

ECONOMIC BURDEN OF MOTORCYCLE ACCIDENTS IN NORTHERN GHANA

M. KUDEBONG¹, F. WURAPA², J. NONVIGNON², I. NORMAN², J. K. AWOONOR-WILLIAMS³ and M. AIKINS²

¹Pharmacy Council, Northern Zonal Office, P. O. Box 1777, Tamale, Ghana, ²School of Public Health, College of Health Sciences, University of Ghana, P. O. Box LG 13, Legon, Accra, Ghana, ³Regional Director of Health Services, Upper East Regional Health Directorate, Upper East Region, Bolgatanga, Ghana

Corresponding Author: Dr Moses Aikins

Email: maikins57@yahoo.com

Conflict of Interest: None declared

SUMMARY

Background: Motorcycles are the most popular means of transportation in northern Ghana, and their accidents are major causes of out-patient attendance and admissions in the Bolgatanga Municipality.

Objective: This paper estimates the economic burden of motorcycle accidents in the Bolgatanga Municipality in Northern Ghana.

Design: Retrospective cross-sectional cost study.

Methods: Data were collected from Drivers and Vehicle Licensing Authority, the Police, health facilities and motorcycle accident victims. Both quantitative and qualitative approaches were used for data collection. Cost analysis was based on the standard road accident cost conceptual framework.

Results: Ninety-eight percent of vehicles registered in the municipality in 2004 – 2008 were motorcycles. The motorcycles were significantly more than the cars registered. The economic burden of motorcycle accidents was estimated to be about US\$1.2 million, of which, 52% were accident-related costs (i.e. property damage and administration) and 48% casualty-related costs (i.e. medical costs, out-of-pocket expenses, lost labour outputs, intangible costs and funeral expenses). Most motorcycle accident victims were in their productive ages and were males. Only a third of the motorcycles were insured. Majority of the riders (71%) did not possess valid driving license and would want to avoid the police. Main motorcycle injuries were head injuries, fractures, lacerations and contusions. Majority of the accidents were caused by lack of formal motorcycle riding training, abuse of alcohol, unrestrained animals and donkey carts.

Conclusion: Motorcycle accidents could be reduced through law enforcement, continuous mass education and helmet use.

Keywords: Motorcycle, helmet, accident-related cost, casualty-related cost, Ghana

INTRODUCTION

Road traffic injuries and deaths are a growing public health concern worldwide.¹ Studies have shown that road traffic injuries are a major cause of death and disability globally, with a disproportionate number occurring in developing countries.² Road crashes are the second leading cause of death globally among young people.³ The annual costs of road traffic crashes in low income and middle-income countries are estimated to be between US\$65-100 billion, more than the total annual amount received in development aid.⁴ The estimated costs as a percentage of the Gross National Product (GNP) in most African countries range from about 0.8% in Ethiopia and 1% in South Africa to 2.3% in Zambia and 2.7% in Botswana to almost 5% in Kenya.⁵ In 2007, the National Road Safety Commission of Ghana estimated road traffic accidents to cost 1.6% of Gross Domestic Product (GDP) which translated to US\$ 165 million.⁶ However, the contribution of the various vehicles including motorcycle was not indicated in the report. The report also noted that motorcycle accidents accounted for 4% of all road traffic accidents in the country.

Motorcycles are one of the most dangerous forms of motorized transportation. Due to small size of their vehicles, motorcycle riders represent a vulnerable group of road users. Motorcyclists are about three times more likely than car occupants to be injured in a crash, and 16 times more likely to die.⁷ Contrary to a car crash, in a motorcycle crash, the riders often absorb all kinetic and compressive energy resulting from the crash.⁸ According to WHO³ even in developed countries where morbidity and mortality rates from motorcycle accidents are low, the risk of dying from a motorcycle crash is twenty times higher than a motor vehicle crash. Another study noted that riders often ignore safety measures, making them more vulnerable to accidents.⁹ Studies in Ghana have also shown that road traffic crashes were a leading cause of death and inju-

ries, and that majority of road traffic fatalities and injuries occurred on roads in rural areas.¹⁰ Ironically, motorcycle can be said to be one of the main types of vehicles in most rural areas. However helmet use by motorcyclists in Ghana is generally low.¹¹

Studies have also estimated various forms of costs of motorcycle accidents mostly in developed countries: medical cost, productivity losses and lost of quality of life.¹²⁻¹⁷ Some studies also cover legislation of helmet use and its cost savings.^{13,15,18,19} There is general paucity of cost data on road traffic accidents and in particular motorcycle accidents from developing countries. In the Bolgatanga Municipality of the Upper East region, road traffic accident has consistently appeared in the top ten causes of out-patient department (OPD) attendance and hospital admission between 2006 and 2008.²⁰⁻²² This paper reports the estimated economic burden of motorcycle accident, motorcycle insurance and riders' license status in the municipality. The paper also further examines the costs in terms of accident-related and casualty-related costs of motorcycle accidents.

Conceptual framework of motorcycle accident costing

The conceptual framework for the study was adapted from the Asian Development Bank²³, which shows clearly the main components of road accident costs (Table 1). The main identified costs are casualty and accident related. Intangible costs (i.e., pain, grief and suffering) constitutes the main social costs, whilst value of lost output, medical costs, funeral costs, out-of-pocket expenditure, property damage costs and administration costs make up the resource costs.

METHODS

The study was a retrospective cross-sectional cost study of reported cases of motorcycle accidents in the Bolgatanga Municipality for the year 2008. Data were collected between May and June 2009.

Study area: Bolgatanga Municipality, capital of the Upper East region, is located in the North-eastern part of Ghana. The region shares borders with Burkina Faso to the north and the Republic of Togo to the east. The estimated population of the municipality was 147,729 in 2008. Generally, the population is predominately rural with the Grunins being the indigenous people.²⁰ Main mobility in the municipality is by bicycles and motorcycles. The streets of Bolgatanga are usually full of motorcycles especially during peak hours and on market days. Scores of people are usually seen carrying their wares mostly animals, poultry and artefacts on their motorcycles.

Study population and sample used: The study populations were: (a) users of official registered vehicles; (b) official recorded accident cases; (c) treated accident cases at hospitals; and (d) motorcycle accident victims.

Official registered vehicles: Data on all registered vehicles from 2004 to 2008 were collected from the Vehicle Registration Log Books of the Drivers and Vehicles Licensing Authority of the Upper East region. Police records of motorcycle accidents within the study period were also collected.

Official recorded accident cases: Police records of motorcycle accidents for 2008 were obtained from the Regional Police Headquarters. This information was complemented with data from the 2008 Annual Report of the Municipal Health Administration. Furthermore, expert opinions of the Senior Nurse In-charge of the Accident and Emergency Ward of the Regional Hospital and the Regional Coordinator of National Road Safety Commission indicated that motorcycle accidents accounted for over 80% of all road traffic accidents (RTA) in the municipality for the past five years. However, there was no official record to corroborate this figure.

Treated accident cases at hospitals: A complete census of all in-patient hospital data of road traffic accident (RTA) cases reported at the regional hospital and out-patient records of RTA cases at Afrikids (a private hospital) for the study period was undertaken. These two health facilities were purposively selected based on the advice of the Municipal Health Administration. Majority of the RTA cases did not have information on the type and make of vehicle involved, number of victims per accident, number of passenger in the accident vehicle and estimated time of accident.

Motorcycle accident victims: The sample size of the motorcycle victims was determined using the 2,353 RTA cases in 2008. Using expected motorcycle accident rate of 80% of all RTA cases, and 74% worst acceptable results (absolute precision of 6%) at confidence level of 95%, a sample size of 160 was calculated using Epi-Info Version 3²⁴. Initial attempt was made to select RTA cases randomly, however, due to unreliable house numbering system in the Municipality, coupled with the tendency for accident victims to provide false house addresses for fear of being tracked by the police, it was extremely difficult to reach the motorcycle accident victims using the house addresses obtained from the police and hospital sources.

Thus, after identifying some willing victims to participate in the study, the Snowball technique was used to obtain the sample size from motorcycle repairers, traditional bone setters and the Accident and Emergency Ward record.

Data collection techniques: The data collection techniques used were: (a) secondary data extraction; (b) in-depth interviews; and (c) focus group discussions.

Secondary data extraction: Data extraction forms were developed to extract secondary data from the records of the regional office of Driver and Vehicle Licensing Authority (DVLA). The data extracted from DVLA records were year of registration of vehicle, type and make of vehicle from 2004 to 2008. Treated accident cases (both in-patient and out-patient cases) were also obtained from hospitals. The data collected covered age, sex, the period of hospitalization, accident outcomes and the costs of treatment.

In-depth interviews: Four in-depth interviews were conducted with the police, the Nurse-In-charge of the Accident and Emergency Unit of the Bolgatanga Regional Hospital, a representative of the Star Assurance Insurance Company, and the regional officer of Driver and Vehicle Licensing Authority (DVLA). The interview at the hospital covered issues on the proportion of motorcycle accidents, the most affected age group, and cost of hospitalization. At the police station, the process of police investigation of accident cases, resources involved, and number of recorded accident vehicles. The registration process and motorcycle license cost, number of registered vehicles was obtained from the Officers In-charge of DVLA.

The average amount paid by insurance companies to motor cycle accident victims and motorcycle insurance costs was obtained from the Regional Sales Manager of Star Assurance Insurance Company. The Stare Assurance Insurance Company was purposively selected due to their popularity on radio education programme on motorcycle accidents prevention in the Municipality at the time of the study and their openness to provide information. The data obtained from the records and in-depth interviews were used in estimating the economic burden of motorcycle accidents.

Focus group discussions: Two focus group discussions (FGDs) each for men and women groups were held with a total membership of fourteen and ten for the men and women's groups respectively. Memberships of the groups were based on their appreciation, understanding and involvement in motorcycle accidents in the past and consisted of victims, relations and

other persons who have been affected in a way by motorcycle accidents.

The setting for the men FGD was at a popular motorcycle repairer's shop, whilst the woman's FGD was conducted near a popular hair dressing saloon in the municipality. A moderator facilitated the discussions and a recorder took notes of the discussion. The FGD guide covered causes of accidents, wearing of helmets, ages affected by accidents, properties damaged as a result of the accidents, effects of motorcycle accidents on immediate families and the society at large.

The sessions were conducted in English and two local languages (i.e., *Twi* and *Hausa*) concurrently and lasted between one to two hours. The recorded discussions were transcribed and complemented with the notes into English. The analysis was done according to the main themes of the FGD. The results of the FGDs were not included in the estimation of socio-economic costs but provided insights into the causes and effects of motorcycle accidents in the municipality.

Cost analysis: The motorcycle accident data used in this study were based on data gathered from the following sources; hospitals, police, insurance company and the interviews. The costs were made up of direct medical costs, household costs (i.e. out-of-pocket expenses, funeral cost, value of lost labour output, intangible cost) and accident-related costs (i.e. property damage cost and administration cost). Table 1 summarizes the estimation approach and the assumptions used.

Ethical considerations

Ethical approval for the study was obtained from the Ghana Health Service Ethical Review Committee. Permission was also sought from the Regional Directorate of Health Services and the Bolgatanga Municipal Director of Health Services (DDHS) prior to data collection. Hospital administration and study subjects were also assured of the confidentiality, data safety and appropriate data usage. There were no known risks of using the data, and benefits of using the collected data were immense to provide evidence-based information on motorcycle accidents. Furthermore, there was no conflict of interest.

RESULTS

Registered Vehicles

From years 2004 to 2008 there were a total of 15, 475 vehicles registered in the municipality, of which 98% were motorcycles. The annual distribution of registered vehicles is shown in Table 2. The statistics show an increase in vehicular registration from 2005 to 2008.

The motorcycle peak increases were in 2006 (over 100%) and 2007 (38%), with 2005 (about 2%) and 2008 (5%) showing lower increases, whilst, the trend of car registrations, showed an up and down increases

from 2005 (54%), 2006 (35%), 2007 (62%) and 2008 (14%). The motorcycles were significantly more than the cars over the study period (i.e., $t(0.025, 4) = 4.127$, $p=0.015$).

Table 1 Estimation method of cost components

No.	Cost component	Estimation
a)	Intangible cost (i.e., pain, grief and suffering (PGS))	Calculated as a percentage of lost labour output (i.e., 20%). Following similar approach by the Asian Development Bank (Asian Development Bank, 2003), intangible costs were estimated as 20% of the total lost labour cost.
b)	Lost labour output (productivity losses)	<i>Accident victims and caregivers:</i> Calculated by multiplying the number of days of work lost due to the accident by each accident victim and caregiver by the average daily wage rate. <i>Fatalities:</i> For fatalities and permanent disabilities the calculation was performed over the rest of their expected productive working life and discounted to an equivalent present value.
c)	Medical costs	<i>In-patient cost:</i> This was obtained by multiplying the estimated total number of in-patient motorcycle accident cases with the average in-patient treatment cost. <i>Out-patient cost:</i> This was obtained by multiplying the estimated total number of outpatient motorcycle accident cases with the average outpatient treatment cost. The summation of in-patient and out-patient cost gives total medical cost.
d)	Out-of-pocket expenditure	<i>Out-of-pocket expenditure:</i> This was computed by multiplying the average out of pocket expenditure incurred by patients by the estimated number of motorcycle accident cases.
e)	Funeral cost	The estimated funeral cost was obtained by multiplying the average funeral performance cost with the estimated number of deaths.
f)	Property damage cost	<i>Motorcycle repair cost.</i> The average cost of repair of motorcycle was multiplied by the estimated number of victims whose bikes were damaged. <i>Motor cycle replacement cost.</i> This was computed by multiplying the average cost of replacing a motorcycle with the estimated number of motorcycles that were damaged beyond repairs. <i>Cost of lost valuables.</i> The cost of valuable items lost was computed by multiplying the average cost of valuable item lost by victims at the time of the accident with the estimated number of victims who lost items. The total property damage cost was thus obtained by summing the motor cycle replacement cost, repair cost and the cost of valuable lost items.
g)	Administration costs	<i>Insurance cost:</i> This is made up of average insurance claim paid to insured accident victim multiplied by the number of motorcycles insured. <i>Police Investigation cost:</i> The police investigation cost was obtained by estimating the gross hourly wage rate of a police officer multiplied by the number of reported annual accident motorcycles. As well as the estimated cost of other resources such as fuel, communication and stationary used during the investigations. The sum of the insurance cost and police investigation cost constitutes the total administration costs.

Table 2 Annual registered vehicles in Upper East Region, 2004 – 2008

Year	Cars	Motorcycle	Total
2004	24	1,334	1,358
2005	37	1,355	1,392
2006	50	3,267	3,317
2007	81	4,508	4,589
2008	92	4,727	4,819
Total	284	15,191	15,475

Source: DVLA, Upper East Region, 2009.

Background characteristics of motorcycle accident victims

Further analysis from the secondary data shows that about 71% (113) of the motorcycle victims were males, whilst the remaining 29% (47) were females. Seventy-

eight percent (125) of the accident victims were within the productive age group of 20–39 years. Amongst the victims, formal sector employees formed 28% (45), informal sector employees 29% (46), students 33% (52) and unemployed victims 10% (17). Majority of the motorcycle accident victims (78%) were riders, 12% (19) were pillions (i.e., passengers) and 10% (16) were pedestrians.

Motorcycle accident injuries

Hospital statistics show that main injuries emanating from these accidents were head injuries, fractures, lacerations and contusions as shown in Table 3. Again more males (74%) compared to women (26%) sustained these injuries.

Economic burden of motorcycle accident

Table 4 shows the total economic burden of motorcycle accidents in the municipality to be US\$1,216,827.69.

This is made up of about 51.9% accident-related costs and 48.1% casualty-related costs. The accident-related costs totalling US\$585,415.37 was made up of property damaged costs of 47% and administration costs of 5%. Whilst the casualty-related cost of US\$631,412.32 was made up of labour output costs (21%), out-of-pocket expenditure (17%), medical costs (5%), intangible costs (4%) and funeral costs (1%).

The socio-economic status of the victims was not studied to provide some information on the affordability of health services to the victims.

Table 3 Type of motor cycle accident injuries

Types of injuries	Sex distribution		
	Male (%)	Female (%)	Total (%)
Contusions/bruises	43(7.7)	15 (2.7)	58 (10.4)
Fractures (humerus, femur etc)	103 (18.5)	56 (10.1)	159 (28.6)
Head injuries	144 (25.9)	35 (6.3)	179 (32.2)
General lacerations	80 (14.4)	24 (4.3)	104 (18.7)
Others (i.e., dislocations, etc)	40 (7.2)	16 (2.9)	56 (10.1)
Total	410 (73.7)	146 (26.3)	556 (100.0)

Source: Bolgatanga Regional Hospital data, Upper East Region, 2009.

Table 4 Economic burden of motorcycle accidents

Casualty-related costs	Total (US\$)	Cost Profile (%)
Medical costs	63,128.30	5.2%
Out-of-pocket expenditure	209,059.69	17.2%
Lost labour output costs	250,915.78	20.6%
Intangible costs	28,257.16	4.1%
Funeral costs	12,128.44	1.0%
<i>Sub-total:</i>	585,415.37	48.1%
Accident-related costs		
Property damaged costs	576,341.38	47.4%
Administration costs	55,070.94	4.5%
<i>Sub-total:</i>	631,412.32	51.9%
<i>Total</i>	1,216,827.69	100.0%

Motorcycle insurance and riders license statuses

About 31% (49) of the motorcycles involved in accidents were insured, whilst 41% (66) of the victims could not tell whether the motorcycles with which they had the accidents were insured or not.

Secondly, 29% (46) of the motorcycle riders possessed valid licenses at the time of the accident. Generally,

29% (46) of the motorcycle riders wore helmet at the time of the accident. However, 58% (27) of riders who possessed valid licenses wore helmet at the time of the accident. Discussants gave various reasons for the non-use of helmets:

"My brother, I spent a lot of money to acquire my motorcycle, in fact I denied myself a lot of goodies to raise money to buy it. If, I wear helmet to cover my face, who will see me? Who will know I also have a motorcycle? What will therefore be the importance of acquiring this motorcycle in the first place?" (Male Discussant)

".... as for me, I do not have means of transport. But I usually ask for a lift to go and have my hair done. So after that, must I wear a helmet to cover it and spoil it? The police and those making noise at the FM stations must give us a break!" (Female Discussant)

Other social costs

Motorcycle victims were mostly in their productive age group and were the bread winners of their families. When they are incapacitated, it negatively affects the household income in some cases resulting in the reduction of household purchasing power and increase of school drop-outs as portrayed by the experience of one Junior School drop-out:

"I am supposed to be in school, but last year, I picked a co-tenant's motorcycle, had an accident and damaged it. My father had no option than to replace the motorcycle with the money he had saved towards paying my school fees. Thus, I could not go to school this year. As for me, I have learnt my lessons". (Male Discussant)

Secondly, an unemployed female polytechnic graduate also attested that:

"Last year, barely a week after I had secured a job with one of these telecommunication companies, my boy friend had a motorcycle accident and was transferred to Duayaw Nkwanta Hospital in Brong Ahafo region. I was compelled to go and take care of him much against the wishes of my employer. We spent about six weeks and I lost such a lucrative job opportunity. I have since been jobless. As I speak, he manages to walk with the aid of clutches, and we are supported by friends, some of whom are gradually getting fed up. We only take consolation in the fact that we still have our lives, because others did not live to tell their stories." (Female Discussant)

Discussants further noted that there are also some extended societal costs that are difficult to quantify. A typical practical example was narrated of the effect of a motorcycle accident death:

"For example, last year, when the Assistant Headmaster of Kongo Secondary School died from a motorcycle accident, the youth of the town dug 21 trenches across the main Bolga-Bawku road, can you imagine how

much it will cost to repair this road? As a result, the police came to the town to arrest a lot of suspected young men. Others fled the town to escape arrests, whilst others stayed in the bush for some time. Can you quantify all these in monetary terms? Again, a lot of vehicles using the damaged road broke down at a great cost to the drivers, the owners and passengers alike. As I speak, some commercial drivers have refused to use that road.” (Male Discussant)

Reasons for not reporting accidents to the police

Most riders do not have licences (about 71%) and will want to avoid the police. Over 70% of participants were also of the view that most of the accidents are caused either by stray animals on the road and footpaths. One discussant elaborated:

“You see, me when I had my accident, it was due to my own mistake. Besides, my motorcycle is not registered. I don’t also have a licence, and on top of that, I was not wearing a helmet, so you want me to go and report myself to the police, no way”. (Male Discussant)

Discussants also noted that generally, the social settings of Bolgatanga township discourage litigation. So accidents were usually settled informally. Another participant, a motor fitter (mechanic) noted:

“In Bolgatanga, we are all one big family, so if you have a problem with your family member you don’t report to the police. If you do that, the police will collect money from the two of you, why don’t you settle it amongst yourself and use that money to treat yourselves and to repair your motorcycle. So that if there is a balance, you can drink beer with it and pour some to your ancestors for saving your lives”. (Male Discussant)

DISCUSSION

This study has estimated the economic burden of motorcycle accidents in the Municipality where motorcycle usage is very high (i.e., 98% of all registered vehicles during the study period). The annual distribution of registered vehicles showed an increase in all vehicular registration with the difference between the motorcycles and the cars statistically significant. The findings also suggest that more young adults, particularly males were involved in accidents. If the current trend continues, more young adult men in the economically active age group will continue to die or get injured as a result of road traffic accident, thus reducing productivity in the municipality.

Invariably, only 31% of motorcycles were insured. Furthermore, only 29% of the motorcycle riders possessed valid licenses and generally use of helmet is low as was also found in a study in the country¹¹. Victims have assigned various reasons for riding without li-

censes and the low usage of helmet. However, the most interesting ones are the high unlicensed riders and the social resolution system. These are difficult issues to be handled by the law enforcement agencies given their low presence in the communities due to their small numbers and competing needs such as conflict, thefts, robbery etc. Whatever the difficulties being faced by law enforcing agencies are, they need to step up their efforts by increasing their presence in the communities.

Secondly, the study also shows that in communities where acquisition of a motorcycle has high social symbol, the use of helmet (to hide ones personality) has low acceptability especially among young women riders and pillions. This is consistent with other findings that helmet use by motorcyclists in Ghana is generally low.¹¹ One way of reducing the injuries and fatality due to motorcycle accidents is increased efforts of the law enforcement agencies especially the police. Besides, other stakeholders in the transport and health sectors need to undertake series of continuous mass education campaigns on the use of helmet and usefulness of insuring motorcycles.

Outcomes of motorcycle accidents are fatal. The majority fatalities occur in male riders within the productive age group of 20–39 years. The main injuries from these accidents were head injuries, fractures, lacerations and contusions. However head injuries and fractures form about 60% of the cases. This shows how serious these accidents could be. Discussants indicated clearly that lack of formal motorcycle riding training, abuse of alcohol, unrestrained animals and donkey carts were the major causes of these accidents.

The estimated economic burden of motorcycle accidents was about US\$1.2 million, of which about 52% was accident-related costs and 48% casualty-related costs. The most significant cost component of the accident-related costs was property damage, whilst the main cost drive of the casualty-related costs was lost labour output. The 2007 annual report of the National Road Safety Commission (NRSC) also reports the annual cost of all road traffic accidents in the country to be US\$165 million (2006), with lost output accounting for 43%, human costs (28%) property damage (16%), administration cost (8%), and medical cost (5%). In comparison to this motorcycle study: property damage costs (17%), administration costs (5%), medical costs (5%), intangible costs (4%) and funeral costs (1%).

The variation in cost profiles might apparently be due the scope and/or focus of the studies. Whilst the NRSC cost was for all vehicles, this study was for only motorcycles in a municipality which has relatively high proportion of motorcycles (i.e., 98%) compared to other

vehicles and also a high proportion of the road traffic accidents (i.e., 80%) are due to motorcycles. Motorcycles are small in size and thus riders are vulnerable.^{7,9} Furthermore, the study evidence suggests that motorcycle accidents incur extensive property damage (i.e., motorcycles). Secondly, the cost approaches used by the studies might differ. The cost categories of the motorcycle study included components such as intangible costs, out-of-pocket expenditure and funeral costs. It is not however clear if these were also covered by the NRSC report. Finally, we do acknowledge that this is a cross-sectional study hence interpretation of the results should be done with caution.

Road traffic accident is one of the leading preventable causes of illnesses and premature deaths, policy makers must implement effective policies to reduce this menace especially among men. Accidents exert a high cost to the society. Moreover, road traffic accident interventions have to compete with other health sectors priority interventions such as communicable diseases which have been traditional favourites of globally funded programs. Policy makers should therefore formulate accident control policies backed with enforceable regulations. Road traffic accident is covered under the emergency component of National Health Insurance Scheme (NHIS) benefits package. Thus in theory, registrants of NHIS have financial access to health care.

However, anecdotal evidence suggests that most fracture-victims believe that orthodox medicine is deficient in bone setting and healing of broken bone. So generally, treatments of fractured bones are usually sorted outside NHIS accredited providers. This leads to increased out-of-pocket expenditure to victims and their families. This provides some important information of advocacy on effective preventive measures to reduce motorcycle accidents and its economic burden in northern regions where the use of motorcycles is predominant.

Limitations of this study are mainly associated with the data and the assumptions in the estimation of the costs. First, motorcycle accidents are usually under-reported in developing countries including Ghana. Therefore, the estimates obtained for this study might not represent the true estimates. This study did not adjust for this shortfall. Second, the estimates of motorcycle accidents were obtained from a cross-sectional study of key informants which might have some variations with reality. Third, there is a great deal of variation in the type of vehicle usage, the nature of accident and costs throughout the country. Given the paucity of data on the cost of accidents, some international literature was used for this estimation. However, as more work is

done on accidents, there will be more data for refined estimates to be carried out in future.

CONCLUSION

In conclusion, motorcycle accident can be fatal and constitutes a high economic burden. Accidents also imposed high intangible cost (i.e. pain, grief and suffering). The study recommends that law enforcing agencies especially the police should ensure that riders put on crash helmets, carry valid licenses and that the motorcycles are insured through health education programmes. Finally, health care providers should improve on record keeping of road traffic accident cases by indicating the type and make of vehicle involved, number of victims per accident, number of passengers in the accident vehicle and estimated time of accident.

ACKNOWLEDGEMENTS

The authors would like to acknowledge the administrative support of the Upper East Regional Health Directorate and the Bolgatanga Municipal Health Directorate. Special thanks also go to the Regional Hospital, the Afrikids (a private hospital), Star Assurance Insurance Company, and the Driver and Vehicle Licensing Authority (DVLA), all in Bolgatanga, Upper East region for their assistance with access to data. Finally, we thank WHO, Alliance for Health System and Policy Research for their financial support for the study.

REFERENCES

1. Agnihotri AK and Joshi HS. Pattern of road traffic injuries: one year hospital-based study in Western Nepal. *Int J Inj Contr Saf Promot*, 2006;13(2): 128-130.
2. Banthia P, Koirala B, Rauniyar A, Chaudhary D, Kharel T and Khadka SB. An epidemiological study of road traffic accident cases attending emergency department of teaching hospital. *J Nepal Med Assoc*, 2006;45(162): 238-243.
3. World Health Organization. *World Report on Road Traffic Injury Prevention: Summary*. 2004. Geneva, World Health Organization.
4. United Nations. General Assembly Adopts Resolution on Easing Global Road Safety Crisis, *Sixty-Second General Assembly Plenary 87th Meeting*, 2008. United Nations
5. Odero W, Khayesi M and Heda PM. Road traffic injuries in Kenya: magnitude, cause and status of intervention. *Injury Control and Safety Promotion*, 2003;10, 53-61.
6. Ghana Government. National Road Safety Commission. 2007 Annual Report. Ministry of Transportation.

7. Branas CC and Knudson MM. Helmet laws and motorcycle rider death rates. *Accid Anal Prev*, 2001; 33(5): 641-648.
 8. Janmohammadi N, Pourhossein M and Hashemi SR. Pattern of Motorcyclist's Mortality in Mazandran Province, Northern Iran. *International Journal of Iranian Red Crescent Medical Society*, 2009;11(1): 81-84.
 9. Okeniyi JA, Oluwadiya KS, Ogunlesi TA, Oyedeji OA, Oyelami OA, Oyedeji GA and Oginni LM. Motorcycle Injury: An Emerging Menace to child Health in Nigeria. *Internet Journal of Paediatrics and Neonatology*, 2005; 5(1).
 10. Afukaar FK, Antwi P and Ofosu-Amaah S. Pattern of road traffic injuries in Ghana: implications for control. *Inj Control Saf Promot*, 2003;10(1-2): 69-76.
 11. Ackaah W and Afukaar FK. Prevalence of helmet use among motorcycle users in Tamale Metropolis, Ghana: An Observational Study. *Traffic Injury Prevention*, 2010;11(5): 522 - 525.
 12. Begg DJ, Langley JD and Reeder AI. Motorcycle crashes in New Zealand resulting in death and hospitalisation. I: Introduction methods and overview. *Accident Analysis & Prevention*, 1994; 26(2): 157-164.
 13. Braddock M, Schwartz R, Lapidus G, Banco L and Jacobs L. A population-based study of motorcycle injury and costs. *Ann Emerg Med*, 1992; 21(3): 273-278.
 14. Hoang H, Pham T, Vo T, Nguyen P, Doran C and Hill P. The costs of traumatic brain injury due to motorcycle accidents in Hanoi, Vietnam. *Cost Effectiveness and Resource Allocation*, 2008; 6(1): 17.
<http://www.resourceallocation.com/content/6/1/17>
 15. Max W, Stark B and Root S. Putting a lid on injury costs: the economic impact of the California motorcycle helmet law. *J Trauma*, 1998; 45(3): 550-556.
 16. Miller T, Levy DT, Spicer RS and Lestina DC. Allocating the costs of motor vehicle crashes between vehicle types. *Transportation Research Record*, 1998; 1635, 81-87.
 17. Wang JS, Knipling RR and Blincoe LJ. The dimensions of motor vehicle crash risk. *Journal of Transportation and Statistics*, 1999; 2(1): 19-43.
 18. Bray T, Szabo R, Timmerman L, Yen L and Madison, M. Cost of Orthopedic Injuries Sustained in Motorcycle Accidents. *Journal of the American Medical Association*, 1985; 254(17): 2452-2453.
 19. Karlson TA and Quade CA. Head injuries associated with motorcycle use - Winsconsin 1991. *Morbidity and Mortality Weekly Report*, 1994;43(23): 429-431.
 20. Ghana Health Service. Bolgatanga Municipal Health Administration 2006 Annual Report. Bolgatanga.
 21. Ghana Health Service. Bolgatanga Municipal Health Administration 2007 Annual Report. Bolgatanga.
 22. Ghana Health Service. Bolgatanga Municipal Health Administration 2008 Annual Report. Bolgatanga.
 23. Asian Development Bank. Road Traffic Accident Costing. Road Safety Guidelines for the Asian and Pacific Region, 2003.
 24. Centers for Disease Control and Prevention. Epi Info™ Version 3.4.1., 2007.
-