution)
To establish knowledge, perception and extent of compliance to OSH Act and other regulations on appropriate road safety practices in Kapseret Sub-County.	Training modules Licensing and certification Road safety regulations Insurance Rider experience Safety compliance	Descriptive statistics (percentages and frequency distribution)
To determine the prevalence of commercial motor cycle related road traffic accidents in Kapseret Sub-County.	Prevalence of accidents Accident causal factors Injury severity Emergency response time Motor-cycle related death	Descriptive statistics (Frequency, %) Pearson's Chi-square
To establish the relationship between socio demographic characteristics of <i>boda boda</i> riders and occurrence of road traffic accidents in Kapseret Sub-County.	Age Gender Level of education Marital Status-Motorcycle ownership	Descriptive statistics Pearson's Chi-Square

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

This section presents the results of the study on the assessment of occupational health hazards and safety needs of commercial motorcyclists in Kapsaret Sub-County, Uasin Gishu County, Kenya. The results presented include; demographic information of the respondents, descriptive and inferential statistics of; predominant occupational hazards, knowledge perception and extent of compliance to OSHA Act, the prevalence of commercial motor cycle-related road traffic accidents, and the relationship between socio-demographic characteristics of *boda boda* riders and occurrence of road traffic accidents in Kapsaret Sub-county.

The study sample size was comprised of 398 respondents out of who 368 were *boda boda* riders and 30 were key informants. All the questionnaires were dully filled giving a response rate of 100 % (table 4.1). According to Neuman (2007), a 50 % response rate is considered sufficient for data analysis and subsequent reporting while a rate above 80 % is deemed as excellent. The high response rate was attributed to the questionnaires being administered face to face and during off-peak hours.

Table 4.1: Response rate

Participants	Targeted size	Turnout	Response Rate
Key Informants	30	30	100
<i>Boda boda</i> Riders	368	368	100

4.2. Socio-Demographic Characteristics of the Respondents

This section presents the socio-economic attributes of the respondents, and they include; age, gender, level of education, daily income and off days in a week.

4.2.1 Gender of the Respondents

Majority of the riders in the study were male 348 (94.6%) with females accounting for only 5.4% of the respondents (table 4.2). The study findings largely concur with that of Okonda *et al.* (2015) where 98 % of the respondents in the study area were found to be male. This implies that the *boda boda* transport business is largely male-dominated. The reasons for the gender discrepancies found in this study is not known, however, it could be, as expounded by Mkutu and Mkutu (2019), due to the escalating incidences of accidents, violence, socio-cultural norms, increased morbidity and mortality, and, the demanding nature of the occupation.

Table 4.2: Gender distribution

	Gender	N (%)	Cumulative Percent
Valid	Male	348 (94.6%)	94.6
	Female	20 (5.4%)	100.0
	Total	368 (100%)	

4.2.2 Age of the respondents

Figure 4.1 provides a visual presentation of the respondents' age. From the study results, majority of the riders (57.1 %) were from the age bracket of 18-35 years and only 6.3% were above 55 years. This is an indication that the commercial motorcycle industry is largely youth-driven. The findings are in line with Luchidio (2013) who found out that majority (71%) of the *boda boda* riders in Kakamega County were young aged between 18-35. This affirmed Amone (2021) who stated that the unprecedented levels of unemployment have driven youths to venture into the *boda-boda* business in a bid to improve their living standards.

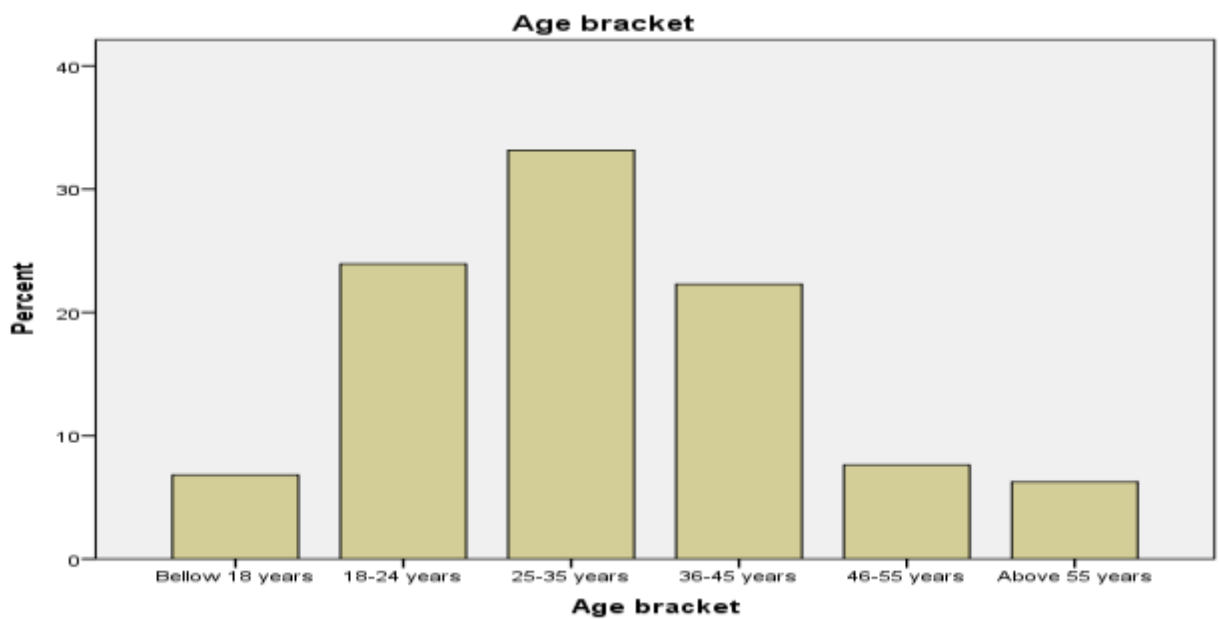


Figure 4.1: Age of the respondent

4.2.3 Respondents level of education

Previous studies have declared education a critical social factor to consider when examining factors that influence safety of commercial riders. This study examined literacy diversity of the riders. As shown in table 4.3, a greater number of the respondents (51.4%) had secondary education, 35.6% attained primary education and only 13% had tertiary education. Therefore, majority of riders in Kapseret Sub-County have some form of formal education, however, very few are skilled crafts men. Previous research undertaken in Turkana County showed that the level of education of commercial riders has a positive and significant effect on

behaviour and adherence to road safety regulations (Okebiro *et al.*,2022). Additionally, educational levels of *boda boda* riders have also been correlated with high prevalence of traffic accidents (Nyachio,2020).

Table 4.3: Education level of respondents

Level of education		N (%)	Cumulative Percent
Valid	Primary	131 (35.6%)	35.6
	Secondary	189 (51.4%)	87.0
	Tertiary education	48 (13.0%)	100.0
Total		368 (100%)	

4.2.4 Motorcycle ownership

The study established that majority (61%) of the respondents owned the motorcycle they operated while 39 % had either leased it or were employed on a commission (figure 4.2). The findings in this study are similar to the study done by Opondo and Kiprop (2018) who found that 55 % of commercial riders in Kenya own the motorcycles that they use in public transportation. This can be credited to the government’s move to zero- rate import duty of motorcycles over a decade ago making it very affordable and an integral part of the informal transport sector in Kenya. Further, access to affordable motorcycle financing with convenient payment plans has contributed to the dramatic increase in motorcycle ownership in Kenya. According to Widyastuti and Adriana (2022) motorcycle ownership has a preventive effect on the incidence of road traffic crashes and significantly reduces the risk of fatal crashes.

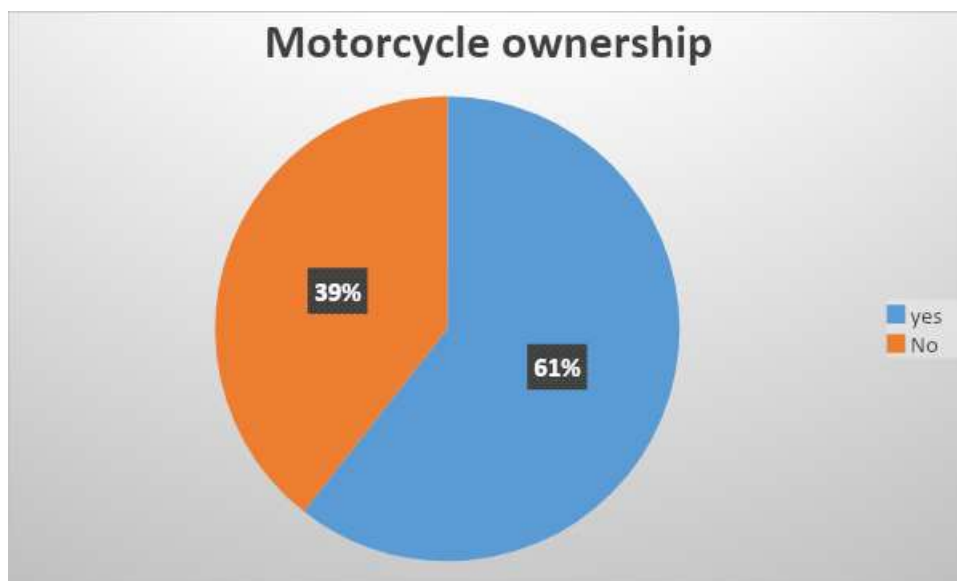


Figure 4.2: Motorcycle ownership

4.2.5 Hours of operation per day

The study sought to establish the versatility in hours of operation amongst *boda boda* service providers. The findings show that commercial riders operate for an estimated average of 12 hours; more explicitly, majority (76.9%) fall within 6-15 hours of operation per day. Noteworthy, 4.1 % of the respondents extend their operating time to more than 16 hours per day. It is thus deduced that as an occupation, commercial riding is highly flexible since it has no fixed time schedule and services are offered on the basis of convenience. The findings are consistent to an observation made by Kitara and Karlsson (2020) in Gulu, Northern Uganda which shows that riders in the region work an average of 14 hours in day and this is deemed to be too long and is associated with physical exertion which has been cited as a vital contributor to *boda boda* accidents in the municipality.

Table 4.4: Operating hours in a day

	Operating hours	N (%)	Cumulative Percent
Valid	0-5hrs	70 (19%)	19.0
	6-10hrs	138 (37.5%)	56.5
	10-15hrs	145 (39.4%)	95.9
	More than 16hrs	15 (4.1%)	100.0
Total		368 (100%)	

4.2.6 Income

In order to understand how sustainable, the *boda boda* industry is, respondents were asked to provide their average income per day. Majority of the respondents (41.3%) daily income ranges between KES 501-800, 32.6 % receive between 300-500 KES per day while 21.7 % earn between KES 801-1500 on average from daily operations as represented in table 4.5. The findings of this study clearly indicate that the *boda boda* industry is lucrative and is a source of livelihood for the local population, thus alleviating poverty levels in Kapseret Sub-County. The income levels found in this study agrees with that of Gitonga (2014) which revealed that the average daily earning of commercial riders in Embu West Sub-County ranges from KES 300-800. A study by Car and General (2022), avers that the *boda boda* sector in Kenya is a key driver of the economy earning a rider about KES 1000 from 15 trips translating to KES 1Billion daily and KES 365 billion in a year for the 1 million riders working in the industry.

Table 4.5: Daily Income in KES

Response	N (%)	Cumulative Percent
0-300	16 (4.3%)	4.3
301-500	120 (32.6%)	37.0
501-800	152 (41.3%)	78.3
801-1000	67 (18.2%)	96.5
1001-1300	10 (2.7%)	99.2
1301-1500	3 (0.8%)	100.0
Total	368 (100%)	

4.2.7 Resting days for boda boda riders in Kapseret Sub County

Estimating the number of off-days in the *boda boda* industry which is classified as an informal sector is critical since overworking can lead to fatigue which can impair the cognitive performance of a rider and consequently increase the risk of a crash. The study revealed that majority of the riders (54 %) had only 1 off day in a week, 148 (40%) did not have any off day while 6 % took 2 off days in a week. These results concur with those of Senda (2023) who found that majority of riders (56.49 %) in Nakawa Division, Kampala work for 6 days in a week while 27.27 % operate daily. According to a report by the International Labor Organization, with regards to work duration and intensity, dependent self-employed persons usually experience worse work –time quality and intensity in comparison to all other categories

of employment (Williams & Lapeyre, 2017). In accordance with the Government of Kenya (2007) which recommends for at least one or two off days per week to prevent burnout, a considerable portion of the riders in this study fall short of the recommended standards thus influencing safety outcomes.

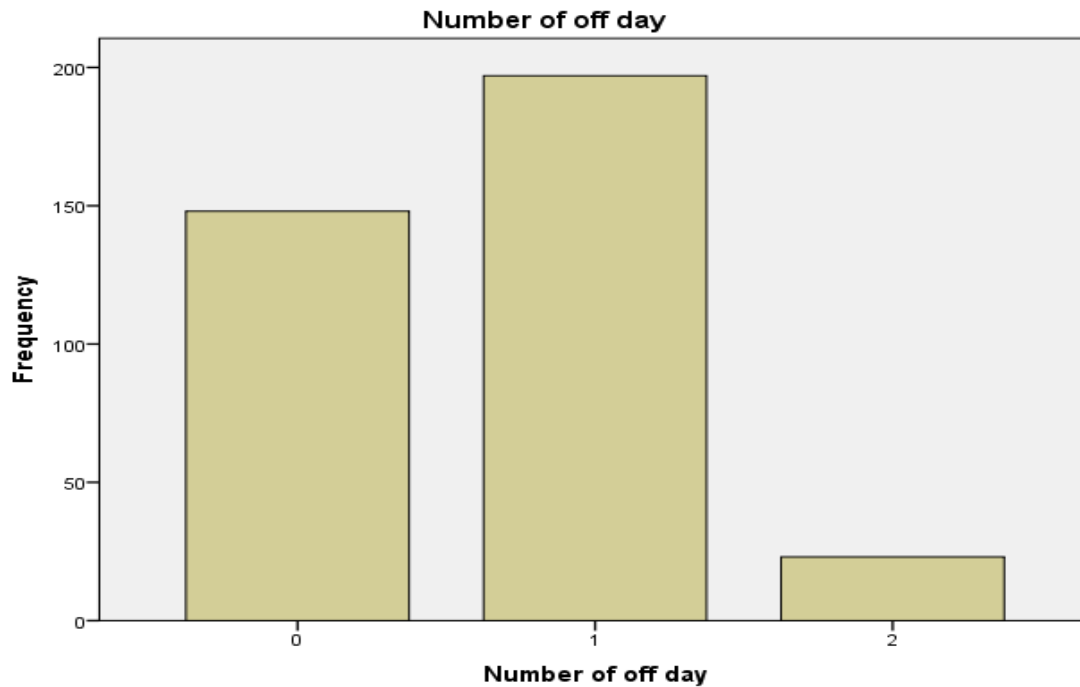


Figure 4.3: Number of off days in a week

4.3 Occupational hazards in the boda boda industry

The first objective of the study sought to assess occupational hazards among commercial motorcyclists in Kapseret Sub-County, Uasin Gishu County. Occupational hazards are essentially risks affiliated with working in a particular work environment and encompasses; physical hazards, chemical, biological, psychosocial hazards and ergonomic/machine risk factors (International Labour Organization, 2019). This study examined rider’s vulnerability to hazards inherent in the *boda boda* industry and the associated occupational health risks. This objective was analysed using descriptive statistics.

4.3.1 Ranking of predominant occupational hazards

The study utilized a Hazard Identification, Risk Assessment, and Control Measures tool(HIRAC) to determine the likelihood of exposure to a hazard. The likelihood to exposure was assessed using scales as (very likely, likely, unlikely and highly Unlikely) and the possible adverse consequence were scored as either (life threatening, detrimental, harmful and negligible). The risk rating for each hazard (high, medium or low) was thereafter determined

using a risk matrix. Figure 4.5 provides a visual presentation of the risk rating ranking across the five major categories of occupational hazards.

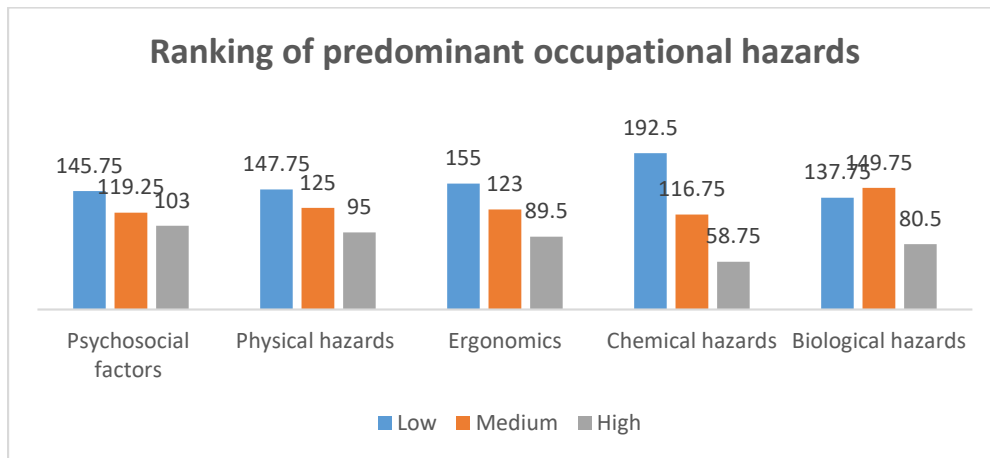


Figure 4.4: Ranking of predominant occupational hazards

From the study results, psychosocial factors emerged as the hazards with the highest risk rating with a frequency of 103; closely followed by the risk of exposure to physical and ergonomic hazards with a frequency of 95 and 89 respectively. The findings reveal that psychosocial, physical and ergonomic factors are predominant hazards impacting on the safety and occupational health of commercial riders in the study area. Epidemiological studies in Shanghai, China by Li *et al.* (2022) suggest an increased risk for musculoskeletal disorders and cardiovascular diseases among commercial riders as an effect of occupational exposure to work stressors. The stressors associated with poor health include whole body vibration, traffic pollutants, demanding work shifts and excessive noise; these risk factors are the greatest contributors to the development of musculoskeletal and cardiovascular disorders among riders (Wilberforce & Odero ,2015). Of note is that chemical hazards had the lowest risk rating across the hazards with a frequency of 192, thus implying that concerns related to chemicals exposure are less prevalent within the *boda boda* industry.

4.3.2 Risk Rating of occupational hazards in the *boda boda* industry.

Risk rating is the process of evaluating the severity of a hazard and categorizing the potential occupational risks in a particular workspace or environment. A high risk rating implies that for a *boda boda* rider, the identified hazard, if not mitigated is likely to result in substantial injury or loss; a medium risk signifies that the recognized hazard is likely to cause the rider minor injury or loss while a low risk rating infers that without mitigation, the recognized hazard could potentially lead to harm, however, the risk to rider is not immediate. The qualitative risk rating of occupational hazards in the study as either high, medium or low

(table 4.6) was essential in determining the overall risk levels in the *boda boda* industry thus informing appropriate control measures.

Table 4.6: Risk Rating of predominant hazards in the *boda boda* Industry

		RISK RATING		
	HAZARDS	Low N (%)	Medium N (%)	High N (%)
1.Psychosocial factors	Stress	73 (19.8%)	91 (24.7%)	204 (55.4%)
	Fatigue	151 (41%)	97 (26.4%)	120 (32.6%)
	Customer aggression	240 (65.2%)	109 (29.6%)	19 (5.2%)
	Violence	119 (32.3%)	180 (48.9%)	69 (18.8%)
2.Physical hazards	Excessive noise levels	238 (64.7%)	78 (21.2%)	52 (14.1%)
	Temperature extremes	79 (21.5%)	211 (57.3%)	78 (21.2%)
	Vibrations	211 (57.3%)	110 (29.9%)	47 (12.8%)
	Pot holes and slippery roads	64 (17.4%)	101 (27.4%)	203 (55.2%)
3. Ergonomics	Poor riding	37 (10.1%)	105 (28.5%)	225 (61.1%)
	Repetitive movements	204 (55.4%)	131 (35.6%)	33 (9.0%)
	Body vibration	224 (60.9%)	105 (28.5%)	38 (10.3%)
	Visual discomfort	155 (42.1%)	151 (41.0%)	62 (16.8%)
4.Chemical hazards	Carcinogens	198 (53.8%)	125 (34.0%)	45 (12.2%)
	Irritants	98 (26.6%)	168 (45.7%)	102 (27.7%)
	Corrosives	265 (72.0%)	73 (19.8%)	30 (8.2%)
	Flammables	209 (56.8%)	101 (27.4%)	58 (15.8%)
5.Biological hazards	Bacteria	148 (40.2%)	118 (32.1%)	102 (27.7%)
	Virus	98 (26.6%)	43 (11.7%)	227(61.7%)
	Parasites	147 (39.9%)	115 (31.3%)	106 (28.8%)
	Fungi	158 (42.9%)	139 (37.8%)	71 (19.3%)

4.3.2.1 Psychosocial hazards

With regards to exposure to psychosocial hazards, the research findings revealed that stress is a high risk factor in the boda boda industry (55.4%), customer aggression emerged as a low-risk concern while violence was identified as a medium psychosocial risk as outlined in table 4.6. This finding classifies stress as the most predominant psychosocial hazard affecting the well-being of boda boda riders in Kapseret Sub-County. A study by Senda (2023) found that majority (84.14 %) of boda boda riders in Kampala had severe distress, 13.92 % had middling distress and intriguingly only 19.4 % of the respondents in the study were psychologically well. Riding related stressors are mainly triggered by environmental and personal factors and usually brings about anxiety, affects attention, active memory and further impairs cognitive neuroscience of a rider.

The aggregated low risk rating of fatigue found in this study differs significantly with the findings of a study conducted in India which found that the incidence of fatigue was significantly higher ($p < 0.05$) among commercial riders than drivers of other transport modes as an effect of non-uniform distribution of seat pressure and prolonged static sitting posture (Balasubramanian & Mani, 2014). The reasons for this discrepancy are currently unclear but differences in cultural and physical constitutions between Africans and Indians may explain the different findings. Additionally, the low risk rating of motorcycling mental and physical fatigue in this study may be attributed to rider biological factors such as age and health which influences physical and cognitive effort and subsequent fatigue levels. In Benin, Ghana, a study by Ahanhanzo *et al.* (2023) revealed a high prevalence of fatigue among motorized two – wheeler riders aged above 50 years, with a significant difference among riders aged below 30 years (14.29 % vs. 9.00 %, $p < 0.05$).

4.3.2.2 Physical hazards

On exposure to physical hazards, the findings in table 4.6 highlight potholes and slippery roads as high risk (55.2%) environmental elements within the occupation. Notably, temperature extreme is classified as a medium-risk concern while excessive noise and vibrations are rated as low risks physical hazards. This implies that poor road infrastructure in Kapseret Sub-county poses a vital occupational risk amongst *boda boda* riders. The findings are in line with Muguro *et al.* (2022) who found out that infrastructure development is not commensurate with motorization in Kenya as witnessed in unmarked bumps, lack of signage, malfunctioned traffic lights, poor road markings and lack of designated riding and cycling lanes thus posing a risk hazard.

The categorization of temperature extremes as a medium risk factor in the *boda boda* work setting denotes that there is a considerably elevated risk of exposure to extreme weather elements among commercial riders in the study area. A study conducted by Shabani and Mamuya (2020) found that commercial motorcyclists often operate in environments characterized by dusty roads and cold weather, heightening their susceptibility to health issues such as asthma, fever, chest pain, acute flu, pneumonia and respiratory diseases which is detrimental to their well-being. Additionally, weather elements have been recognized as risk factors for fatal motorcycles accidents. As outlined in a study by Hsu (2024), exposure to higher temperatures among motorcyclists is associated with increased risks of road traffic accidents as an effect of physiological response to heat stress resulting in fatigue, impaired cognitive function and elevated stress levels (95%CI: 1,041, 1.092).

4.3.2.3 Ergonomic hazards.

In regards to Ergonomic hazards, the study findings illuminate the static riding posture of *boda boda* riders as a substantial high risk factor (61.1%). It is thus deduced that the seated posture adopted by *boda boda* riders is a key ergonomic risk factor often predisposing riders to the risk of musculoskeletal disorders. More often than not, *boda boda* riders are exposed to whole-body vibration, cumbersome sitting posture, long riding time, routine muscular effort and seat discomfort as an effect of their workspace thus exposing riders to the risk of developing work-related musculoskeletal disorders (Jaiyesimi *et al.*, 2018). A similar study in Malaysia reported a high prevalence (82.3 %) of lower back pain among occupational motorcyclists in the country (Isa *et al.*, 2011)

Conversely, from the study findings, repetitive body movements and whole body vibration are rated as low risk factors within the *boda boda* work environment. This finding contradicts results reported by Chen *et al.* (2009) who found that more than 90% of the motorcycle riders in the study had a distinctively higher vibration dose value ($VDV_{(8)}$) (mean $23.5 \text{ m/s}^{1.75}$) exceeding the recommended ISO 2631-1 health guidance caution of ($17 \text{ m/s}^{1.75}$). The study therefore infers that there is limited knowledge on the adverse health impacts of whole-body vibration (WBV) exposure among commercial motorcyclists in the country. Previous studies have reported muscular fatigue, discomfort, lower back pain, vestibular and visual disturbances, musculoskeletal issues, and impaired nervous system function as health effects of WBV exposure (Roseiro *et al.*, 2016; Moreno *et al.*, 2011; Ndimila *et al.*, 2015). According to Shivakumara and Sridhar (2010) the magnitude of exposure to WBV is dependent on ergonomic features of the motorcycle, age of the automobile, motorcycle specifications, sitting posture and age of the rider.

4.3.2.4 Chemical hazards

In the evaluation of predominant chemical hazards associated with commercial riding, insights from table 4.6 revealed that carcinogens, corrosives and flammables were collectively classified as low risks hazards with the risk associated with exposure to irritants categorized as moderate (45.7%). This implies that majority of *boda boda* industry sector players are oblivious to the risks associated with exposure to toxic chemicals in their work environment predisposing them to health problems like respiratory, skin and neurological disorders. Long-term occupational exposure to road traffic pollutants such as carbon monoxide, ground level ozone were reported to be statistically higher ($p < 0.05$) among professional motorcyclists in Porto Alegre, Brazil with O₃ levels showing a strong positive correlation with plasmatic lipid peroxidation ($(p < 0.001, 0.8995)$) (Carvalho *et al.*, 2018).

According to Gromadzińska and Wąsowicz (2019) riders in the transport industry are exposed to hazardous chemicals as an effect of incomplete combustion of fuels, fuel evaporation and motorcycle emissions which constitute a variety of chemical compositions; Polycyclic aromatic hydrocarbons (PAHs), volatile organic compounds (VOCs) and heavy metals. Research conducted in Hanoi, Vietnam on exposure to traffic pollutants revealed that motorcyclist had a mean black carbon concentration of 29.4 µg/m³ compared to 10.1 µg/m³ for bus passengers (Quang *et al.*, 2021). Consequently, commercial riders face heightened levels of long-term black carbon exposure, potentially increasing their vulnerability to cardiovascular diseases and respiratory mortality.

4.3.2.5 Biological Hazards

The findings on biological hazards highlight a significantly elevated risk (61.7 %) associated with exposure to viruses in the commercial riding setting while exposure to bacteria, parasites and fungi consistently receive a low risk rating. The high risk rating in relation to exposure to viruses can be attributed to the coronavirus (COVID-19) pandemic which posed a great health threat to riders in the *boda boda* industry. This reflection does not differ from findings reported in South-South Nigeria which pointed out that COVID-19 added another risk dimension to commercial riding as an effect of the operational setting of motorcycles which gave no room for social distancing (Avwioro *et al.*, 2022). Additionally, *boda boda* riders often come into close contact with pillion passengers and are thus prone to viral diseases such as influenza (flu) which is highly contagious and may result in life –threatening health complications including pneumonia. One study conducted in Sagamu, Nigeria found that the prevalence of cough was higher among commercial motorcyclists compared to the non-

motorcyclist's controls (71% vs 21%) and the differences were statistically significant (P-value <0.001) (Adefuye *et al.*,2015).

Boda boda operators are also highly susceptible to communicable diseases such as HIV (human immunodeficiency virus) and Tuberculosis (TB). A study done in Mbarara Municipality, Uganda revealed that commercial riders in the region had a high HIV prevalence at 9.9 % which was higher than the national HIV prevalence level (5.7%) (Tumwebaze *et al.*, 2020). With regards to the risk of TB (a bacterial infection), a study conducted by Karanja *et al.* (2023) in Nairobi discovered that the TB prevalence rate among *boda boda* riders in the metropolis was 1972 per 100,000 people, which is more than twice the national prevalence rate of 558 per 100,000 people. The high prevalence of exposure to TB among commercial riders is attributed to close contact to infected persons and active cases particularly during passenger transportation.

4.3.3 Risk perception

From the study results, majority of riders (64 %) perceived commercial riding to be risky while 36 % (133) considered the work dynamics of the *boda boda* industry to be quite safe (figure 4.4). These findings concur with those of Mbegu and Mjema (2019) who found that more than 80% of the riders in Mbeya Tanzania were cognizant of the inherent risks affiliated with the occupation. In a similar study conducted in Kampala city, Wamune *et al.* (2019) reported that in spite of *boda boda* transport being highly patronized, most riders perceive it to be the most life-threatening mode of transport due to the associated risks. In the event of crash, riders have a 34 –fold higher risk of fatality when compared to motor-vehicle drivers and are thus classified as the most vulnerable road users in the world (World Health Organization, 2017).

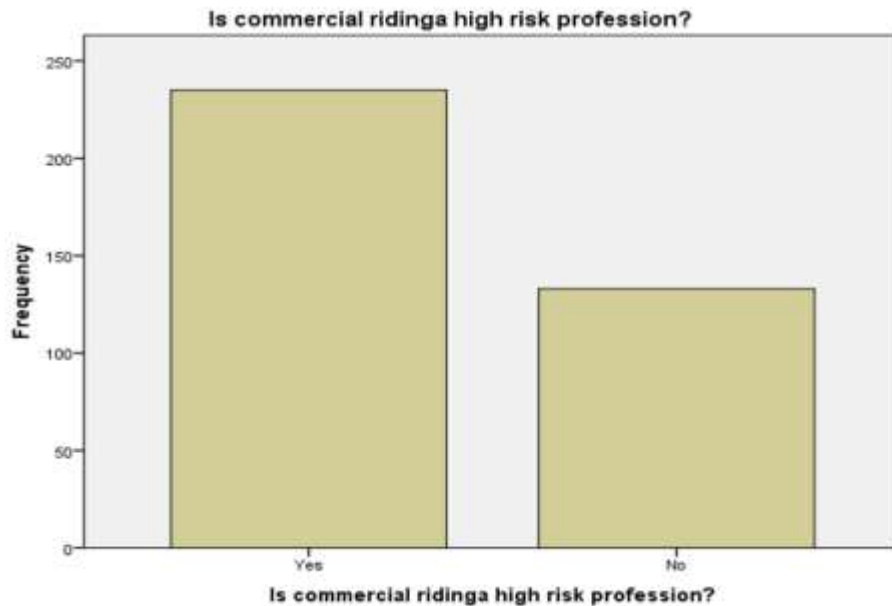


Figure 4.5: Risk perception

4.4 Knowledge, perception and extent of compliance to recommended OSH practices among commercial motorcyclists in Kapseret Sub-County.

The second objective of this study sought to establish knowledge, perception and extent of compliance to recommended OSH practices among commercial motorcyclists in Kapseret Sub-County. This objective was analysed using descriptive statistics.

4.4.1 Training on operation of motorcycles

According to the NTSA Regulation on Training, Testing and Licensing of drivers, all *boda boda* riders in Kenya are obligated to undertake mandatory formal training from accredited training centres (National Transport and Safety Authority, 2015). The findings in figure 4.6 revealed that 52.4 % of the respondents had received formal training while 47.6 % of the *boda boda* riders did not have formal training on the technical soft skills of operating motorcycles. This implies that just over a half of the *boda boda* riders in Kapseret Sub-County have successfully met the NTSA threshold for formal training in road safety. This finding contrast with a previous study by Nyachieo (2020) on *boda boda* rider training in Kisumu East Sub-County where majority of the riders (62%) had received informal training from fellow riders with only 38 % of the respondents having obtained formal training. The novice riders in the study reported that the exorbitant cost of formal training had driven them to resort to informal methods of training (self-taught and apprenticeship); Unfortunately, the informal alternatives heightens the risk of accidents, injury and potentially fatal crashes. In Northern Uganda, a study by Lagoro (2020) revealed that *boda boda* riders with prior training were less prone to fatal accidents (OR=0.104, 95%CI: 0.038-0.281; p<0.001). A similar study on safety

of motorcycle taxis in Nigeria recommended the introduction of mandatory training of riders in a bid to tame rogue riders and subsequently reduce the prevalence of accidents in the country (Zava ,2021).

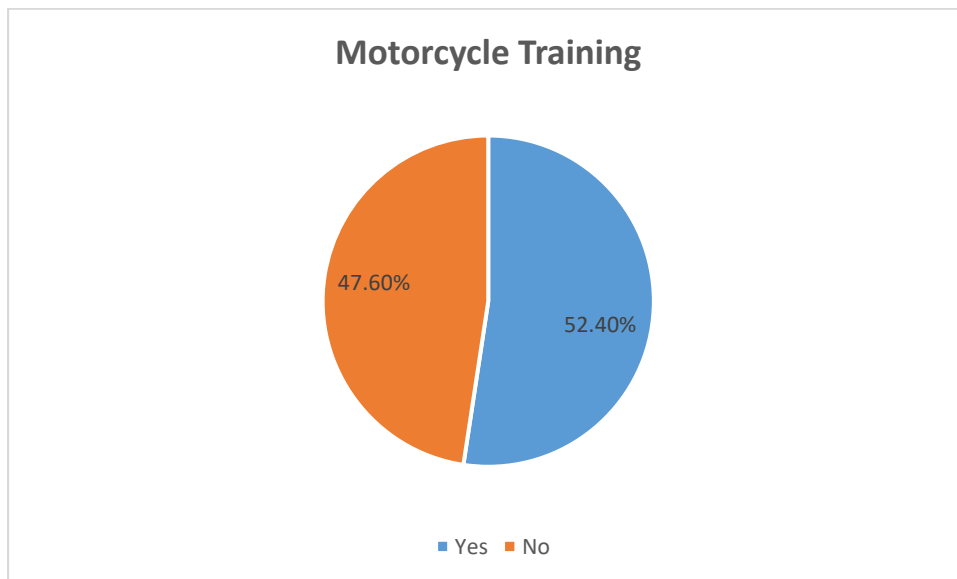


Figure 4.6: Formal rider Training

4.4.2 Practical experience on motorcycle riding.

Rider experience serves as a cornerstone for on-road interactions influencing road positioning skills, risk perception and the corresponding safety behaviour. When probed on riding experience with specific reference to years of operation as licensed commercial riders in the industry, the study findings revealed that majority of the *boda boda* operators (62%) had been operating for 4-7 years. It is thus deduced that the *boda boda* industry is fairly new, largely youth-driven and is a viable source of livelihood. This reflection does not differ from those reported in Kakamega County where 95 % of the *boda boda* respondents in the study had been in operation for less than 5 years with only 5 % having over 6 years' experience in the industry (Luchidio,2017). According to a study by Zuma *et al.* (2021) riding experience is a key determinant of crash occurrence among *boda boda* riders in Kilifi County with the findings revealing a statistically significant association ($p=0.020$, $\chi^2 = 7.760$). The acquisition of riding experience not only heightens information processing but also elevates cognitive skills and manoeuvring competence. This in turn leads to reduction in operational errors among *boda boda* riders.

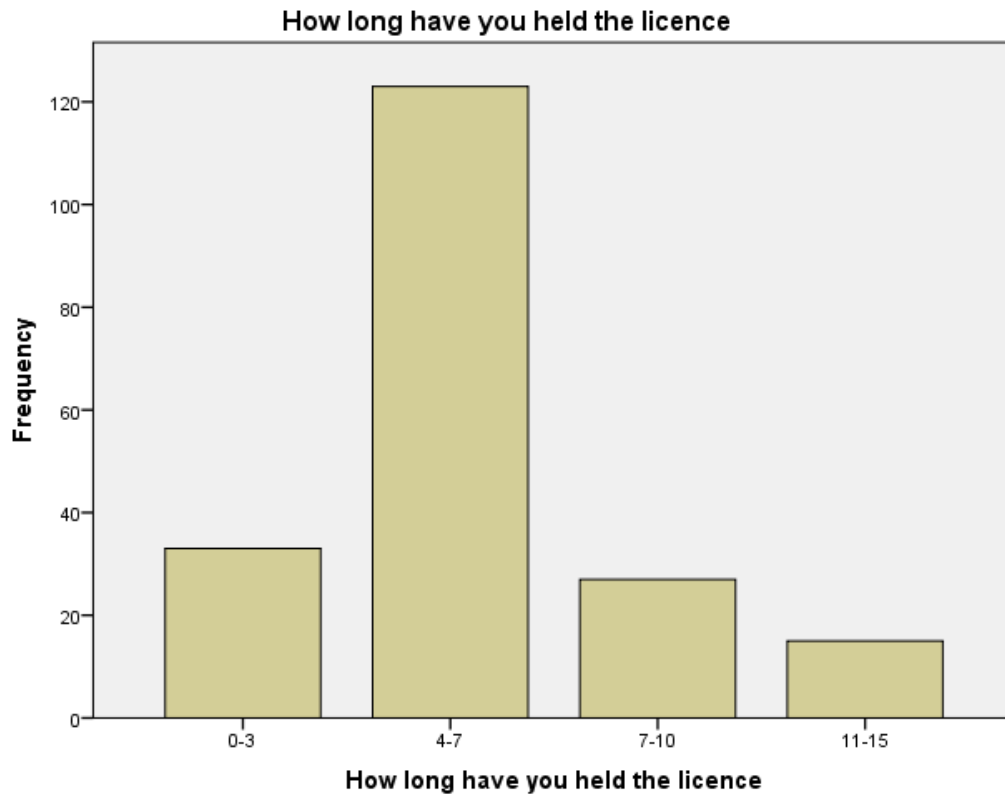


Figure 4.7: Years of formal on-road riding experience

4.4.3 Knowledge on road safety rules and regulations governing the *boda boda* sector

According to the NTSA regulations of 2015, all *boda boda* operators are required to have two helmets and two reflector jackets and is affirmed by the Traffic Act Cap 403. Considerable research has proven helmets to be effective in reducing the risk of head injuries which account for majority of fatalities among commercial motorcyclists in Africa. The study findings in table 4.7 reveal a substantial knowledge gap as majority of the respondents (68%) lacked requisite knowledge on mandated number of helmets a rider should possess; A significant majority acknowledged owning just one helmet. Conversely, the study findings affirm that most commercial riders are not conversant with recommended crash helmet safety regulations that govern the *boda boda* industry. The study findings largely concur with those of Oginni *et al.* (2007) where a mere 20% of the commercial motorcyclists in a study in Lagos Nigeria demonstrated adequate knowledge regarding crash helmets as safety devices.

In adherence to NTSA regulations, *boda boda* riders are also required to carry one passenger at a time, with restrictions on carriage of loads to a height of 2 meters and a maximum width of 15 cm for safety purposes. The study findings reveal a notable lack of awareness as only 34 % of the respondents demonstrated familiarity with the legal mandate restricting riders to ferrying multiple passengers at ago. NTSA regulations further mandates riders to always

have their headlights on as a vital safety feature that aids in visual conspicuity of the Motorcycle. In regards to awareness on *boda boda* conspicuity, only 122 riders (30.4%) were conversant with the law. These results concur with those of Nguyen *et al.* (2018) who found that only 36.3 % of *boda boda* riders in Moshi Tanzania recognized the essentiality of compulsory headlights usage while riding. Previous studies have shown that daytime running lights are critical safety features for *boda boda* riders and substantially aid in lowering incidences of fatal accidents.

Table 4.7: Knowledge on safety rules and regulations governing the sector.

Knowledge on recommended safety regulations	Response	Frequency	Percentage
Number of helmets a rider should have	Yes	118	32 %
	No	250	68 %
Number of pillion passengers to be ferried at a time	Yes	125	34%
	No	243	66%
Having headlights on while riding	Yes	112	30.4%
	No	256	69.6
Number Plate visibility	Yes	261	71%
	No	107	29%
Licencing	Yes	320	87%
	No	48	13%

4.4.4 Compliance to recommended OSH Practices

The study further sought to establish the extent of compliance to recommended OSH practices among commercial motorcyclists in Kapseret Sub-County. According to the Occupational Health and Safety Act, all self-employed persons are mandated to use appropriate Personal Protective Equipment and clothing to guarantee their safety at work. Regarding adherence to PPE usage in the sector, results summarized in table 4.8 depict that a staggering 69% of the *boda boda* riders rarely and in most cases never provide helmets to their passengers. Additionally, only 41.5 % of the riders consistently wear their helmets while riding. In terms of compliance with use of reflector jackets, the study findings revealed that approximately half, specifically 50.5% of *boda boda* riders in Kapseret Sub-County prioritize safety by consistently wearing reflector jackets during their rides. Concerning the utilization of protective gloves, the findings reveal that a mere 12.8 % of riders in the study area adhere to the safety regulation of

incessant use of protective gloves. The findings of this study clearly indicate that there is a low compliance to recommended safety practices among *boda boda* riders in the industry and this may be attributed to poor law enforcement. The results are consistent with Hagan *et al.* (2021) who found that compliance to stipulated safety regulations is fairly low (59.2%) among commercial riders in peri-urban Ghana with younger riders (30-39) being associated with significantly low levels of compliance.

The OSH Act further prohibits self-employed persons from engaging in behaviours or activities that amounts to a hazard in their work setting. In the examination of on-road riding behaviours, the study found that 47.8 % of *boda boda* riders in Kapseret Sub-County always exceed the stipulated speed limit of 50Kph. On on-road use of mobile phones, the findings revealed that majority of the riders often operate their mobile phone while riding which is prohibited by the law. With respect to illicit drug use, the study established that only 13.9 % of respondents have never operated their motorcycles under the influence of psychoactive substances encompassing both alcohol and illicit drugs. It is thus deduced that majority of riders in the study area frequently partake in precarious on-road riding behaviours which is quite alarming due to the inherent risks associated with such behaviours. The study findings largely concur with those of Olusayo *et al.* (2015) who found that commercial motorcyclists in Ogbomoso, Nigeria often disregard safety laws and engage in risky stunts and behaviours such as drunk riding, overloading, novice riding and riding without helmets.

In accordance with NTSA regulation, commercial motorcyclists are mandated to ferry just one passenger at a time and are prohibited from carrying heavy luggage that obscures the rear-view mirrors. However, findings on compliance with these safety regulations revealed that majority of the respondents (42 %) often transport multiple passengers concurrently, with only 12 % admitting to never carrying both luggage and passengers simultaneously. This could be compared to findings of a study conducted in Kisumu, Western Kenya which revealed that 53 % of *boda boda* riders in the region ferry multiple passengers in one motorcycle (Poehler, 2019). The outcomes indicate that compliance to NTSA safety regulations among *boda boda* riders is fairly low increasing the risk of accidents. Notably, while prohibited in many jurisdictions, the practice of ferrying multiple passengers is not unique to Kenya. In Cameroon for example, it was observed that 70.7% of *boda boda* in the country transport multiple passengers (Mefire *et al.*, 2015). A study done in South West Nigeria found that riders operating >2-occupant motorcycles face a higher risk of accidents and related injury compared to riders of 2-occupant motorcycles (OR 2.1, 95% CI 1.1 - 4.3). The increased risk was

attributed to the design and handling dynamics of motorcycles; which performs optimally when carrying a maximum of two persons as an effect of control stability (Sunday *et al.*, 2012).

Table 4.8: Compliance to recommended OSH practices.

Statement	Always N (%)	Often N (%)	Sometimes N (%)	Rarely N (%)	Never N (%)
1 Ferry more than 1 passenger	77 (21%)	154 (42%)	100 (27.2%)	35 (9.5%)	1 (0.3%)
2 Transport passengers & heavy luggage at same time	99 (27%)	119 (32.4%)	46 (12.5%)	59 (16.1%)	44 (12%)
3 Exceed the speed limit of 50kpha while riding	176 (47.8%)	85 (23.1%)	60 (16.3%)	34 (9.2%)	13 (3.5%)
4 operate phone while driving	48 (13.3%)	138 (38.3%)	102 (28.3%)	43 (11.9%)	29 (8.1%)
5 Use daytime headlights when riding	31 (8.4%)	67 (18.2%)	76 (20.7%)	137 (37.2%)	57 (15.5%)
6 Overtake from left side of the road	23 (6.3%)	100 (27.2%)	64 (17.4%)	138 (37.5%)	43 (11.7%)
7 Divert to the passenger road when traffic is congested	47 (12.8%)	119 (32.5%)	104 (28.4%)	63 (17.2%)	33 (9%)
8 Wear helmet	152 (41.5%)	104 (28.4%)	73 (19.9%)	34 (9.3%)	3 (0.8%)
9 Provide helmet for passengers	47 (12.8%)	22 (6%)	45 (12.2%)	107(29.1%)	147(39.9%)
10 wear a reflective jacket	186 (50.5%)	98 (26.6%)	34 (9.2%)	36 (9.8%)	14 (3.8%)
11 Wearing protective gloves	47 (12.8%)	51 (13.9%)	148 (40.2%)	61 (16.6%)	61 (16.6%)
12 Ride under the influence of alcohol	22 (6%)	57 (15.5%)	159 (43.2%)	79 (21.5%)	51 (13.9%)

4.5 Prevalence of commercial motor cycle related road traffic accidents in Kapseret Sub-County.

The third objective of this study sought to determine the prevalence of commercial motor cycle related road traffic accidents in Kapseret Sub-County. This objective was analysed using descriptive statistics as well as inferential statistics (Chi-squared test)

4.5.1 Prevalence of commercial motor cycle related road traffic accidents among study participants in Kapseret Sub-County.

Motorcycle related traffic accidents account for 58.8 % of all reported road traffic crashes in East Africa and is the leading cause of morbidity with significantly higher rates of mortality reported amongst *boda boda* riders (World Health Organization, 2017). Commercial riders are disproportionally vulnerable since they are often exposed with finite protective gears and thus face an increased risk of serious injuries and fatality when compared to other road users. The findings on accident involvement in table 4.8 indicates that majority of the study participants (57.5%) had been involved in an accident over the last 12 months with 42.5 % reporting not the slightest bit of accident involvement. The prevalence of self-reported accident involvement among the respondents within the past 12 months was 57.5% which is higher than that recorded in similar studies in Embu County, 24 % (Ngari,2020), Owo , Western Nigeria ,53% (Olasinde *et al.*, 2022) and Bamenda, Cameroon where the prevalence of commercial motorcycle accidents was reported to be 21.5% (Wankie *et al.*,2021) According to the NTSA statistics, in 2022, commercial motorcyclists accounted for the highest number (1,209) of road fatalities in the country and thus ranked the most precarious mode of transport in Kenya (National Transport and Safety Authority, 2022) .Data obtained from Police records at Kapseret Sub-County Police headquarters revealed that a total of 121 *boda boda* related crashes had been recorded over the last 12 months with 11 riders being involved in a fatal crash (table 4.9)

Table 4.9: Prevalence of commercial motorcycle-related road traffic accidents among the study participants.

Accidents	N (%)	Cumulative Percent
0	155 (42.5%)	42.5
1-3	148 (40.5%)	83.0
4-6	55 (15.1%)	98.1
7-9	6 (1.6%)	99.7
Above 10	1 (0.3%)	100.0
Total	365	

Table 4.10: Police Records on boda boda Crash Severity

Crash Severity	Total number of accidents(N)	%
Minor	121	63.7
Serious	58	30.5
Fatal	11	5.7
Total	190	100

Source: Kapseret Headquarters Police Station Records.

4.5.2 Motorcycle Crash Injuries

Motorcycle crashes are often catastrophic and result in incapacitating and fatal injuries thus placing an enormous economic burden on the public health systems, the government, injured riders and intangible suffering on their dependents. The severity of riders' injuries upon impact is dependent on speed, use of PPEs, road infrastructure, force and object of impact. With regards to the nature of injuries sustained during the accidents, majority of the respondents (92) reported a significantly higher incidence of multiple scrapes and bruises ,65 suffered from fractures and dislocations ,18 sustained head injuries while 17 sustained chest and abdominal injuries. Notably, these findings concur with the study done by Oigo (2018) on motorcycle injury patterns at Kenyatta National Hospital where more than half of the admitted riders sustained head and facial injuries with abrasions and lacerations accounting for 72.6 % and 25.8% of all the anatomical injuries. Non- helmeted *boda boda* riders usually sustain severe craniofacial injuries (concussion, skull and facial fractures, focal and diffuse brain injury) which are often fatal. In Kenya, morbidity statistics from hospitals reveal that injuries from

boda boda accidents account for 2.5 % of clinical visits, 22-64 % of admissions in the trauma unit and 51 % of surgical procedures (Saidi & Mutisto, 2013).

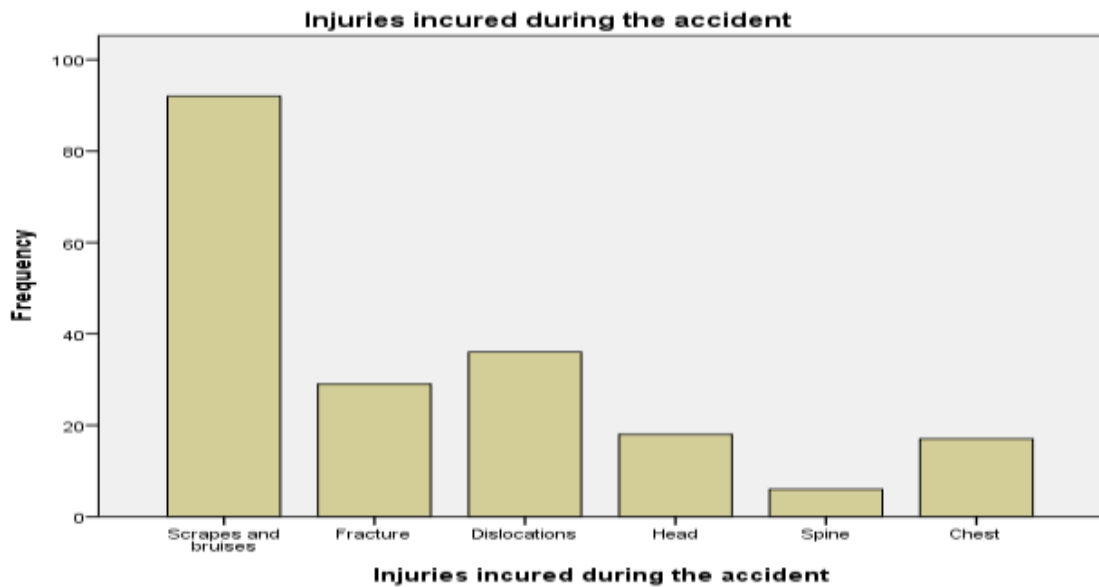


Figure 4.8: Sustained Injuries

4.5.3 Relationship between formal training and accident involvement

The study further sought to establish whether there is a significant association between commercial rider training and crash involvement. The chi-square test results revealed that there was a significant relationship between formal rider training and accident involvement ($\chi^2=151.7$; $df = 4$; $P= 0.000$). It is thus deciphered that formal training plays a vital role in enhancing rider competence and perception to risks and hazards thus lowering the prevalence of crash involvement. The observed association between formal training and crash involvement was affirmed by majority of key respondents who placed emphasis on mandatory *boda boda* training in a bid to curb escalating cases of traffic accidents in the industry. Inferentially, the findings of this study differs with the findings of a study by Nyachieo (2020) which revealed that formal *boda boda* rider training had no statistical significant relationship with crash involvement in Kisumu County ($\chi^2=2.60$; $df=1=P=0.107$).

Table 4.11: Chi-square test for formal training and accident involvement

Chi-square tests				
	Value	Df	Asymp. Sig. (P-value)	
Pearson Chi-Square	151.729 ^a	4	.000	
Likelihood Ratio	184.944	4	.000	
Linear-by-Linear Association	143.533	1	.000	
N of Valid Cases	365			

4.5.5 Perceived factors contributing to boda boda accidents

The study also explored perceived behavioural and environmental factors that contribute to *boda boda* accidents in Kapseret Sub-County. With regards to alcohol and other drugs abuse, majority of the study participants (54.9 %) reported a higher likelihood of crash occurrence while riding under the influence of alcohol as illustrated in table 4.12 below. Impairment as an effect of drug abuse may pose a higher risk to motorcyclists than drivers on account of balance and cognizance required to safely operate in the traffic environment. The study findings largely concur with those of Raga *et al.* (2023) that there is a significant statistical relationship between alcohol abuse and commercial motorcycle accidents in Southern Ethiopia in that drunk riders were 2.3 times more likely to be involved in a crash when compared to sober riders (AOR = 2.304, 95% CI: 1.3, 5.14). Similarly, Osinowo *et al.* (2017) found significant statistical relationship present between alcohol intake and road traffic accidents among *okada* riders in Nigeria [$\chi^2= 11.3$, $df=3$, $p=0.010$). Intoxication as a result of drug abuse among commercial riders in Kenya presents a serious economic and public health concern due to the associated injuries and fatalities.

Table 4.12: Perceived factors contributing to boda boda accidents.

Factors contributing to <i>boda boda</i> accidents	Highly Likely N (%)	Likely N (%)	Unlikely N (%)	Highly Unlikely N (%)
1 Use of alcohol & other drugs	202 (54.9%)	85 (23.1%)	46 (12.5%)	35 (9.5%)
2 Operating a phone while riding	86 (23.4%)	80 (21.7%)	154(41.8%)	48 (13.0%)
3 Poor visibility	195 (53%)	114 (31%)	44 (12%)	15 (4.1%)
4 Over speeding	140 (38.1%)	83 (22.6%)	77 (21%)	67 (18.3%)
5 Fatigue	35 (9.5%)	60 (16.3%)	118(32.1%)	155(42.1%)
6 Rider inexperience	108 (29.3%)	124(33.7%)	84 (22.8%)	52 (14.1%)
7.Reckless overtaking	98 (26.6%)	177(48.1%)	38 (10.3%)	55 (14.9%)

Notably on the perceived risk of operating a mobile phone while riding, a substantial 54.8% of the study participants held the view that it is unlikely or highly unlikely for a rider to be involved in a crash due to cell phone use. This implies a that majority of riders operate their phones while riding and are not cognizant of the associated risks such as decreased reaction time, situational unconsciousness and impulsive responses which increases the likelihood of fatal accidents. As stated in a study by Truong and Nguyen (2019), the prevalent use of mobile phone while riding significantly increases the risk of crash involvement (coefficient=0.197, p-value=0.02). In a similar study in Ethiopia, on-road users of mobile phones were 4.42 times more likely to be involved in an accident in comparison to motorcyclists that operate their phones off-road (AOR = 4.42, 95%CI: 2.73, 7.15) (Raga *et al.*,2023). According to WHO, distracted riding while using a phone impairs reaction times and increases the risk of crash by approximately 4 times when compared to riders not operating mobile phones (WHO,2022)

In regards to fatigue, majority of the study participants (42.1 %) reported that it is highly unlikely for a rider to be involved in a crash as an effect of fatigue. This clearly indicates that

most *boda boda* riders tend to work for prolonged periods and are non-cognizant of the risks brought about by fatigue which can lead to fatal accidents. The findings of this study are inconsistent with the findings of a study by Kwangsukstith *et al.* (2023) who found that extended working hours was associated with an increased risk of crash involvement among commercial riders in Thailand due to fatigue. The study further established that physical and mental fatigue can impair judgement, cognitive awareness and slow real-time reaction and is a substantial contributor to road traffic crashes.

Remarkably, in terms of the perceived risks of reckless overtaking, 48.1% of the respondents cited careless overtaking as a likely contributor of *boda boda* accidents in Kaperset Sub-County. Exogenous stressors like traffic congestion and time constraints coupled with personal frustrations and economic pressures were reported as key factors fostering imprudent overtaking in the region. With respect to rider experience, the study revealed that the likelihood of accident involvement is substantially high (63%) among inexperienced *boda boda* riders. This implies that riders with a short stint of experience are more prone to accidents when compared to their more seasoned counterparts. Notably, these findings concur with the study done by Tumwesigye *et al.* (2016) that riding experience of less than two years is a major modifiable risk factor associated with motorcycle accidents and related injuries in Kampala City, Uganda (OR = 4.18, 95%CI: 2.64–6.58). This finding is also supported by a study conducted in Kilifi County by Zuma *et al.* (2021) who noted that there was a statistically significant association between riding experience and accident occurrence ($\chi^2 = 7.760$, $p = 0.020$); commercial riders with less than four years' experience recorded a higher frequency of accidents.

4.6 Relationship between socio demographic characteristics of boda boda riders and occurrence of road traffic accidents in Kaperset Sub-County.

The fourth objective of this study sought to establish the relationship between socio demographic characteristics of *boda boda* riders and occurrence of road traffic accidents in Kaperset Sub-County. The Chi-square Test results on the association between *boda boda* accidents and each of the explanatory socio-demographic variables are shown in the table below.

Table 4.13: Chi-square Test Results on the association between social demographic characteristics and accident involvement

Chi-Square Tests					
Gender			Value	Df	Asymptotic significance (2-sided)
	Pearson Square	Chi-	2.216 ^a	4	.696
	N of Valid Cases		365		
Age			Value	df	Asymptotic significance (2-sided)
	Pearson Square	Chi-	158.487 ^a	8	.000
	N of Valid Cases		365		
Level of education			Value	df	Asymptotic significance (2-sided)
	Pearson Square	Chi-	137.305 ^a	8	.016
	N of Valid Cases		365		
Marital status			Value	df	Asymptotic significance (2-sided)
	Pearson Square	Chi-	47.837 ^a	8	.581
	N of Valid Cases		365		
Motorcycle ownership			Value	df	Asymptotic significance (2-sided)
	Pearson Square	Chi-	131.402 ^a	4	.018
	N of Valid Cases		365		

With regards to gender, the results showed that there was no statistically significant difference between male and female motorcyclists with regards to accident involvement in Kapseret Sub-County ($p=0.696 > 0.05$). However, these findings are contrary to those reported by Salako *et al.* (2013) in South West Nigeria who found that there is a higher prevalence for

high –risk behaviours among male riders often resulting in fatal accidents. Correspondingly, Nwadiaro *et al.* (2011) established that male riders have a significantly higher risk of crash involvement in Central Nigeria with a reported male to female accident involvement ratio of (M: F =4.8: 1.). In Africa male account for 70 % of road accidents fatalities and this has been attributed to low risk perception, attitude and fatalistic on-road behaviours (World Health Organization, 2017). A study on predictors and prevalence of road traffic injuries in Kenya revealed that male (($p = 0.001$) were significantly far more likely to incur fatal injuries than females in the event of a crash (Gathecha *et al.*,2018)

With respect to age, the study findings show that there was a statically significant relationship between age of the commercial riders and accident involvement ($\chi^2=158.487$; $df=8$; $p=0.000$). This signifies that the discrepancy in prevalence of accident involvement between the selected age groups (18-35) and (36-55) is significant and can be attributed to inexperience and behavioural patterns. The results are congruent with the findings of Nyachieo (2020) which revealed that there is a negative correlation between age and crash involvement ; the coefficients were statistically significant at 95% confidence level ($r=-0.598$; $p=0.000$) .This agrees with the assertions of Havugimana and Mutekanga (2020) who found that the percentage variance in compliance to road safety measures between *boda boda* riders aged 18 to 35 (5.1%) and riders aged 36 and above (70.2 %) in Kampala was statistically significant (95% CI: 0.05-0.01; $p= 0.000$). The propensity for crashes among young riders is considerably high as an effect of aggressive riding patterns, the tendency to be audacious and disregard of road safety regulations.

In regard to level of education as a socio-demographic characteristic, the study established that there exists a statistically significant association between education level of *boda boda* riders and road crashes at 95% confidence level ($p=0.016 <0.05$, level of significance). This indicates that rider education can be a vital intervention for preventing motorcycle crashes and may be associated with the aptness to read and decipher road signs. Notably, the findings concur with a study done by Okebiro *et al.* (2022) in Lodwar town, Turkana County that there exist a significant association between education level of commercial riders and motorcycle crashes ($\chi^2=8.547$; $df=4$; $p=0.00$) as an effect of on-road traffic behaviour. Further, findings regarding predisposing individual factors associated with riding behaviour of *boda boda* riders in Ghana revealed that the propensity of crashes was remarkably high among commercial riders that had attained basic education (45.6 %) as compared to riders who had attained secondary (14%) and tertiary education (4.4%) (Konlan *et al.*,2020).

On the subject of motorcycle ownership, the findings of the study show that at 5% level of significance, there was a statistically significant relationship between motorcycle ownership and accident involvement in Kapseret Sub-County ($p=0.018$). The observed higher risk of accident involvement among riders on hire or commission could be attributed to risky riding patterns like over speeding and overloading in a bid to meet set targets. These findings are consistent with a study done by Francis *et al.* (2023) who found that commercial motorcyclists who lease their motorcycles in Dar es Salaam, Tanzania were significantly associated with higher odds (OR = 2.69, 95% CI: 1.68–4.32) of road traffic accidents when compared to their counterparts who own their motorcycles. In a similar study conducted in Ghana, Hagan *et al.* (2021) noted that *boda boda* riders who did not own motorcycles were 61% less likely to adhere to safety regulations, consequently increasing their susceptibility to accidents.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

The study assessed occupational health hazards and safety needs of commercial motorcyclists in Kapseret Sub-County, Uasin Gishu County Kenya. This section presents a summary of the key study findings as well as conclusions and recommendations. Areas for further research have also been suggested.

5.1. Conclusions

Based on the findings of this study, the following conclusions were made:

- i. Psychosocial, physical and ergonomic hazards featured as the predominant occupational hazards impacting on the safety and health of commercial riders in Kapseret Sub-County.
Stress is the most predominant psychosocial hazard affecting the well-being of *boda boda* riders in Kapseret Sub-County. Poor road infrastructure is a major physical hazard for commercial riders in the region. The sitting posture adopted by *boda boda* riders is a key ergonomic hazard and a risk factor for work-related musculoskeletal disorders.
- ii. A substantial knowledge gap is evident regarding the prescribed NTSA safety regulations for personal protective gears, pillion passengers and motorcycle headlights. Consequently, compliance to recommended Occupational Safety and Health (OSH) practices, particularly regarding the usage of helmets, reflector jackets and safety gloves among *boda boda* riders in the region is fairly low. Moreover, Riders in Kapseret Sub-County frequently partake in precarious on-road riding behaviours such as operating under the influence of psychoactive substances, on-road use of mobile phones and exceeding the speed limits, all of which is quite alarming due to the inherent risks associated with such behaviours.
- iii. The prevalence of *boda boda* accidents in Kapseret Sub-County was 57.5% with alcohol abuse, reckless overtaking and rider inexperience being reported as risk factors for motorcycle accidents in the region.
- iv. The study established a significant relationship between the following socio-demographic attributes of *boda boda* riders; age, education level, motorcycle ownership and accident involvement in Kapseret Sub-County.

5.2. Recommendations

This study makes the following recommendations:

- i. The study recommends for an overhaul of the *boda boda* sector policies to encompass occupational hazards and existing laws on occupational safety. In addition, the informal sector should be institutionalized in order to safeguard *boda boda* riders against work–cycle risks and guarantee their social protection. Policy briefs outlining these recommendations will be disseminated to both county and national governments to facilitate swift implementation.
- ii. The National Transport and Safety Authority in collaboration with the County government should undertake concerted road safety campaigns and create awareness to *boda boda* operators on stipulated regulations that govern the sector in order to enhance compliance levels within the industry.
- iii. The study recommends stricter and maximal enforcement of road safety rules through regular inspection crack downs in a bid to tame rogue riders and significantly lower the escalating cases of *boda boda* accidents.
- iv. The design and implementation of *boda boda* accident preventive measures should take into account the differential impact of social-economic determinants and work-related factors.

5.3 Suggestions for Further Research

The findings of this study would provide a base for more research on occupational hazards and safety needs of commercial motorcyclists in Kapseret Sub-County, Uasin Gishu County, Kenya. However, the study was not entirely exhaustive and recommends the following for further research:

- i. Psychosocial attributes influencing commercial rider behaviours in Kenya.
- ii. Assessment of ergonomic risks associated with the riding posture of *boda boda* riders.
- iii. An investigation on how seasonal weather variations influence frequency and severity of commercial motorcycle accidents in Kenya

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APPENDICES

Appendix A: Questionnaire for *boda boda* riders.

My name is Petrolina Bore. I am a postgraduate student pursuing a Master of Science in Environmental Occupational Safety and Health. I am doing a research on *boda boda* motorcycle safety. I am carrying out an extensive assessment of factors that exacerbate the risk of motorcycle operation in Uasin Gishu County and the findings will help policy makers take action on improving road safety and will also facilitate the refinement of training interventions. I hereby kindly ask you to fill this questionnaire which will enable the researcher obtain important information from the research

The information offered will be treated with the necessary confidentiality and will be unduly disclosed. The information will only be used as pertaining to this study and not otherwise.

Your assistance and cooperation will be greatly appreciated.

SECTION A

Socio-demographic information

The following sections will ask some questions about you. Kindly tick as appropriate

1. Name..... (Optional)
2. What is your Gender? Male () Female ()
3. What is your age bracket? Below 18 () 18-24 () 25-35 () 36-45()
46-55 () above 55()
4. Level of education. Primary () Secondary () Tertiary ()
5. Marital status Married () Single () Divorced () Widowed ()
6. Operating Base
7. a. Name of the sacco.....
b. What is the importance of being in a sacco?
8. Is this motorcycle yours? Yes () No ()

If the *boda boda* motorcycle is not yours, what nature of agreement do you have with the owner?

9. How many hours do you operate per day?
10. How many kilometers do you cover per day?.....
11. How often do you meet your targets? Always () Often () Sometimes () Never ()
12. Do you experience pressure in meeting the set targets? Yes () No ()
- b. what strategies have you put in place to ensure you meet your targets?

 ...
13. How much money do you make per day from the boda boda motorcycle business?

14. How many off days do you get in a week? (Please specify the off days)

15. What do you like about the *boda boda* business?.....

16. Challenges in the boda boda industry

Challenges your currently experiencing as a <i>boda boda</i> rider	Proposed solutions

17. Is it culturally acceptable for women to ride boda boda in Kapseret Sub-County?

SECTION B

Training and safety needs

18. Do you have any motorcycle training? Yes () No ()
19. Where did you go for training? Driving school () Apprenticeship () Self-taught ()
 Specify if none of the above is
20. How many theory lessons did you do?

21. How many practical lessons did you do?
22. List the topics that were covered in your motorcycle training.....

23. Did you do an assessment test after the course? Yes () No ()
24. How long have you held the license?

SECTION C

25. Compliance to safety regulations in the *boda boda* sector

Compliance in the <i>boda boda</i> industry(please tick appropriately)	Always	Often	Sometimes	Rarely	Never
a. Ferry more than 1 passenger at a time					
b. Transport passengers and heavy luggage at the same time					
c. Exceed the speed of 50 Kph while riding					
d. Operate phone calls while driving					
e. Use daytime headlights when riding?					
f. Overtake from the left side of the road					
g. Divert to the passenger road when Traffic is congested?					
h. Wear a helmet					
i. Provide a helmet for passengers					
j. Wear a reflective jacket					
k. Wear protective gloves					
l. Ride under the influence of alcohol					

SECTION D

Awareness of road safety regulations and statutory requirements

26. What license is required to enable you ride a motorcycle? BCE () E () A ()
FG ()

27. At what age are you allowed to obtain a license as a *boda boda* rider?.....

28. Motorcycles are governed by which act of laws of Kenya? Traffic () *Boda boda* ()
NTSA () Police ()

29. Which traffic rules are you aware of as a commercial rider?

30. How many helmets should you have as a *boda boda* rider? One () Two () Three ()
None

Why is it important to have a helmet as a rider?

.....

31. How many passengers should you carry at a time? One () Two () Three () or more

32. How many vehicles should you overtake at a time? None () One () Two ()

or more ()

Explain your answer above

33. How often should the headlights of a motorcycle be on while riding Always ()

Often () Sometimes () rarely () Never ()

Why?

34. Should the number plates of a *boda boda* be visible at all times? Yes () No ()

Please explain.....

35. What aspects of riding do you need a refresher course in?

.....

36. What should the government do to improve the safety of riders, passengers and other road

users?

SECTION E

37. Motorcycle related accidents

Category of Road Users	Likelihood of being involved in an accident with a <i>boda boda</i>			
	Highly Likely.	Likely	Unlikely	Highly Unlikely
Drivers				
Motorcyclists				
Pedestrians				
Pillion Passengers				
Pedal cyclists				

38. How many accidents have you been involved in the past one year? (If none please proceed to question 43

.....

39. What caused the accident?

40. Time of accident Daytime () Night time ()

41. Which injuries did you incur during the accident?

Scrapes and bruises	Fractures	Dislocations	Head	Spine	Chests

42. What was the emergency response time?

.....

.....

43. Perceived factors contributing to *boda boda* related traffic accidents

Factors contributing to <i>boda boda</i> accidents	Probability of an accident occurring			
	Highly Likely.	Likely	Unlikely	Highly Unlikely
Use of alcohol and other drugs				
Operating a phone while riding				
Poor visibility				
Over speeding				
Fatigue				
Rider inexperience				
Reckless overtaking				

44. From your experience, do you agree that certified *boda boda* riders rarely get involved in road accidents? Yes () No ()

SECTION F

Occupational hazards

45. As a *boda boda* rider, do you believe that you are one of the high-risk professions?

Yes () No ()

46. What occupational health issues are you experiencing as a rider?

.....

47. Have you been admitted over the last one year with illness/injuries related to *boda boda* riding? Yes () No ()

48. Do you have an Insurance cover for you motorcycle? Yes () No ()

Please specify the insurance cover that you have

49. Status of the Insurance cover Valid () Expired ()

50.a) What challenges do you experience when trying to get an insurance cover?

b.) What should be done to overcome the challenges?

Appendix B: Hazard Identification, Risk Assessment and Control measures (HIRAC)

Tool

C o n s e q u e n c e	Probability				
		Very Likely	Likely	Unlikely	Highly Unlikely
	Life Threatening	High	High	High	Medium
	Detrimental	High	High	Medium	Medium
	Harmful	High	Medium	Medium	Low
	Negligible	Medium	Medium	Low	Low

HAZARD		RISK ASSESSMENT		Risk rating
		Probability of exposure	Consequence	
1. Psychosocial factors	Stress			
	Fatigue			
	Customer aggression			
	Violence			
2. Physical hazards	Excessive noise levels			
	Temperature extremes			
	Vibrations			
	Pot holes and slippery roads			
3. Ergonomics	Poor riding /Siting posture			
	Repetitive body movements			
	Body vibration			
	Visual discomfort/eye strain			
4. Chemical hazards	Carcinogens (Toxic fumes)			
	Irritants			
	Corrosives (brake fluids, diesel oil, oils)			
	Flammables (petrol and diesel spills)			
5. Biological hazards	Bacteria			
	Virus			
	Parasites			
	Fungi			

THE END Thank you for taking part in this research and May the Almighty God bless you!

Appendix C: Key Informant Interview Guide.

KEY INFORMANTS INTERVIEW GUIDE

EGERTON UNIVERSITY,
P.O.BOX 536,
EGERTON.

Dear sir/madam,

I am a postgraduate student pursuing a Master of Science in Environmental Occupational Safety and Health. I am doing a research on *boda boda* motorcycle safety and accident causative factors in Uasin Gishu County. I am carrying out an assessment of factors that exacerbate the risk of motorcycle operation in the County and the findings will help policy makers take action on improving road safety and will also facilitate the refinement of training interventions. I have chosen you as one of the key informants because you are conversant with motorcycle road safety issues. I will ask you some questions concerning *boda boda* motorcycle safety. The information offered will be treated with the necessary confidentiality and will be unduly disclosed. The information will only be used as pertaining to this study and not otherwise. Your assistance and cooperation will be greatly appreciated.

Yours faithfully

Signature.....

- 1.Name of respondent (optional)
2. Name of institution
3. The position of respondent in the institution.....
4. Currently, do you as an organization have any program on road safety? Yes () No ()
Please explain your answer above.....
5. Why do you think there are so many accidents involving motorcycles in Kapseret Sub-County?
.....
.....
7. Is there anyone in charge of traffic accidents prevention/ control in your organization/department? Yes () No ()
8. If yes what activities are they engaged in regards to road safety?
.....
9. In your view which ergonomic modifications should be made in the design of motorcycles?.....

10. Are there driving/riding schools specifically for motorcycle riders in this town? Yes ()
No ()

Please explain/specify.....

11. Do you think *boda boda* riders are adequately trained to ride? Yes () No ()

Please explain your answer above

12. How do commercial riders break the traffic rules?.....

.....

13. Which malpractices exist in the issuance of *boda boda* licenses?

.....

What do you think can be done to reduce malpractices in the issuance of *boda boda* licenses?.....

14. Do you think organizing the *boda boda* riders in SACCO's and groups have helped in the safety of riders?.....

15. In addition to the training offered to riders, what other competencies do they need?.....

16. Hazard Identification, Risk Assessment and Control measures (HIRAC) Tool

Appendix 2: Hazard Identification, Risk Assessment and Control measures (HIRAC) Tool

C o n s e q u e n c e	Probability				
		Very Likely	Likely	Unlikely	Highly Unlikely
	Life Threatening	High	High	High	Medium
	Detrimental	High	High	Medium	Medium
	Harmful	High	Medium	Medium	Low
	Negligible	Medium	Medium	Low	Low
HAZARD			RISK ASSESMENT		Risk rating
		Probability of exposure	Consequence		

1. Psychosocial factors	Stress			
	Fatigue			
	Customer aggression			
	Violence			
2. Physical hazards	Excessive noise levels			
	Temperature extremes			
	Vibrations			
	Pot holes and slippery roads			
3. Ergonomics	Poor riding /Siting posture			
	Repetitive body movements			
	Body vibration			
	Visual discomfort/eye strain			
4. Chemical hazards	Carcinogens (Toxic fumes)			
	Irritants			
	Corrosives (brake fluids, diesel oil, oils)			
	Flammables (petrol and diesel spills)			
5. Biological hazards	Bacteria			
	Virus			
	Parasites			
	Fungi			


THE END Thank you for taking part in this research and May the Almighty God bless you!

Appendix D: Research Permit from NACOSTI

REPUBLIC OF KENYA
NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY & INNOVATION

Ref No: 205404

RESEARCH LICENSE




This is to Certify that Miss. PETROLINA CHEPCHUMBA BORE of Egerton University, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Uasin-Gishu on the topic: **Assessment of Occupational Health Hazards and Safety Needs of Commercial Motorcyclists In, Kapseret Sub-County, Uasin Gishu County, Kenya for the period ending : 16/March/2024.**

License No: NACOSTIP/23/23904

Applicant Identification Number: 205404

Director General
NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY & INNOVATION

Verification QR Code



NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.

See overleaf for conditions

Appendix E: Ethical Clearance Approval from Egerton University

EGERTON

TEL: (051) 2217808
FAX: 051-2217942



UNIVERSITY

P. O. BOX 536
EGERTON

**EGERTON UNIVERSITY INSTITUTIONAL SCIENTIFIC AND ETHICS
REVIEW COMMITTEE**

EU/RE/DIR/009

Approval No. EUISERC/APP/216/2023

10th February, 2023

Petrolina Chepchumba Bore
P.O.Box, 7256
Nakuru
Telephone +254708620586
E-mail: borepet20139@gmail.com

Dear Petrolina,

**RE: ETHICAL APPROVAL: ASSESSMENT OF OCCUPATIONAL HEALTH
HAZARDS AND SAFETY NEEDS OF COMMERCIAL MOTORCYCLISTS IN
KAPSERET SUB COUNTY, UASIN GISHU COUNTY, KENYA**

This is to inform you that *Egerton University Institutional Scientific and Ethics Review Committee* has reviewed and approved your above research proposal. Your application approval number is *EUISERC/APP/216/2023*. The approval period is *10th February, 2023 –11th February, 2024*.

This approval is subject to compliance with the following requirements;

- i. Only approved documents including (informed consents, study instruments, MTA) will be used.
- ii. All changes including (amendments, deviations, and violations) are submitted for review and approval by *Egerton University Institutional Scientific and Ethics Review Committee*.
- iii. Death and life-threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to *Egerton University Institutional Scientific and Ethics Review Committee* within 72 hours of notification
- iv. Any changes, anticipated or otherwise that may increase the risks or affected safety or welfare of study participants and others or affect the integrity of the research must be

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reported to *Egerton University Institutional Scientific and Ethics Review Committee* within 72 hours.

- v. Clearance for Material Transfer of biological specimens must be obtained from relevant institutions.
- vi. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal.
- vii. Submission of an executive summary report within 90 days upon completion of the study to *Egerton University Institutional Scientific and Ethics Review Committee*.

Prior to commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology and Innovation (NACOSTI) <https://oris.nacosti.go.ke> and also obtain other clearances needed.

Yours sincerely,



Prof. Raphael M. Ngunjiri

CHAIRMAN, EGERTON UNIVERSITY INSTITUTIONAL SCIENTIFIC AND ETHICS REVIEW CTTEE

RMN/BK/

Appendix F: Abstract of Published Paper



Assessment of Occupational Health Hazards and Safety Needs of Commercial Motorcyclists in, Uasin Gishu County, Kenya

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ABSTRACT

In Kenya, the commercial motorcycle (*boda boda*) industry is one of the largest informal sector employing over 2 million riders and is a source of livelihood to 5 million Kenyans. Unprecedented levels of youth unemployment in Uasin Gishu County have driven novice riders to venture into the *boda boda* business with minimal recourse of the occupational hazards and risks they will be exposed to. The objective of the study was to generate data on predominant occupational health hazards among commercial motorcyclists in Uasin Gishu County, Kenya. The study used a cross-sectional research design. A two-stage cluster sampling technique was used to select study participants to the desired sample size of 368. Qualitative and quantitative data was collected using questionnaires and the Hazard Identification, Risk Assessment and Control measures (HIRAC), tool. The data was analyzed using descriptive and inferential statistics. From the findings, psychosocial, physical and ergonomic hazards featured as the predominant occupational hazards among commercial riders in Uasin Gishu County. The results revealed that stress is a significant psychosocial health hazard affecting the wellbeing and safety of *boda boda* riders in the County. Additionally, the study established that the prolonged static sitting posture adopted by riders is a key ergonomic risk factor thus predisposes riders to the risk of developing work-related musculoskeletal disorders. This study recommends for interventions aimed at enhancing capacity and behavior change in the *boda boda* sector through refinement of the training curriculum, concerted sensitization on statutory requirements and strict enforcement of safety laws to enhance occupational safety in the *boda boda* industry during the 2nd UN Decade of Action for Road Safety 2021-2030.

Keywords: Occupational health, Hazards, Risk factor, Occupational safety, *Boda boda*

INTRODUCTION

Occupational hazards refer to long-term and short immediate risks associated with a specific work environment subsequently affecting the health and safety of workers and can be categorized as ergonomic stressors, physical, biological, psychosocial and chemical hazards (Melرداد, 2020). Motorcyclists are among the most vulnerable road users (VRUs) globally, accounting for nearly a quarter of global road traffic mortality annually (WHO, 2018). In Kenya, the severe economic hardship in the country coupled with high rate of unemployment has necessitated continuous increase in the number of people riding commercial motor-cycles for their livelihood with minimal recourse of the occupational hazards and risks they will be exposed to. The increased popularity of *boda boda* as a mode of transport in Uasin Gishu County has resulted in escalating cases of occupational injuries and fatalities and has thus put an enormous burden on the health care sector.

Motorcyclists are often exposed to the following physical hazards excessive heat, deafening noise levels, vibrations, lacerations and cuts resulting from physical injuries (ILO, 2019). A study revealed that modern helmets sound attenuation properties are quite poor offering low frequency attenuation which is not effective considering that at 60 km/h the noise resulting from wind around the helmet is reported to be at about 90 dB(A) (McCombe, 2003). Subsequently, riders often experience hearing impairment due to prolonged exposure to

