THE COST OF MOTORCYCLE ACCIDENTS IN UGANDA

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Abstract

Understanding the cost of the road traffic accidents (RTAs) has been of interest to many scholars and policy makers for a long time. In Uganda like many developing countries in

Africa, injuries due to motorcycle accidents represent a major but often neglected emerging public health problem and contribute significantly to the overall road traffic injuries. This research study therefore explored the costs of motorcycle accidents and the pain, grief and sufferings of the motorcycle accident victims using a multi-method approach. Unlike many studies on cost of accidents which use the traditional human capital approach, this study in addition to the human capital approach, applied the Willingness-to-pay (WTP) approach to estimate the cost of motorcycle accidents. WTP method was used to estimate the value that boda boda riders would pay for reducing the risk of loss of life based on Contingent Valuation (CV) method. We extend the analysis to also explore the key coping mechanisms adopted by the Boda-boda riders amidst the challenges the riders face when they suffer motorcycle accidents.

The data were obtained from multiple sources, including a survey of 1600 boda boda cyclists in Kawempe and Central divisions in Kampala City, interviews with accident victims and their immediate family members, traffic police records, hospitals and national statistics on selected economic aggregates. The results show that motorcycle accidents are associated with huge economic and non-economic burden borne by the accident victims and the society as a whole. The study established that it costs approximately 7 million shillings (or 2800 USD) to treat a boda boda accident victim who is severely injured. Based on annual police statistics on motorcycle accidents for 2012; the Ugandan economy losses more than UGX 3 billion (1.2m USD) value of output due to days away from productive work as result of severe injuries and death. Likewise, the cost of motorcycle repairs amounted to UGX 350 million (140,000 USD).

The study also estimated the value of preventing motorcycle accidents. The estimates show that on average boda boda riders are willing to pay Ug Shs 222,550 (89 USD) a year for a reduction in mortality risks associated with motorcycle accidents that translate into UGX 4.45 billion (US$1.78m), the value of statistical life (VOSL). Overall, the combined economic burden of the motorycle accidents (repairs, medical costs, lost output and imputed cost of pain grief and suffering) were estimated to be approximately US$ 3.6 million annually. This cost is about 0.02% of Uganda's GDP in 2013. The key policy implication of the study is that reducing motorcycle causalities and fatalities will reduce social and economic sufferings of victims, unlock growth and free resources for more productive use. The findings provide the cost-benefit analysis of any investment in areas that will promote the prevention, treatment, care and management of motorcycle accidents in Uganda.

Introduction

Injuries due to motorcycle accidents represent a major but often neglected emerging public health problem in developing countries and contribute significantly to the overall road traffic injuries (Peden, 2004; Kobusingye, et al, 2001; 2002). Available evidence from annual crime reports shows that road safety in Uganda is poor and has deteriorated over the last 20 years. The increase in the rate of road accidents is mainly due to the growing number of vehicles and lack of appropriate road safety interventions. The number of people who die due to road traffic accidents has grown from 660 in 1991 to 2,954 in 2010. According to Annual Crime and Traffic Road Safety Report, 2011, 17.3 percent of deaths were due to motorcycle accidents. Estimates from the World Health Organization show that by 2020, deaths from traffic accidents are projected to rank second to HIV/AIDs (WHO, 2005).

The growth of hired/commercial motorcycles (commonly known as *boda boda in Uganda*) as a mode of transportation in Uganda has increased road safety challenges (Annual Traffic Report, 2011). Statistics show that Kampala city alone is estimated to have between 50,000-80,000 boda boda cyclists and that two patients die on average every week as a result of boda boda accidents. The national referral hospital (Mulago Hospital) alone receives between 10 and 20 victims of boda boda accidents daily. Boda boda business is a money-making activity involving many players; and given the rate of unemployment in Uganda, the number of boda boda motorcyclists is expected to increase so will the motorcycle accidents. Evidence shows that as the number of motorcycles rises, the number of accidents, especially to motorcycle riders, will increase (Umar et al, 1995; Widyastuti, 2012). The empirical evidence elsewhere shows that the probability of a motorcyclist being injured in an accident is higher than that for car users (see Widyastuti and Bird, 2004). The pain, grief, suffering and loss of life as well as the economic consequences of boda boda accidents can be huge for the individual victims, their families and the country at large, but are seldom estimated empirically.

Notwithstanding the above, the continued increase in the number of boda boda accidents has created demand for necessary road safety improvements. However,

information and evidence on the costs of boda boda accidents such as the immediate hospitalization and rehabilitation costs and indirect costs to the society (e.g. opportunity cost in terms of lost labour and output; lost financial support to the families and relatives of the victims; costs in terms of disability and death of victims) have not been fully examined and this explains partly why interventions to prevent the problem are very few and largely adhoc in Uganda. There has been little effort to estimate the costs of boda boda accidents in Uganda. A recent study conducted by Makerere University College of Health Sciences and the department of Orthopaedics is the only available study on costs of boda boda accidents. The study revealed that at least 62.5% of the budget allocated to the directorate of Surgery at Mulago hospital is spent on victims of accidents involving boda boda and that the average cost of treating a boda boda victim with head injuries or broken limbs is about UGX 700,359 (or US$280) [1]. However, this study does not provide a full scale and magnitude of the costs of boda boda accidents because it focuses on costs borne by the health system (Kigera et al, 2010). Government and other stakeholders need accurate information and evidence particularly on how much saving can be gained by implementing road safety improvements to address boda boda causalities. Anecdotal information and reporting of accidents by the media and police traffic department limits our understanding of the extent to traffic safety problem to design appropriate policy action. Interventions for effective road injury prevention need to be based on data and objective information, not on anecdotal evidence. Therefore, there was a need for a comprehensive research study which estimates both direct and indirect costs of boda boda accidents in Uganda. The present study is the first of its kind to provide a comprehensive estimate of the costs of boda boda accidents using the widely used traditional human capital method and the willingness-to-Pay method.

[1] The average exchange rate at the time of the study was 1US$ = UGX 2500

Study aims and objectives

The main aim of the research study was to build evidence on the cost of motorcycle accidents in Uganda and provide the rationale for investing in national road safety programmes. The specific objectives of the study were:

(i) To estimate the direct and indirect costs of motorcycle accidents
(ii) To establish the pain, grief and suffering of motorcycle accident victims
(iii) To draw policy recommendations for improving road safety in Uganda

Methodology

Interventions to improve road safety require information on the benefits of improved safety based on imputed values or valuation of human life. There are various techniques available to value road casualties and these include: Gross Output method (Human Capital Approach), the Net Output method, the Life Insurance approach, the Court Awards approach (the amounts awarded by the Courts for compensation to survivors or surviving dependants in the case of a fatality), Implicit public sector valuation approach, the friction-cost approach (valuing the cost involved in replacing the killed or injured person to restore the previous production level) and Willingness to pay method.

The traditional method of valuation is the human capital method. This method involves estimating an ex-post sum of various identifiable costs, such as loss of work income and medical expenses minus the pain and suffering (Abelson, 2008). However, since the fundamental premise of welfare economics is that public policy decisions should reflect the preference of those who will be affected by them; willingness-to-pay approach has become conceptually more satisfactory way of measuring the costs of accidents (Abelson, 2008; Maier et al, 1989). According to Widyastuti and Mulley (2005), the use of the human capital approach to estimate the cost of accidents alone is inappropriate and a combination of human approach and individual willingness to pay is recommended. Therefore, this study established the medical and repair costs and lost

output as a result of boda boda accidents, and what individuals are willing to pay for reduced risk of injury or death due to boda accidents. The use of the two approaches provides more value for estimating human cost.

Studies by TRL (1995) and Silcock and TRL (2003) have concluded that human capital method should be supplemented with some human element which is very subjective. The subjective costs have been valued using the Willingness to Pay (WTP) method. The WTP measures by how much the concerned individuals are *ready* to pay in order to improve their safety and thus provide information on the extent of the need to promote an effective intervention to the affected community.

Economic reasoning suggests that the missing price information associated with safety issues can only be substituted by the amount people are willing to pay for the respective "product". The method evaluates how individuals value safety, rather than react to how much an accident might have costed them (Widyastuti, 2012). The WTP method is considered appropriate where there is need to pursue social welfare as a result of accident reduction (Jacobs et al., 2000); provides a practical of understanding the value the individuals or community places on road safety (Sakashita, et al, (2012); and a conceptually more satisfactory way of addressing the issue of accident loss (Maier et al, 1989). Estimating the cost of boda boda accidents using the combination of gross output and individual willingness to pay methods provides a better value and offers policy recommendations that justify interventions to reduce road accidents in general and boda boda accidents in particular.

However, given that the majority of boda boda riders come from poor backgrounds; the direct financial and opportunity costs of accidents are the tip of the iceberg in comparison to the pain, grief and suffering of those involved in boda boda accidents. In most of the studies using the human capital approach, a fixed percentage to the direct cost and loss of productivity has always been added to represent the pain, grief and suffering.

Willingness-To-Pay method (WTP)

The value of individual life reflect what people would be willing to pay (or sacrifice) to obtain benefits or to avoid costs (Jones-Lee, 1989). This ex-ante approach involves some assessment of risk and the willingness of individuals to commit resources in exchange for reducing this risk to an acceptable level. This trade-off between risk and economic resources, measured in terms of the marginal rate of substitution of wealth for risk of death or injury, accords well with the fundamental principle of social cost-benefit analysis that public sector allocative decisions should be based upon the preferences of those who will be affected by the decision concerned.

WTP method was used to estimate the value that individuals would pay to avoid the intangible costs that result from injury in a motorcycle accident or death. The implementation of the WTP is through a survey questionnaire and there are two methods of collecting data in order to estimate how much an individual would be willing to pay for a reduction in the risk of sustaining an accident. These are: the “Revealed Preferences” and the “Stated Preference” approaches. The State Preference technique is more appropriately used when the WTP information cannot be verified from the market and is considered superior because it is possible to ask questions directly about the trade-off between risk and money; and it is also possible to consider a wider and more systematic range of trade-offs than is available in the Revealed Preference approach (Widyastuti, 2012).

Researchers implementing the Stated Preference technique have commonly used the Contingent valuation (CV) approach (Chaturabong, 2010). This approach was adopted in this current study. The questionnaire was designed to determine the amount of money that each motorcycle user would pay to reduce the risk of loss of life from motorcycle accidents. Data gathered on the number of accidents, number of severities of motorcyclist per each severity type (fatal, slight and serious) and demographic information for motorcycle deaths and injuries obtained from police reports were used to present a picture of the probability of casualty involved in the accident. The

questionnaire comprised of questions related to (a) the socioeconomic characteristics and household characteristics of motorcyclists; (b) the riding behavior and the risk-taking behaviors of motorcycle users such as size of engine, helmet use, experience of involving in the accident; and (c) the valuation questions which were designed to ask the respondents to provide the estimates of the relevant rates that they are willing to pay for a reduction in the probability of fatality and injury due to the boda boda accidents.

In the design of CV questions, three scenarios were used to elicit respondents' willingness-to-pay. In each scenario both open-ended and closed-ended questions were used. The first scenario is to evaluate the WTP of respondents in their own risk of death, the second scenario is to evaluate the WTP to reduce the risk of severe injury, and the third scenario is to evaluate the WTP of respondents to participate in proposed Kampala city authority interventions to streamline boda boda industry and reduce accidents. According to Chaturabong et al, (2010), for the closed-ended question (also referred to as a "dichotomous choice" or "referendum" question), the respondent is asked whether he or she is willing to pay a specified amount of money presented as the value of the risk reduction. The respondent is expected to answer "yes" or "no." For the opened-ended question, the respondents is asked to state the maximum amount that he or she is willing to pay for the good that is being valued (in this case, accident risk reduction).

First Scenario: Risk of Fatality

In the first scenario, the respondents were told that it is estimated that in Uganda , an average of 10 out of 100,000 people die as result of road accidents in a year. In the closed-ended question, the respondents were asked: *"Are you willing to pay a certain amount of money to reduce the fatality risk from 10 to 5 deaths in every 100,000 people or 50% reduction in fatality risk?"* The respondent then answered "yes" or no". In the open-ended question, the respondents were simply asked "*How much they are willing to*

pay to reduce fatality risk from 10 to 5 deaths in every 100,000 people or 50% reduction in fatality risk".

Second Scenario: Risk of Severe Injury

In the second scenario, the respondents were asked to imagine that they have to wear the helmet while riding motorcycle. The cost of helmet is 50,000[2] Uganda shilling per helmet, the probability to have severe injury due to the motorcycle accident is 10/100,000 each year.

In the closed-ended question, the respondent were asked: *"Are you willing to pay 50,000 shillings to buy a helmet which can reduce the risk of severe injury from 10 to 3 severe injured people in every 100,000 people or reduction in risk of severe injury by 70%?"* The respondent then answered "yes" or no. The second question asked if respondents are willing to pay for the Helmet if the price is increased- over a range of price figures up to the average maximum price derived from the pilot."

Third Scenario: Boda boda streamlining program by KCCA

As earlier pointed out, KCCA has planned to streamline the boda boda industry through a number of efforts that include registration of boda boda riders in city, training of riders, issuing operational permits, supply reflector jackets and helmets, gazzetting stages and introduction of wardens, among others. Out of these proposed interventions, we considered two options: (i) supply of reflector jackets and helmets and (ii) training. This is because these interventions are directly related to reducing accidents. The closed ended question was: *If it costs Uganda shillings 100,000[3] (and higher price ranges) to get a reflector jacket and helmet (or training) would you be willing to pay this amount to reduce by half the number of boda boda accidents and injury each year in Kampala?* The second question was: *"What is the maximum amount of money would you pay to*

[2] The average cost of a helmet

[3] The range of actual costs were established from the market and KCCA

get a reflector jacket and helmet (or training) to reduce by half the number of boda boda accidents and injury each year in Kampala?

According to Krupnick et al, (2002), many contingent valuation (CV) studies fail to pass the test of internal and external validity because of three types of problems: (1) rrespondents may not understand the risk changes they are asked to value; (2) respondents may not believe that the risk changes apply to themselves; and (3) respondents may lack experience in trading money for quantitative risk changes or lack the realization that they engage in this activity. These pitfalls are challenging because of the low level of education of the respondents, and our approach to dealing with the problem was to explain to respondents using real examples about probabilities and risk reductions during contingent valuation survey. Evidence shows that a brief training of the respondents in the survey regarding probability, risk, and risk changes enables the respondents to process risk information better and thus become more elaborate about their preferences for risk reduction (Mahmud, 2005). This fact was established during pre-test of the survey instruments and was highly emphasized during data collection.

In the CV questionnaire, we exposed the concepts of probability of different events occurring, risks, and implications of risk changes such as flipping a coin, to determine which team starts a football match, and buying a lottery ticket as examples to introduce the concept of probabilities to the respondents. Mortality risk was discussed using the example of risk of dying from traffic accidents. The respondents were asked test questions after each example. If the respondent got the answer right, then the enumerator would proceed to WTP questions otherwise the process was repeated until the respondent got it right.

Computation of Value of Statistical Life

The aim of using the willingness to pay approach described above was to estimate the boda boda rider's marginal rate of substitution (MRS) between money and the reduction of risk of being killed in a boda boda accident. Therefore to compute the value of

statistical life (VOSL) and its covariates, we apply similar approach as Maier et al, (1989). If we denote the *i-th* boda boda rider's marginal rate of substitution by MRS_i.

Then the estimate for $MRS_i = \frac{b_i}{5/100{,}000} = \frac{b_i 100{,}000}{5}$

For example, in the study, boda boda riders were asked their willingness to pay to reduce the fatality risk from 10 to 5 deaths in every 100,000 people or 50% reduction in fatality risk and if the answer is b_i, then the marginal rate of substitution can be estimated. In a population of *N* boda boda riders, the average of MRS ($\sum_i MRS_i \frac{1}{N}$) is interpreted as the willingness to pay for a risk reduction which reduces the expected number of the deaths by 1(5). This is referred to as the Value of Statistical Life (VOSL) or the marginal value of safety (MVS). Based on individual evaluations, we examined the influence of socioeconomic characteristics of rider and different attributes (age, education, rider's experience, marital status, monthly income, motorcycle ownership, number of dependents, ever experienced an accident). In the estimating the regression model, we adopted log-linear model (where MVS is in logs) specification over linear specification with the help of the Box-cox test[4].

Computation of lost output/ productivity

Lost output/productivity refers to the losses suffered by the country as a result of the loss of productive capacity of people affected by motorcycle accidents. The total average lost output for a fatal motorcycle accident is the sum of each future year's lost output, which was estimated based on the following formula adopted from (Anh et al, 2005):

[4] Box Cox = $N/2*\log(RSS_{largest}/RSS_{smallest}) \sim \chi^2$. If estimated value exceeds critical value (from tables Chi-squared at 5% level with 1 degree of freedom is 3.84) *reject* the null hypothesis that the models are the same (ie there is a significantly different in terms of goodness of fit).

Lost output (fatality) = $\sum_{i=1}^{N} \frac{W(1+g)i}{(1+r)i}$

Where

W= average yearly per capita gross domestic product

r= discount rate

g= growth rate of the economy

i= average number of years of lost output per fatal accident

In the study, we included both the average and median age of victims in fatal accidents for better information estimated at 35 and 28 years respectively[5]. The average loss of productive years is computed based on a retirement age of 60 years. Hence, the average number of years foregone by a fatal motorcycle accident is 25 and 32 respectively. The average GDP per capita is 1.4 m Uganda shillings ($558) in 2013. The average growth rate of the economy for the last 10 years is 7%. Therefore, the g considered in this study is 7%. The discount rate (r) considered is 12% based on ***prime Interest rates*** in Uganda (Central Bank Rate). The *N* is 571, based on the number motorcyclists who were reported dead by the police in 2011/2012 (Annual Police Report, 2012).

The table 1.1 summarizes the cost components that were computed under the human capital approach/Gross Output Method.

Table 1.1: Cost components of human capital approach

Component of costs	Data requirements	Data sources	Estimation
Hospital /Medical costs	-Hospitalization days (serious and slight injuries); daily hospital costs for a serious	-Hospital medical records -Survey data	$MC_i = (DST_i * HC_i) + GP_i$ Where: MC_i is medical cost of a serious or slight injury

[5] These figures were obtained from Mulago hospital data base of people who died as a result boda boda accidents.

	and slight causalities and; and general practitioner costs for serious and slight causalities.		causality; DST_i is duration of stay, (days of hospitalization) for injury causality HC_i is daily hospital costs for injury causality; and GP_i is general practitioner costs for injury causality.
Lost output/productivity	**Fatal causalities and permanent disabilities** -Average age of fatal cases -Average age of retirement -Average income (monthly earnings)	-Hospital and medical records from health facilities -Police traffic department -Survey data	Lost labor output of fatalities and permanent disabilities were computed over the rest of their expected productive working life and discounted to an equivalent present value.
	Serious and slight causality -Time lost due to serious and slight injury causality		Calculated as the average daily wage rate of each person involved in the crash, multiplied by the number of days off work, and summing up for all the people involved in the crash.
Motorcycle damage	-Motorcycle damage cost	-Survey data	Calculated as the average cost of motorcycle repairs multiplied by the number of motorcycles involved in the boda boda accidents.

Qualitative data collection

In order to establish the pain, grief and suffering of boda boda accident victims, in-depth interviews were conducted. In-depth interviews were conducted with victims of boda boda accidents identified through the division chairpersons and where possible from Mulago hospital which has reasonable number of boda boda accident victims. The in-depth interviews elicited rich descriptions of the experiences of the victims. This method provided holistic data that depict systemic influences and effects of these accidents, the constraints and opportunities of the victims and how they think and act towards the phenomenon under study. In this study, the common threads were victims of boda boda accidents with permanent disabilities and serious injuries. Standard procedures for conducting key informant interviews were followed.

Data sources

The study adopted a multi-approach method to estimate the costs of motorcycle accidents. Therefore, data used in estimating the direct and indirect costs of motorcycle accidents and the pain, grief and sufferings of the motorcycle accident victims were obtained from multiple sources, including a survey of 1600 boda boda cyclists in Kawempe and Central divisions in Kampala City, traffic police records, hospitals and national statistics on selected economic aggregates. The boda boda cyclists who participated in the survey were randomly selected from boda boda stages with the help of stage boda boda chairpersons. In order to establish the pain, grief and suffering of boda boda accident victims, in-depth interviews were also conducted with victims of boda boda accidents and their immediate family members.

Descriptive findings

A total of 1600 respondents were interviewed in this study. The respondents were hired/commercial motorcycle users (boda boda riders) who work in Kampala City. Tables 1.2 show the socio-economic characteristics of boda boda cyclists. Although many people view boda boda business as an extremely odd job and implies that only the less educated and less significant section of the people are the ones engaged in it, our survey results reveals that more than 50% of the boda boda riders had received secondary education and higher; 83% married, 79.1 previously employed, 62.8% relying on boda boda business, nothing else; and 73% own the motorcycles they ride.

Table 1.2: Socio-economic characteristics boda boda cyclists

Characteristics	Frequency(n=1600)	Percent
Education		
No education	83	5.2
Primary education	712	44.5
Secondary education	763	47.7
Post secondary	42	2.6
Marital status		
Single	251	15.7
Married	1,334	83.4
Divorced/separated	15	0.9
Previous employment status		
Employed	1,265	79.1
Additional sources of income		
Nothing else	1,004	62.8
Farming	214	13.4
salaried employment	27	1.7
Other	282	17.6
Casual workers (building/driving)	73	4.6
Motorcycle ownership		
self fully paid	839	52.4
self on loan	328	20.5
Contracted	426	26.6
Others	7	0.44

The results in table1.3 shows that boda boda riders on average earn more than the average monthly income of a Ugandan from all sources standing at UGX 303,700 according to Uganda Bureau of Statistics Household Survey, 2009/2010. For instance the average daily and weekly income of boda boda cyclist in Kampala is 22, 237 and 131, 574 Uganda shillings respectively. According to estimates of the 2012 statistical abstract based on the Household consumption expenditure data of Uganda Bureau of statistics, about 50% of the richest households in Kampala spent at least Shs. 475,500/= per month on consumption as of financial year 2009/10 (in 2005/06 constant prices). Therefore, putting these figures into perspective of the boda boda rider's incomes per month; it implies that the boda boda riders are among the richest income earners in Uganda. What is not clear is whether the boda boda riders know this fact because it has bearing on their spending behavior in particular and attitude to road safety in general.

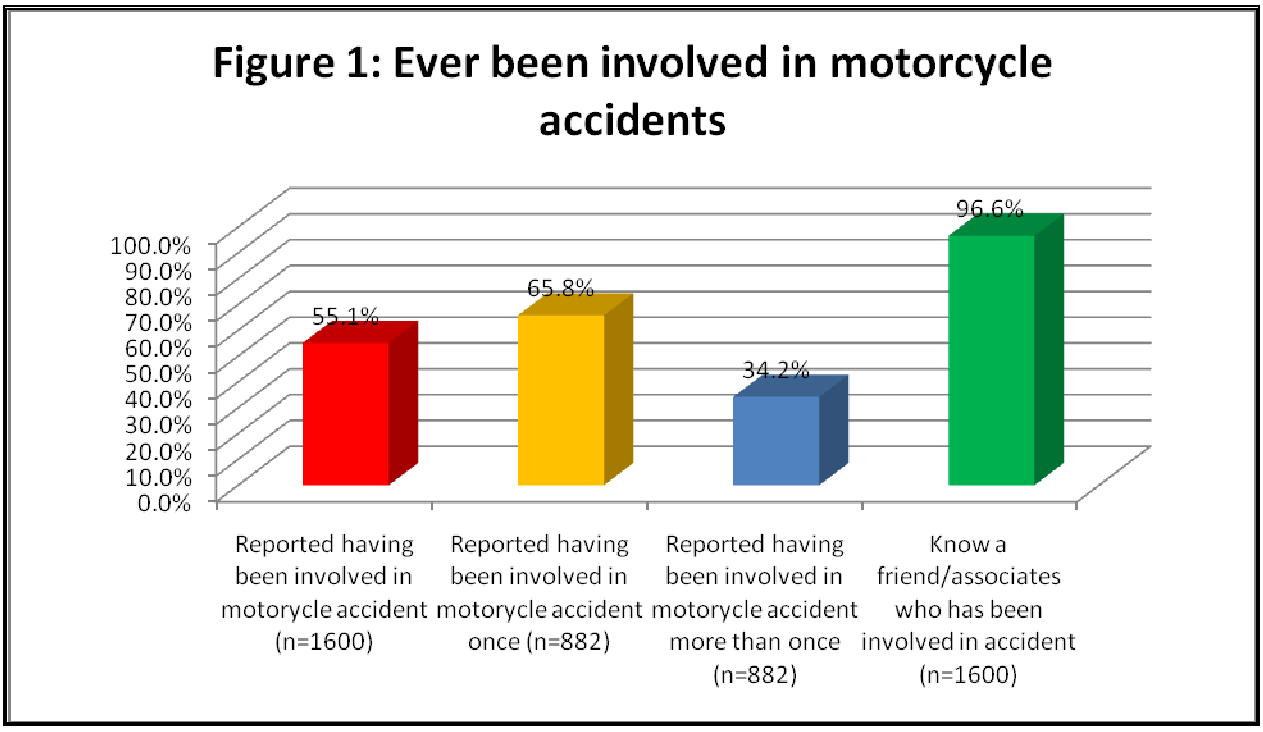
The table also shows that average age of the boda boda riders is 30 years. This implies that the majority of boda boda riders are the young population of Uganda. In respect to the number of dependants and experience with boda boda business, it is evident in table 4.2 that the average number of dependents per cyclist is 5.5 and rider's experience of 5.8 years. One can infer from the rider's experience result and the fact that the majority of riders had been previously employed (79%) and focused on boda boda business alone (63%; that boda boda riders are not mainly in the boda boda occupation because of economic hardship and high rate of unemployment but rather out of their objective choice like other people are in their other occupations. This implies that boda boda riders do appreciate and love their occupation and for purposes of the safety, they will be willing to accept any change that improves their work and welfare.

Table 1.3: Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Daily income	1,600	22,236.9	7,701	5,000	60,000
Weekly income	1,600	131,573.8	47,047	10,000	420,000
Age (years)	1,600	30.3	6.1	17	65
Number of dependents	1,549	5.5	3.2	1	30
Rider's experience	1,600	5.8	3.7	0.08	24

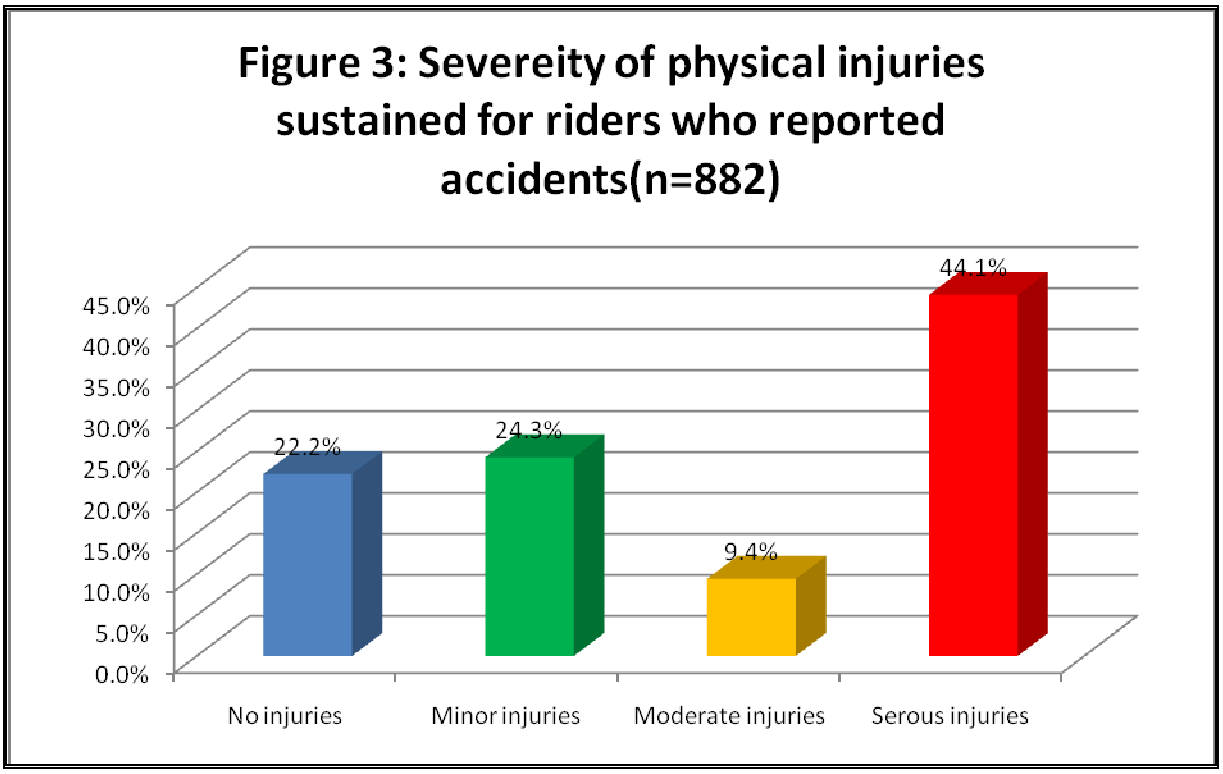
Incidence and severity of motorcycle accidents

Out of 1600 motorcycle riders who participated in the survey, 55.1% of boda boda riders had experience at least an accident. Figure 1 shows that 34.2% of the riders had experienced more than one accident in their life time as boda boda riders. The respondents were further asked whether they know any of their friends or associates who have been involved in a motorcycle accident that resulted in an injury. More than 96% of the respondents responded in the affirmative. These figures indicate that majority of the boda boda riders get involved in motorcycle accidents that results into injury.

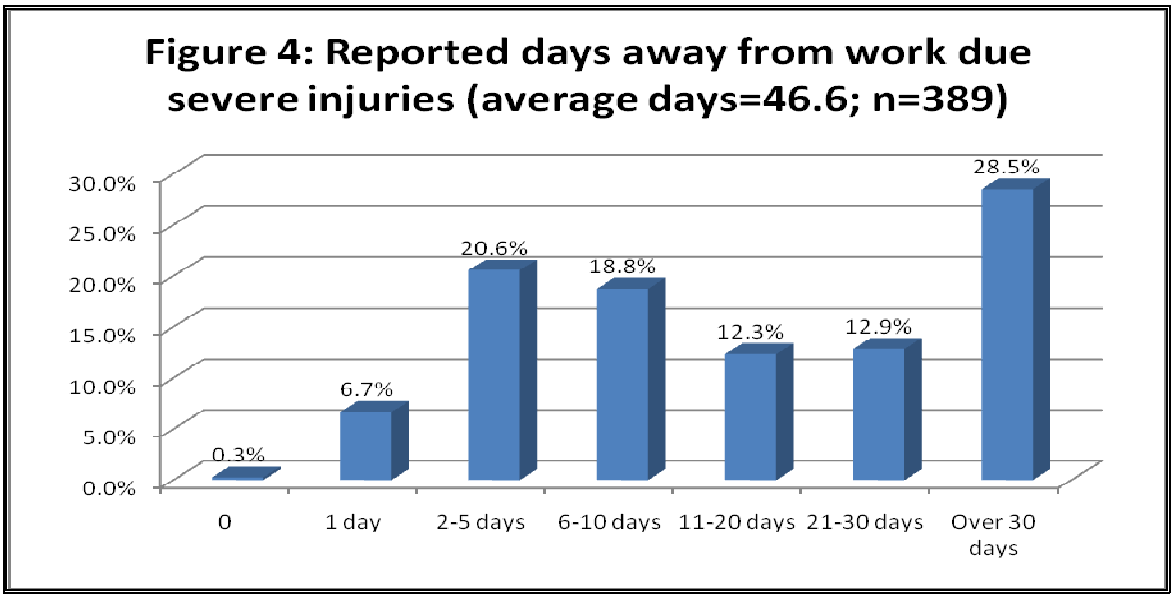


Severity of physcial injuries

Boda boda riders who reported to have been involved in motorcycle accidents where asked to indicate the level of physical injuries sustained and whether the rider was wearing a helmet or not. The severity of physical injuries sustained was classfied based on four categories. No injury meant the rider did not visit a health facility; minor injuries for those who visited the health facility but not hospitalised nor had any breakage or scratch; moderate injuries for those who visited healthy facilities and had some breakage or needed aftercare; and serious injuries for those who had been hopsitalised at least one day.

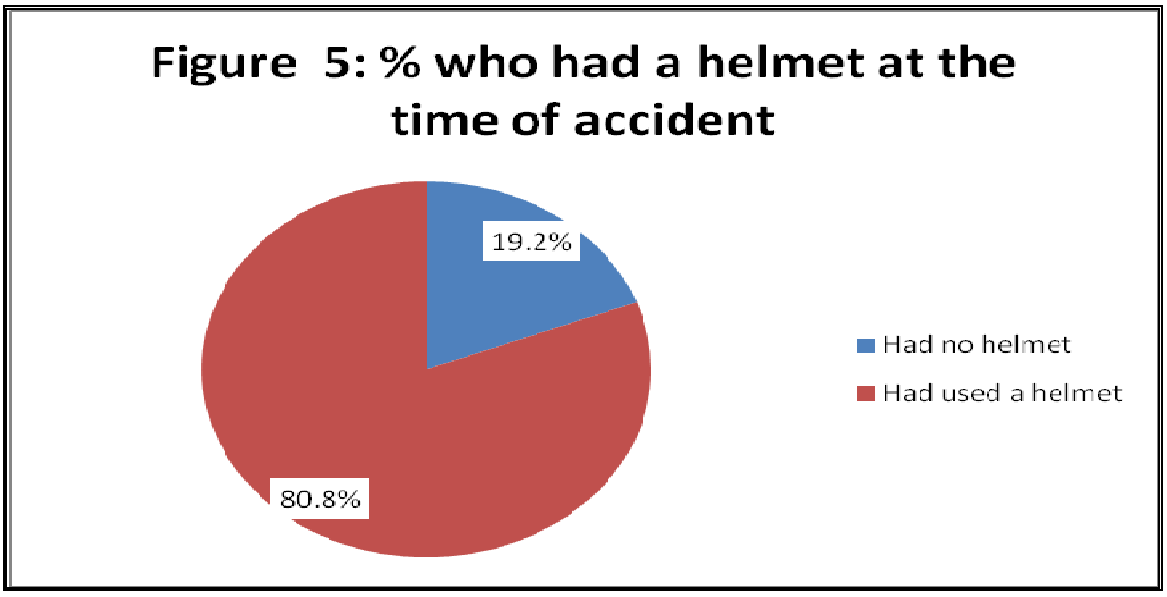


The results presented in figure 3 above show that 44.1% of boda boda riders who had experienced accidents reported that the accidents resulted into serious injuries requiring them to be hospitalised at least one day. In economic sense, this implies that most of the motorcycle accidents have economic repurcusions on the riders in form of medical expenses and days away from work. In the figure 4, the total number of days away from work are presented. Figure 4 shows that on average boda boda riders spend approximately one and half months away from work due to injuries sustatined from accidents.

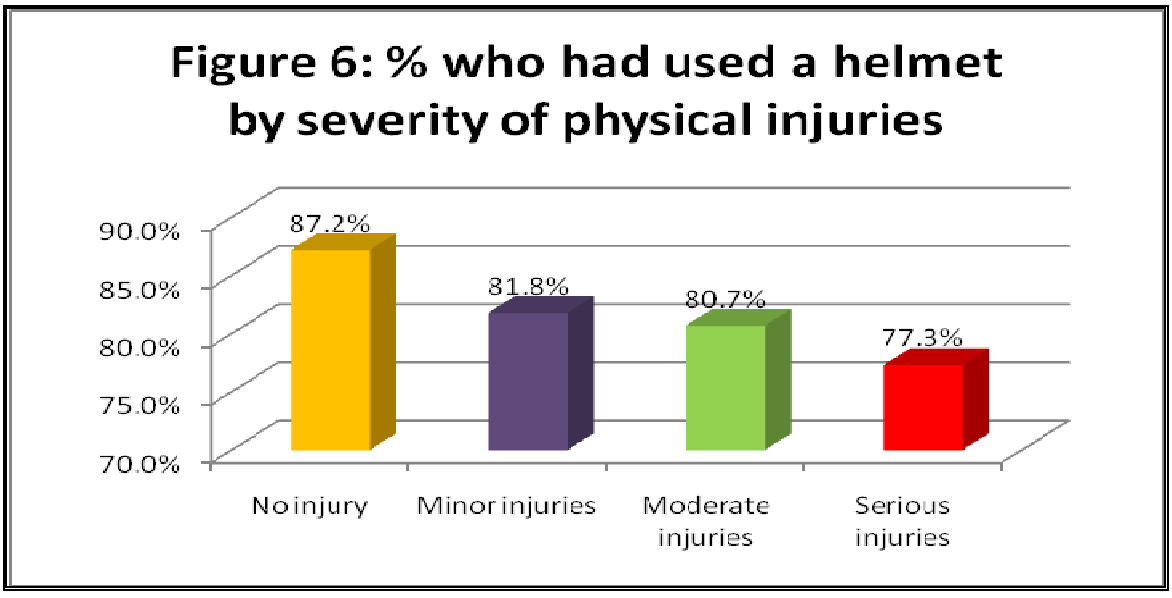


Helmet use and severity of injuries

The use of the helmets has been established as one of the effective ways of protecting motorcyclist from head injuries and fatalities resulting from motorcycle crashes. It is common in Uganda, to find motorcyclist with helmets but not using them. Therefore, in this study, riders who reported accidents where asked whether they had used a helmet. Out of the 882 boda boda cyclist who had reported involvement in any motorcycle accidents, more than 80% had used a helmet at the time of accident (figure 5).

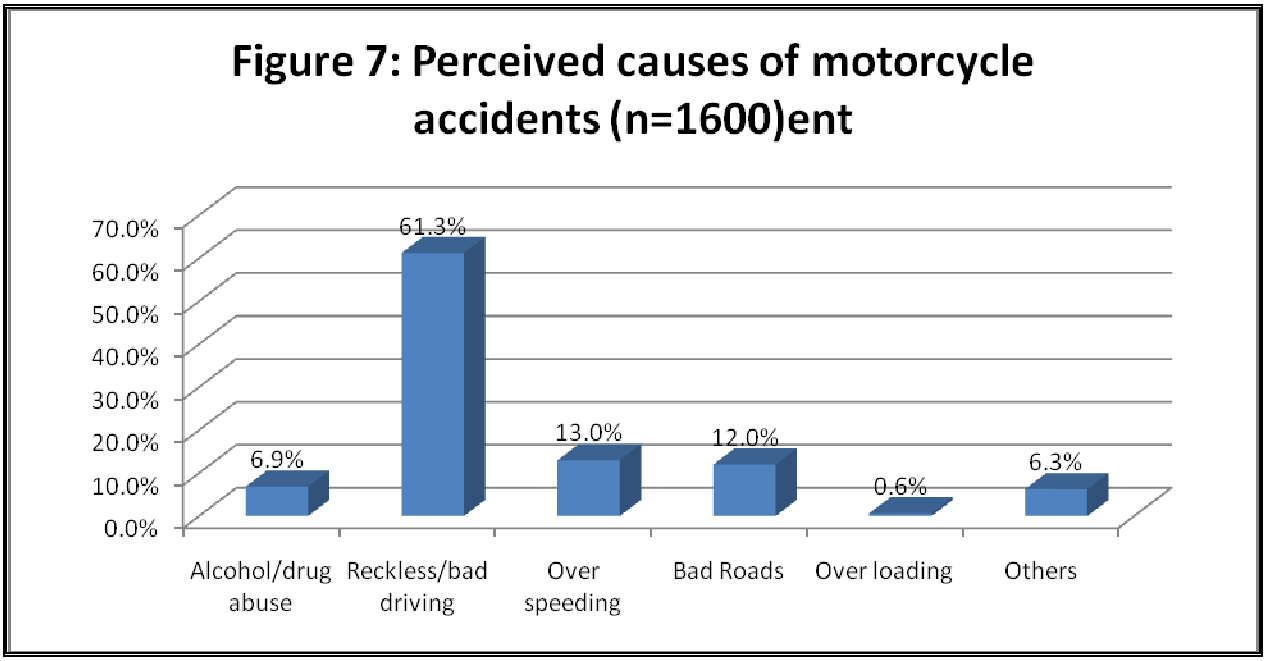


In figure 6, we compared the level of severity of physical injuries sustained and helmet use. The results depict that the number of boda boda riders who had helmets reported less severe injuries. However, we did not find significant differences in the number days away from work as results of severe injuries between the helmet users and non users.



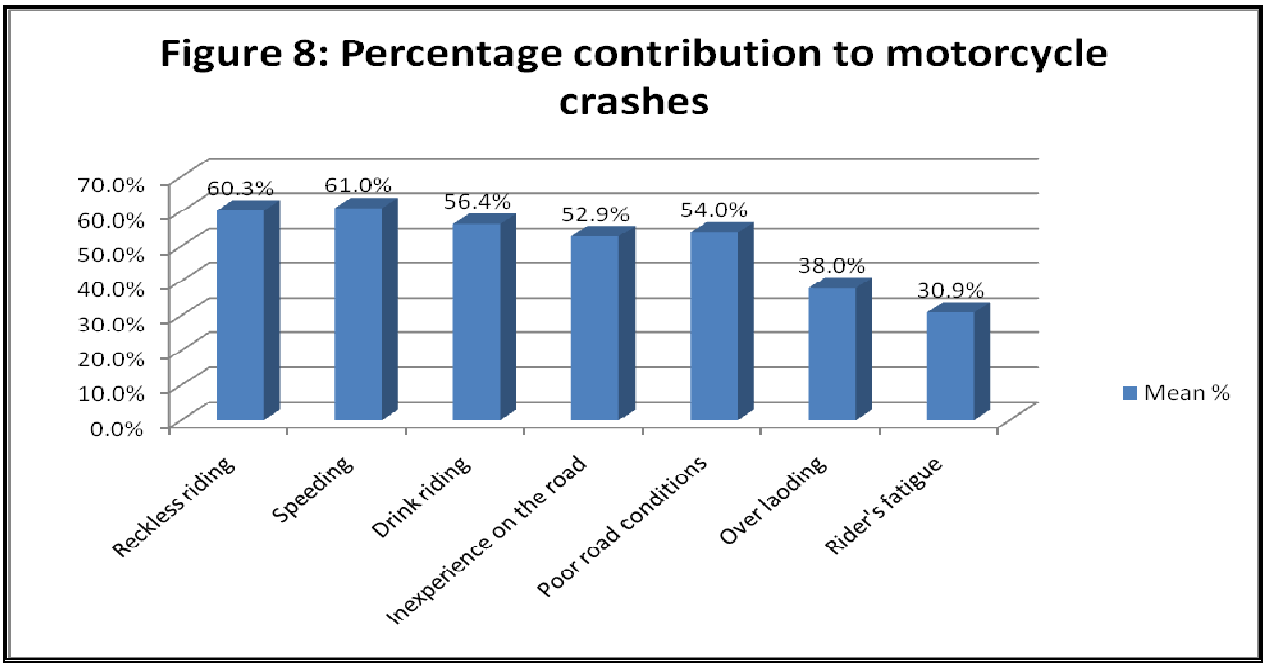
Rider's perception on the causes of motorcycle accidents

A total of 1600 respondents to the questionnaire listed what they considered to be the main causes of fatal motorcycle accidents. Altogether, their responses led to a list of many causes that were categorized into seven broad categories. These categories are alcohol/drug abuse, reckless/bad driving, over speeding, bad roads, overloading and others. Figure 7 below presents the percentage responses. Reckless driving (61.3%) and over speeding (13%) were the most common cause of motorcycle accidents given by the respondents. This implies that the risky behavior of the boda boda riders is reported to be responsible for the majority of fatal motorcycle accidents in Kampala. Bad roads (slippery surface, pot holes, bends etc) and alcohol/drug abuse were mentioned by 12% and 7% of the respondents respectively as one of the major causes of fatal motorcycle accidents in Kampala.

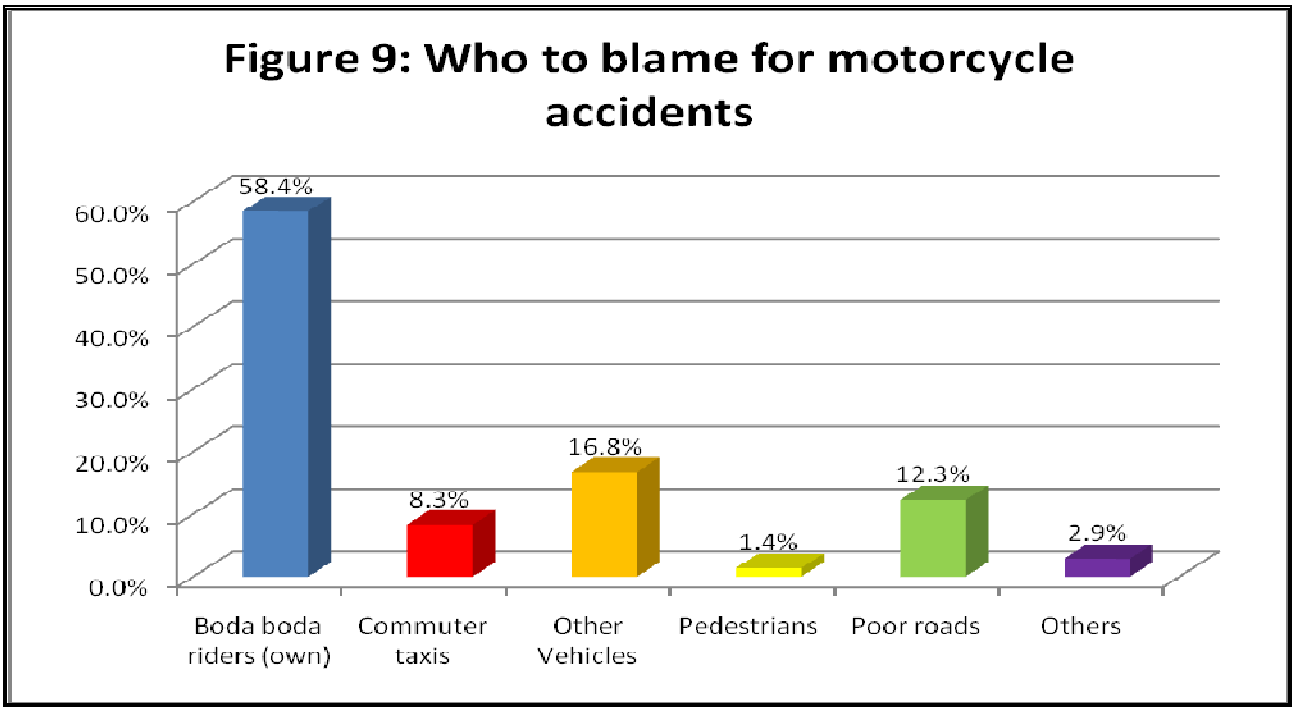


Respondents were also asked to indicate the percentage contribution of the various factors in the crashes involving boda boda riders in the last year. The findings are presented in figure 8 below. In the figure, it is also evident that the majority of riders put blame on the reckless riding and speeding as the major factors responsible for serious

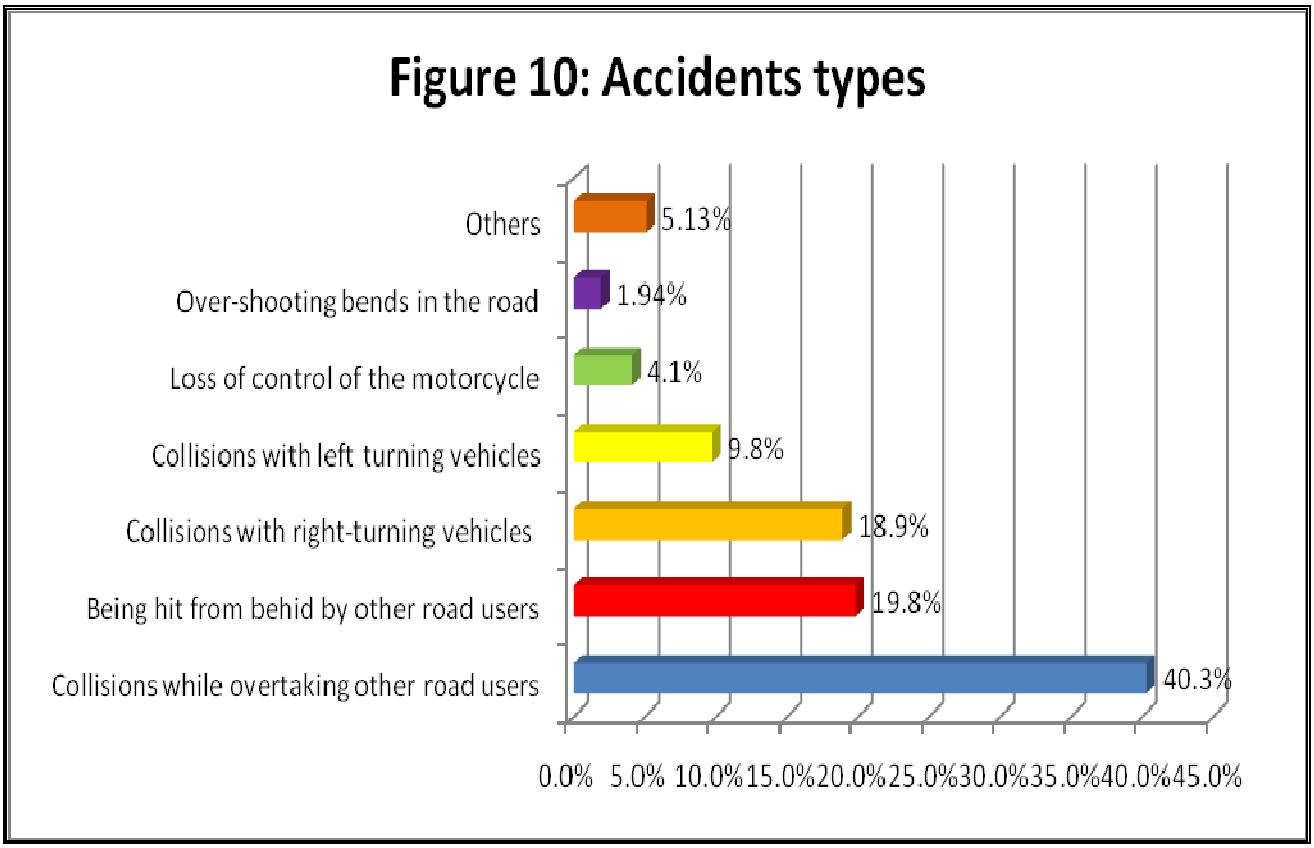
motorcycle accidents. However, the figure also shows that drink riding, inexperience on the road and poor road conditions on average contributed more than 50% of the serious crashes involving boda boda riders in Kampala. Overloading and rider's fatigue were on average blamed for causing 38% and 31% of the serious crashes involving boda boda riders.



Nonetheless, riders where asked the category of the road users responsible for motorcycle accidents. The following figure 9 depicts who to blame for motorcycle accidents in Kampala. The majority of the riders (58.4%) thought that it is themselves who were primarily to blame for accidents involving motorcycles. Commuter taxis, other vehicles, and poor roads were also blamed for the significant number of motorcycle accidents.



Finally, six types of accidents were listed and the boda boda riders were asked to choose what they thought motorcyclists were most at risk at. The results shown in Figure 10 reflect a strong opinion that most motorcyclist are at risk of being hit while overtaking other road users. This implies that boda boda riders are especially vulnerable to collisions when overtaking other roads users . About to 20% of respondents indicated being vulnerable to being hit from behind by other road users and collisions with right-turning vehicles. ,. Approximately 10% of riders regarded collisions with left turners as being a particularly risky manoeuvre. Few boda boda riders regarded loss of control and overshooting bends as a major cause of accidents experienced by motorcyclist.



Empirical findings

This part presents the cost components of motorcycle accident in Uganda. The cost components are estimated into two groups: tangible costs and intangible costs. The study computed the cost of treatment (medical expenses), repair costs lost output due severe and fatality, value of statistical life based willingness to pay approach and pain, grief and suffering.

Medical costs of motorcycle accidents

Although medical costs constitute only a small proportion of the total costs of motorcycle accidents, the medical costs consitute the first and most tangible economic burden experienced by the victim and the immediate family members and friends. The figures in table 1.4 presents the total medical cost based on data estimates from the survey and mulago hospital. The results shows that the medical costs per cyclist who is

seriously injured translate into **7,977135** Uganda Shiilings. If we consider the the data from Uganda Police department between January-December, 2012 in which 3043 motorcyclists were reported to have been seriously injured as a result of motorcycle accidents in Uganda, this translates into **24,274,423,022 shilllings**, apprpximately **24** billion Uganda shillings.

Table 1.4: Medical cost of boda boda accidents

Components	Description	Amounts/ days	Total medical cost (DST*HS)+GP in Ugshs per cyclist
DST	Duration of days from work as result of injury/days of hospitalization (obtained from the survey)	46.6	
HS	Hospital cost for injury causality (average treatment cost of injury obtained from survey)	156,154	
GP	General practitioner costs for injury causality (obtained from Mulago study and represent the average cost to maintain a boda boda patient	700,359	
Total			**7,977,135.40**
	If consider the total number persons who were seriously injured as a result of motorcycle accidents between January-December 2012 based on Police Data		**24,274,423,022**

Source: Survey, Police Traffic Department, and Mulago study

Nevertheless, for better information even when we consider slightly lower estimates from mulago hospital study by Kigera et al (2010) of 56,740 Ug shs and 8.3 days as the average cost of maintaining a patient in wards and hospitalization days respectively, medical cost of motorcycle accidents both to the individual and the country as whole is substantial as indicated in table 1.5 below.

Table 1.5 Medical cost of boda boda accidents

Components	Description	Amounts/days	Total medical cost (DST*HS)+GP in Ugshs per cyclist
DST	Days of hospitalization	8.3	
HS	Average cost of maintaining a patient in wards	56,740	
GP	General practitioner costs for injury causality (obtained from Mulago study and represent the average cost to maintain a boda boda patient	700,359	
Total			**1,171,301**
	If consider the total number persons who were seriously injured as a result of motorcycle accidents between January-December 2012 based on Police Data		**3,534,268,943**

Source: Survey, Police Traffic Department, and Mulago study

Lost output/productivity

Analysis of the survey data reveals that an estimated 389 boda boda riders were away from work due to serious injuries from motorcycle accidents, amounting to an average of 46.6 lost days of work (Table 1.6). Valuing this missed time at the workers' actual daily incomes, an estimated **403 million** shillings of economic output was lost due to time off from productive activities. Using Police data in 2012 which reported 3,043 motorcycle accidents with serious injuries and based on average number days away from work and average daily income from the survey, it is evident in the Table 3.5 that over **3 billion** shillings of economic output was lost in 2012.

In addition, computation of the lost output due to premature death from motorcycle accidents was **446,963** per cyclist, translating into **255,216,071** Uganda shillings in 2012, if we consider the number of persons killed as results of motorcycle accidents in January-December 2012 and average of age death at 35. The computation of economic loss based on median age 28 still presents a huge economic loss to the

nation amounting to 185,382,316 Uganda shillings. These findings imply that prevention of fatality from motorcycle accidents and disability from severe injuries could have significant economic payoff.

Table 1.6: Lost output due serious motorcycle accidents and fatality

Lost productivity due to serious motorcycle injury				
	Number of days away from work due serious injury from accidents (average)	**Average daily income**	**Number of people involved**	**Total cost (Ughs)**
Study sample	46.6	22237	389	403,098,994
Police data 2012	46.6	22237	3,043	3,153,291,101
Lost productivity due to fatality motorcycle accidents				
	average GDP per capita (W)	**$(1+g)^i$**	**$(1+r)^i$**	**Total cost (Ughs) $W((1+g)^I /(1+r)^i)$**
Average age	1,400,000	(1+0.07)^25	(1+0.12)^25	446,963
Median age	1,400,000	(1+0.07)^32	(1+0.12)^32	324,663
Based on Police data 2012 where 571 persons died as result of motorcycle accidents =N				
Average age	Lost output= $\sum_{i=1}^{N} \frac{W(1+g)i}{(1+r)i}$			**255,216,071**
Median age				**185,382,316**

Source: Survey, Police Traffic Department, Mulago Hospital and Ministry of Finance, Planning and Economic Development

Repair costs

In the survey we established the cost of repairs for those respondents who experienced motorcycle accidents. Results in table 1.7 shows that on average boda boda riders spend three times their daily incomes on motorcycle repairs (79,524 Ugshs). However,

the average costs for severe injuries were slightly higher (115098 Ugshs) implying that the costs of motorcycle repair rises with severity of the accident. Therefore, a total of 70 and 44 million shillings on average was incurred as cost of repairs for overall accident victims and those who reported severe physical injuries respectively. Estimating the repairs costs based on 3043 severe motorcycle accidents reported by Police data in 2012, the country lost approximately **350** million shillings in repair costs.

Table 1.7: Repair costs due motorcycle accidents

Variable	Number	Mean	Std Deviation	Total cost
Repair costs	882 accidents victims	79,524	129,744.70	**70,140,168**
Repair costs	389 severe injury victims	115097.7	161329.3	**44,773,005**

Source: Survey results

WIllingess to pay (WTP) for fatality reduction

In any attempt to value the impact of any policy on society, reserchers measures peoples' strength of preference for safety initiatives using the WTP approach and compute the VOSL. The VOSL should be thought of as convenient way to summarize the value of small reductions in mortality risks. This is what economist refer to as monetary value of reducing mortarity risks, commonly called "value of life". The expression "value of life" is an unfortunate reduced form of the value of statistical life (VOSL). Alternative terms for VOSL are *value per ststistical life*; *value per life saved*; and *value of prevented fatality*. The VSL does not measure what an individual is willing to pay to avoid death with certainty. It measures the willingness to pay for a very small change in risk. To understand the VOSL concept and our computations, the highlight below demonstrate the concept and how we arrived at the figures presented in table 3.7 with an example:

*Suppose that in City composed of 100,000 identical individuals (in this case motorcycle riders in Kampala), there is an investment project that will make the city's roads safer. However, it is known based on Police Data that on average 10 motorcyclists die every year on these roads, and the project is expected to reduce from 10 to 5 the number of expected fatalities per year. Ths implies that the annual risk of dying due motorcycle accident is 10 in 100,000 and the anticipated project or intervention would reduce this number from 10 to 5 in 100,000. In statistical sense, this means that the project or any safety intervention would reduce the annual risk of dying from motorcycle accidents by 0.0005 (5/100,000). In a population of 100,000, any safety intervention is expected, in a statistical sense, to result in 5 fewer death from motorcycle accidents each year. Suppose now that each member of the city (in this case a boda rider) is willing to pay 222550 (average amount we obtained from survey) annually to reduce the risk dying from motorcycle accidents from 10 to 5 in 100,000 (half the numder of fatalities in 100,000). Therefore, the value of preventing one fatality in one accident is defined as the aggregate amount that all affected individuals in society are willing to pay for these small risk reductions. The corresponding VOSL would be Ug Shs 222550/(5/100,000) = (222550*100000)/5 =* ***4,450,000,000*** *($1,780,000). This represents the estimated value of life.*

In the study out of the 1600 boda boda riders who participated in the survey, over 96% of boda boda riders interviewed were willing to pay for a risk reduction which reduces the expected number of deaths from 10 to 5 out of 100,000. This implies that boda boda riders in Kampala are willing to pay price to reduce the risk of fatal motorcycle accident. Figure 11 presents the distribution of the willingness to pay values. It is evident in the figure that boda boda riders are willing to pay between 3,000 and 5 millions shillings to reduce the number of deaths from motorcycle from 10 to 5 out of 100,000. However, the majority are willing to pay less than 100,000 shillings and between 100,000-500,000 shillings (49.3%). The avearge amount the riders were willing to pay was 222550, impling that on average boda boda riders are willing to forfeit 222,550 a year in order to

obtain reduction in risk of dying from motorcycle accidents from 10 in 100, 000 to 5 in 100,000.

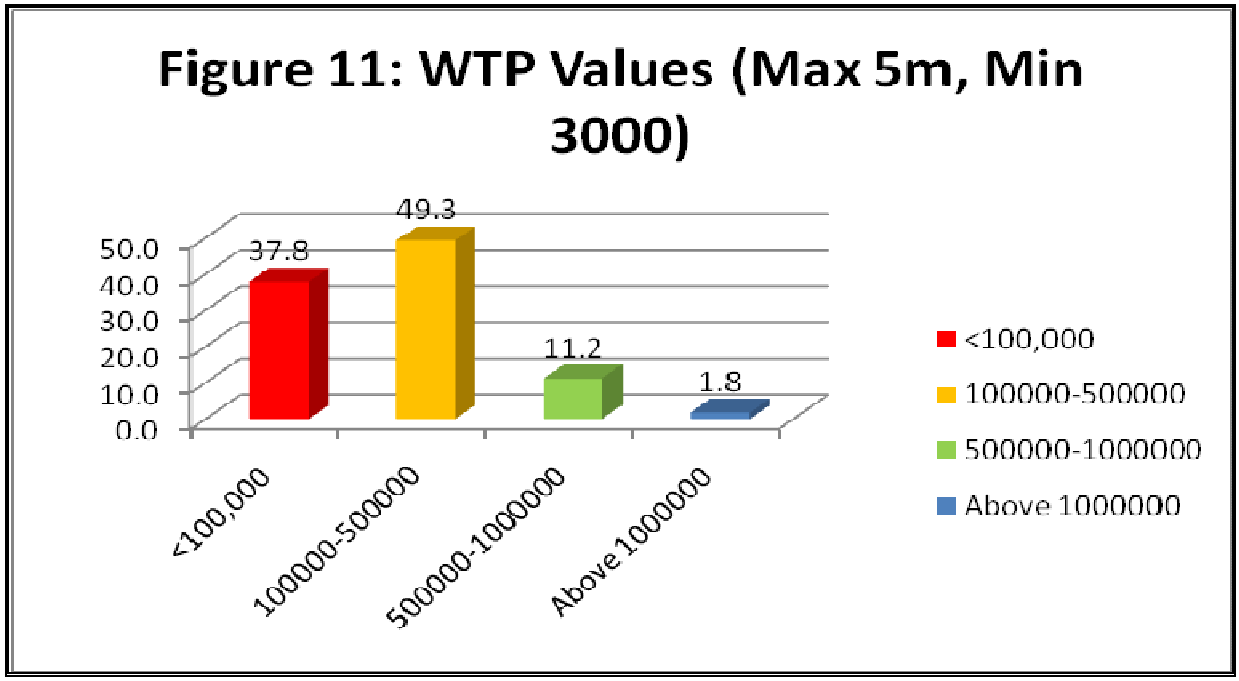


Table 1.8 presents the value of statistical life for Ugnada by means of contigent valuation. In th questionnaire results on willingness to pay to reduce fatality from motorcycle accidents indicate that boda boda riders were prepared to pay, on average 222550 Ug shs for a risk reduction of five chance in 100,000 that they would be killed in the year due to motorcycle accidents. Therefore, the `value of an average life' in this instance would be (222550 x 100,000)/5 =4.45 billion Uganda shillings. This is defined as the total amount that boda boda riders selected in Kampala would pay per year to save 5 statistical lives resulting from motorcycle accidents.

Table 1.8: The value of statistical life(VOSL)

Description		Average of MRS for all respondents give the WTP for a risk reduction which reduces expected deaths by 1(5)
Marginal rate of substitution (MRSi)	Income change due a unit change in a risk given by: $\frac{b_i}{5/100{,}000} = \frac{b_i 100{,}000}{5}$ ▪ b_i *represent the average amount the boda boda riders were willing to pay*	
Total WTP	This value is referred to as the value of saving statistical life or marginal value of safety	**4,450,000,000** ($1,780,000)

Economic Burden of Motorcycle Accident Costs

To estimate the economic burden of motorcycle accidents in Uganda, medical costs of accidents, lost output due to severe injury and fatality, repair costs and human costs (pain, grief and suffering). The computation of lost output is based on 2012 Police Data that reported the number of persons killed and injured from motorcycle accidents. In 2012, there were 3043 officially reported severe accidents from motorcycle accidents and 571 people who died. These figures exclude the number persons who had minor injuries. In the estimation of medical expenses, the computations are based on results obtained from a study in Mulago on the cost of treating a boda boda patient. Pain, grief and suffering are calculated as a percentage of lost labour output due injury and fatality. The percentages considered are based Asian Development Bank estimates of 28% and 50% of the total cost of a fatal and injury accident respectively. Table 1.9 shows the estimated economic burden of motorcycle accidents in Uganda is Ug shs 8, 902,482,162 (approx US$ 3.6 million). Although these figures do not take into account the administrative and funeral costs of motorcycle accidents, the estimates reveal that if motorcycle accidents continue, country's growth prospects will fall by US$ 3.6 million

annually. Medical expenses and lost output due to severe injury are the biggest component of motorcycle costs contributing 40% and 35% respectively.

Table 1.9: Estimates of national motorcycle costs

Item	Total cost (Ug shs)	% Contribution
Medical expenses	3,534,268,943	39.7
Lost output due severe injury	3,153,291,101	35.4
Lost output due to fatality	225,216,071	2.5
Repair costs	350,000,000	3.9
Human costs(Pain, grief and suffering)	1,639,706,050	18.4
Total	**8,902,482,165 (US$3.6 million)**	**100.0**

Factors influencing WTP values

The relationship between the WTP values (rider's marginal value of safety) and the underlying influence of socio-economic factors was investigated by means of a regression analysis. In this study, the log-linear regression model was applied to analyse the significant factors influencing willingness to pay of respondents. The independent variables considered in the analysis include the age in complete years, motorcycle riding experience, education dummies, marital status, motorcycle ownership status and dummy if ever experienced an accident. The results of regression analysis are presented in the table 1.10 below.

Table 1.10: Regression analysis results

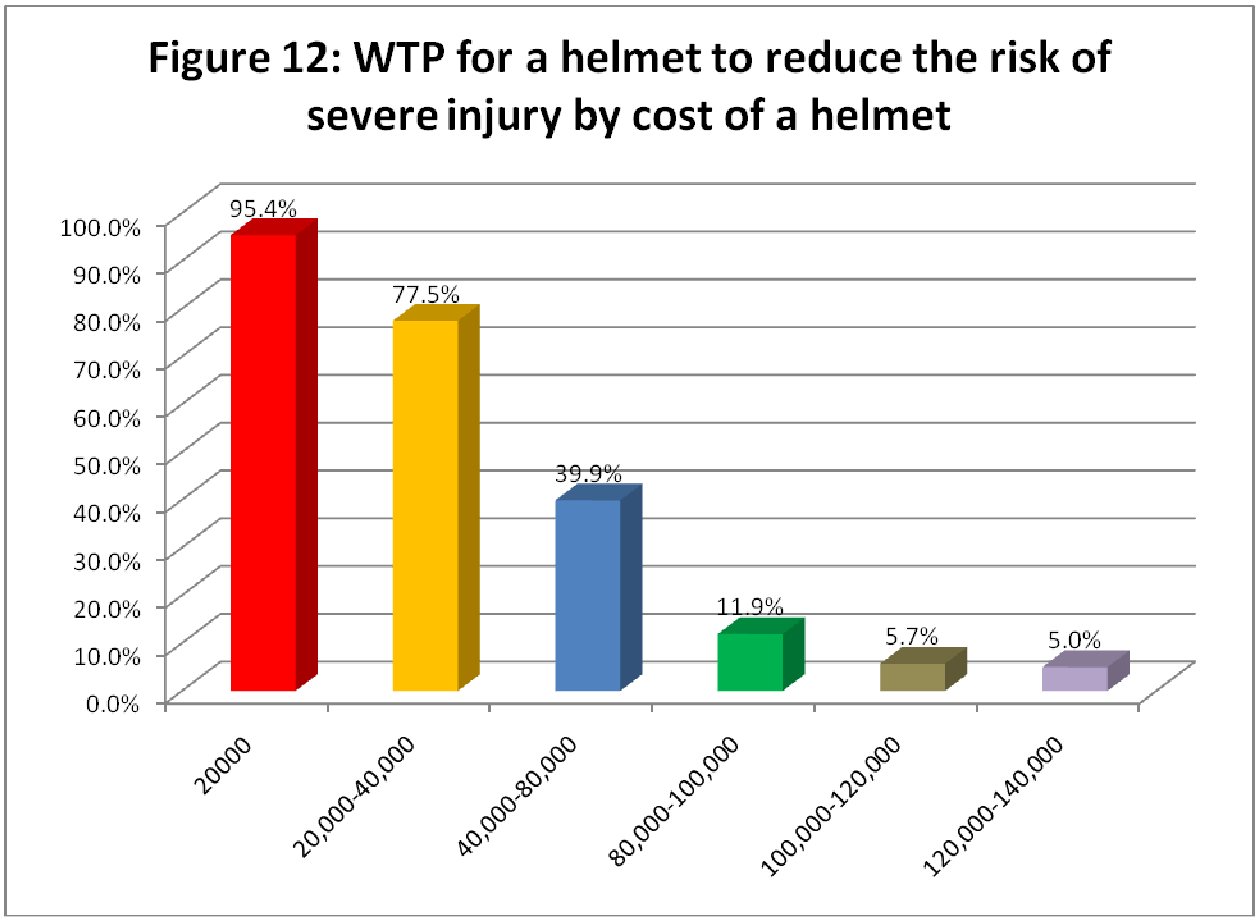
LnMVS	Coef.	Robust Std. Err.	T	P-value
Age	0.007	0.006	1.080	0.282
Monthly_income	0.000	0.000	2.270	0.023*
Riding experience	-0.005	0.010	-0.460	0.649
Primary	-0.190	0.143	-1.330	0.182
Secondary	-0.159	0.142	-1.120	0.264
Married	-0.150	0.084	-1.780	0.076**
Number of_Dependants	0.001	0.011	0.080	0.936
Ever_Had_Accident	-0.049	0.062	-0.780	0.436
Owns_motorcycle	0.217	0.071	3.060	0.002*
Constant	21.289	0.226	94.370	0.000

"" statistically significant at 5%; and "**" statistically significant at 10%*

The results in the table 1.10 above show that only three variables were statistically significant. These include income, marital status and motorcycle ownership. From economic point of view, positive significant effect of income concurs with many studies that have found that higher incomes are associated with higher WTP values. As expected riders who own motorcycles significantly and positively influence WTP values. Surprisingly however, being married is associated with less WTP values when comparing with unmarried motorcycle riders. In many studies, age has proved to an important factor explaining willingness to pay for safety. In this study surprisingly, age is not statistically significant although it has the right sign. The other factors that are insignificant are education, number of dependents, riding experience and accident experience. The negative coefficient on education and riding experience suggest that these variables not only being unimportant in rider's risk evaluation but they are associated with lower *MVS.*

WTP to reduce the risk of Severe Injury

In the survey respondents were asked whether they are willing to pay 20,000 shillings for a helmet which reduces the risk of severe injury from 10 to 3 out of 100,000 people or reduction in risk of severe injury by 70%. The results in figure 12 show that over 95% of the boda boda riders who participated in the study were willing to pay 20,000 shillings to get a helmet which reduce the risk of severe injury by 70%. However, the willingness to pay for a helmet reduced more significantly as we varied the cost of helmet from 20,000 to 140,000 shillings. This implies that although the majority of boda boda riders are willing to pay price premiums to acquire helmets that reduce severe injury, their willingness to pay undoubtedly is conditioned by the price of the helmet. For example, the willingness to pay for a helmet dropped to 12% for a price between 80,000 and 100,000 shillings and subsequently to 5% for prices above 100,000. Therefore, any efforts to promote the use of quality helmets which are normally priced above 100,000 shillings on the domestic market, one should consider price subsidization policy for the majority of the boda boda riders to acquire them.



Finally, we explored the willingness to pay 100,000 shillings to obtain a reflector jacket and helmet/training to reduce half the number of boda boda accidents and injury in Kampala. These are some of the interventions KCCA has proposed to implement in the efforts to streamline the boda boda industry in Kampala. The results in the figure 13 below shows that 53.46% of the riders interviewed were not willing to pay for these activities. This implies that KCCA will face some challenges in changing the face of boda boda industry in Kampala. A well integrated programme that incoorpotates the views of different stakeholder in the boda boda industry is need to have smooth transition from disorganised to organised industry.

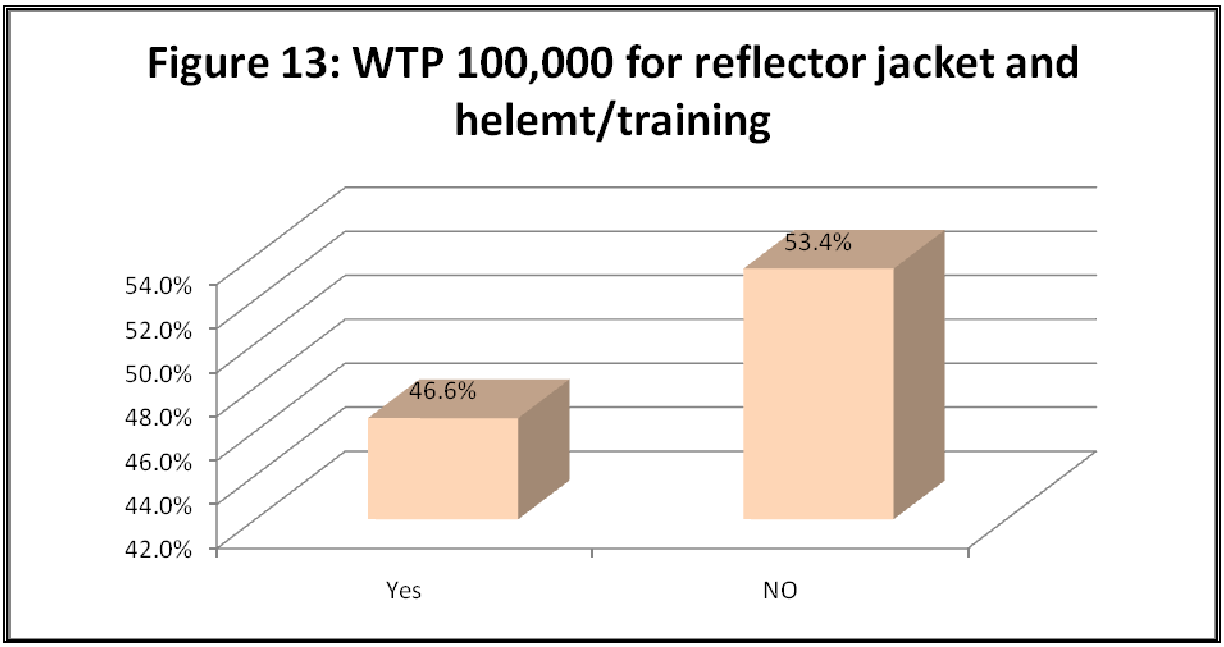


Figure 13: WTP 100,000 for reflector jacket and helemt/training
54.0%
52.0%
50.0%
48.0%
46.0%
44.0%
42.0%
46.6%
53.4%
Yes
NO

Conclusions and recommendations

The descriptive analysis from the study show that the incidence and risk of motorcycle accident is high and boda boda riders themselves are hugely to blame in most of the accidents they get involved in. Therefore, safety initiatives should mostly target the behaviours of motorcycle riders alongside other road users. For instance, public awareness campaigns are needed to change the behaviour of motorcycle riders and also in supporting the enforcement of legislative traffic regulations and measures. It is perhaps true that most boda boda riders do not understand the health and economic implications associated with their reckless behaviour. The study results provide rich information that is helpful for fact-based advocacy to change behaviour of boda riders. Information on the cost of accidents to the individual and society as a whole can be used by Boda boda associations, Local administrations and authorities and civil society organizations to influence behaviour change among boda boda riders. For instance, the awareness campaigns from these stakeholders should communicate to the riders the health and economic consequences of undesirable traffic behaviour and associated motorcycle accidents. The police should intensify the use of the combination of enforcement and penalties to prevent the violation of traffic regulations and increase road safety.

This study highlights the direct and indirect cost of motorcycle accidents in Uganda using a multi-method approach. The quantitative estimates and descriptions from the qualitative interviews have provided both the tangible and intangible costs of motorcycle accidents (both for fatality and severe injuries) and estimates are considered to be huge for a poor developing country. This information should serve to provide a momentum for safety improvement of motorcycle industry in Kampala and the rest of the country.

In the first part of cost estimation of motorcycle accidents, the study provides estimates of intangible costs (such as medical expenses, lost output/productivity due injury and death and repair costs). The estimates show that motorcycle accidents are associated with huge burdens borne by the accident victims and their families and friends, as well a society as a whole. The estimation and presentation of these costs highlights the need

for every member of society to recognize and be aware of the importance of road safety. Clearly, the results show that it costs approximately 7 million shillings to treat a boda boda accident victim who is severely injured; and more 3 billion Uganda shillings was lost due to lost days away from productive work as result of severe injuries and death. The motorcycle repair costs accumulated to 350 million Uganda shillings based on 2012 police data on motorcycle accidents.

The study also provides estimates of the value of preventing motorcycle accidents based on the willingness-to-pay method using a contingent evaluation. The estimates show that on average boda boda riders are willing to sacrifice Ug shs 222,550 a year for reduction in mortality risks associated with motorcycle accidents that translate into 4.45 billion shillings ($1 1,780,000), the value of statistical life (VOSL). This implyies that boda boda riders are willing to trade 4.45 billion shillings per year for a risk reduction which reduces the expected number of motorcycle fatalities from 10 to 5 lives. This represents the monetary value of increased safety and shows that boda boda riders are concerned about traffic safety and willing to trade a sizeable amount of money for improved safety. The estimates are quite comparable to those from other developing countries. Regression analysis results of the factors influencing marginal value of safety (MVS) reveal that income, marital status and ownership of motorcycles significantly influences rider's evaluation of safety. The results on the effects of motorcycle ownership on *MVS* should of interest to government and boda boda associations in efforts to streamline boda boda industry. The efforts that enable the riders to own the motorcycles seem to affect safety evaluations.

In the summary, the economic burden motorcycle costs were approximately US$ 3.6 million. Although these figures do not take into account the administrative and funeral costs of motorcycle accidents, the estimates reveal that if motorcycle accidents continue, the country's growth prospects will fall by US$ 3.6 million annually. Medical expenses and lost output due to severe injury are the biggest component of motorcycle

costs contributing 40% and 35% respectively. The fact that the current initiatives and level of investment are inadequate to halt or reverse the rising motorcycle fatalities and injuries, the political will and funding levels in the sector should be commensurate with the scale of accidents and associated economic costs.

The qualitative part of the study reveals that the effect of pain, grief, and suffering when the Boda-boda rider gets an accident goes beyond the individual life of the rider and affects the work, health and the family life of the rider. Therefore in seeking to design intervention programs to help the riders involved in motorcycle accidents, it is important for such programs to adopt a holistic approach to be effective. In addition, there is need for intervention programs at both family-and-work level which can help the riders and their families to quickly recover from the pain, grief and suffering they face. What is clearly demonstrated in the study is that the family and the work place are the key areas of support for the rider to deal with the demise of the motorcycle accidents yet there was no report of any systematic intervention program in our interviews which is utilizing these institutions to help the riders overcome the cost of pain, grief and suffering caused by motorcycle accidents. Therefore, the existing boda boda associations and leadership structure at boda boda stage level should be empowered to have organized welfare/health care systems that can assist members when they face accidents.

It is also demonstrated in the study that coping by Boda-boda accident victims is complicated by lack of professional support. The provision of professional support tailored to the unique conditions faced by the Boda-boda RTA victims should be a critical focus for effective policy intervention. We suggest the strategy of working with the family of the riders and the Boda-boda leadership stage structures to effectively extend such services. The study also offers some key insights into the necessary reform in the health system geared towards effectively meeting the needs of motorcycle accidents victims in the Boda-boda sector. Specifically, we recommend the need to promote health insurance tailored for the Boda-boda riders for them to afford personalized health care in the event of the RTA, and programs that geared at changing

the perception health workers towards boda boda accident victims. This can go a long way in addressing the cost of pain, grief and suffering they endure.

Policy implications

The paper presents the monetary value of increased safety from motorcycle accidents in Uganda and more specifically, the study presents both social and economic rationale for safety investments and interventions to improve the road traffic safety for motorcyclists. The key policy implication of the study is that reducing motorcycle causalities and fatalities will reduce social and economic sufferings of victims, unlock growth and free resources for more productive use. The findings provide the cost-benefit analysis of any investment in areas that will promote the prevention, treatment, care and management of motorcycle accidents in Uganda.

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