A study of common causes of mortality among Fishermen in Lake Victoria, Kenya

Opemo D.O [1], Aloo P.A[2], Arudo J.A[3] , Mbithi J.N[4]

1. Department of Biological sciences, Kenyatta University.
2. Department of Aquaculture and Fisheries Management, Karatina University.
3. Department of Advanced Nursing Studies, Aga Khan University, Nairobi, Kenya
4. Department of Biochemistry.

Corresponding Author: Aloo P.A, Department of Aquaculture and Fisheries Management, Karatina University. P.O Box 1957-10101, Karatina., Kenya Email:aloopenina@yahoo.com

SUMMARY

The fishing industry in Kenya plays an integral role in the socio-economic development of Kenya. However, the working environment of fishermen is characterized by a wide variety of occupational hazards and mortality attributed to work related diseases or accidents and injuries, which, are poorly reported. Most of the reported cases are in the formal sector, while the informal sector such as fishing, where most people are employed, are largely ignored. The objective of this study was to determine the causes of mortality and identify factors that influence mortality among fishermen in Lake Victoria. A two-year retrospective mortality survey using verbal autopsy was carried out among fishermen in eight riparian districts of Lake Victoria in Kenya. The study successfully followed up a total of 3058 deceased fishermen. The mean age at death was 33 years (SD: ± 9.5) and a median of 32 years ranging between 15 – 54 years. Peak mortality reported among fishermen aged 25 - 29 years (19.8%) and 30 – 34 years (19.3%) was comparable. The findings revealed that the major causes of death were HIV – related infections (33.8%) followed by drowning (14.3%), pulmonary tuberculosis (12.4%), and malaria (10.4%). Results of this study show that there is an urgent need to identify strategies that would prevent HIV – related infections and drowning among the fishing community.

Afr J Health Sci. 2014; 27(1):19-29]

Introduction

The fishing industry provides livelihood to approximately 100 – 200 million people worldwide, of which 95% live in the developing countries [1]. In Kenya, the fisheries industry employs over 1million people directly and indirectly [2] Overall, the industry accounts for 25% of the country's total employment in the informal sector and 14.5% of the country's total employment [3]. Export of fish and fishery products earn Kenya about 4billion shillings annually [4]. Lake Victoria dominates the fishing industry with 94% output [3,5], and an annual catch amounting to 25% of the total catch from African Inland Fisheries [6]. The industry provides 50% of the animal proteins consumed worldwide with Africa accounting for 19% of this protein [7]. Moreover, the fishing industry provides the cheapest animal protein to all Kenyan ethnic groups regardless of socio-economic status, thus the industry plays an integral role in socio-economic development of the country.

Although fish is an important source of protein and the industry employs millions of people around the world, the working environment of fishermen is characterized by a wide variety of occupational hazards [8]. From the available literature, the major contributing factors to high mortality among the fishermen are the fatal accidents and diseases [9].

Statistics on all-cause and cause-specific mortality among fishermen in the developing world is not available. In many countries, routine vital statistics are of poor quality and often incomplete or unavailable even where the registration of deaths is legally required as in the case of Kenya [10]. Similarly, a comparative demographic study on civil registration conducted among under five years old children revealed that compared to Verbal Autopsy (VA), causes of death reported through civil registration were less useful for health policy issues [11]. In countries where vital registration and routine health information systems are weak, the application of VA in cross-sectional surveys has been commended for assessing cause-specific mortality. Verbal Autopsy is an indirect method of ascertaining biomedical causes of death from information on symptoms, signs and the circumstances preceding death, obtained from a caretaker of a deceased. It is considered as the most appropriate tool that can be used in rural areas where the majority of deaths occur at home [12].

Whereas there is a general policy on reporting of both health facility and community deaths, occupational deaths and fatal injuries resulting from fishing activities appear to be grossly under-reported leading to ineffective decision-making. The aim of this study was to bridge the information gap on cause-specific mortality among fishermen and the risk factors associated with such causes of death.

Materials and Methods

Study site and population

Lake Victoria is the largest fresh water body in Africa with an area of 69,000 km^2. The lake is shared by Tanzania (49%), Uganda (45%) and Kenya (6%). The Kenyan waters, which is 4,128 km^2 has a shoreline of approximately 400 km with 293 fish landing beaches of which 208 are gazetted. The lake has a total of 23,000 fishing vessels with approximately 70,000 fishermen of whom 50% are not registered by the respective Beach Management Units (BMUs). The riparian districts have a total population of 2,679,000 out of which 2.6% are fishermen.

Sampling

The study was conducted in 8 districts that border Lake Victoria in Nyanza Province, Kenya. The districts included Busia, Bondo, Kisumu, Nyando, Rachuonyo, Homa Bay, Suba and Migori. The study covered deceased fishermen who died between August 1998 and July 2000 and who worked in the beaches of the eight riparian districts. The riparian districts were used as clusters in order to identify the risk factors associated with mortality among the fishermen. The number of gazetted beaches and registration of vessels and fishermen per district guided the selection. Systematic sampling method using an interval of four beaches was used giving a total of 52 beaches from the 208-gazetted beaches. The vessels where the fishermen worked before death were identified through snowball sampling, where one respondent gave the researchers the name of another respondent, who in turn provided the name of a third, and so on. Using the methods of Fisher *et al.*, [13], a sample size of about 400 deceased fishermen was obtained in each district.

Study Subjects

The study subjects included deceased fishermen who must have worked in the gazetted beaches and residents of the riparian districts and died between August 1998 to July 2000 and must have worked in the vessels registered by the Fisheries Department. They included male fishermen aged 15 to 55 years, who were registered members of a given beach for at least 6 months and had worked in the given vessel for a minimum of three months before death.

Data collection

Six community interviewers (VA team) per beach were recruited and trained to conduct VA interviews. The interviews were conducted in either of the local languages, *Luo* or *Bunyala*, using a questionnaire translated from English to the two languages and checked for accuracy by translating back to English. A modified version of VA tool designed by Chandramohan [14] was used. The sections that were retained in the questionnaire included: demographic data of the deceased, circumstance of death, summary of the main signs and symptoms reported by respondent, list of hospitalization, specific questions about cause of death unrelated to illness and specific questions to elicit signs and symptoms of the final illness. Additional questions on lifestyle, type of vessels, fishing gears and type of propulsion were included in the questionnaire after consulting with the Fisheries Department. Once the deaths were reported to the researcher through the beach leaders, the researchers allocated the deaths to the VA team for follow up and for detailed description of events surrounding the death in order to validate the event. Signed informed consent to participate was sought from all respondents at the beginning of each interview. Three independent physicians reviewed copies of the VA information from each of the cases reported. Each ascribed a single cause of death except where this was not possible. Diagnosis was considered to be reached if at least two physicians agreed on a cause of death. If all the three disagreed on a cause of death or where there was more than one cause of death assigned by a physician, a panel of 3 physicians reviewed the questionnaire and where possible a diagnosis was reached by consensus.

Data Analysis

Analysis of data was conducted using SAS version 8.01 (SAS Institute, Cary, NC, USA). Differences in the proportions were determined by calculating the confidence interval and the summary of Chi square statistic using Mantel Haenszel stratified cross-tabulations. P-values < 0.05 were considered statistically significant. Proportions were calculated using total causes of death while the denominator was calculated based on the total number of deaths. Differences in the associations between categorical variables were assessed using Logistic Regression Analysis. The Logistic Regression model was fitted to compare the association of causes of death and demographic, socio-economic factors, as well as fishing related factors.

Results

Demographic characteristics of deceased fishermen

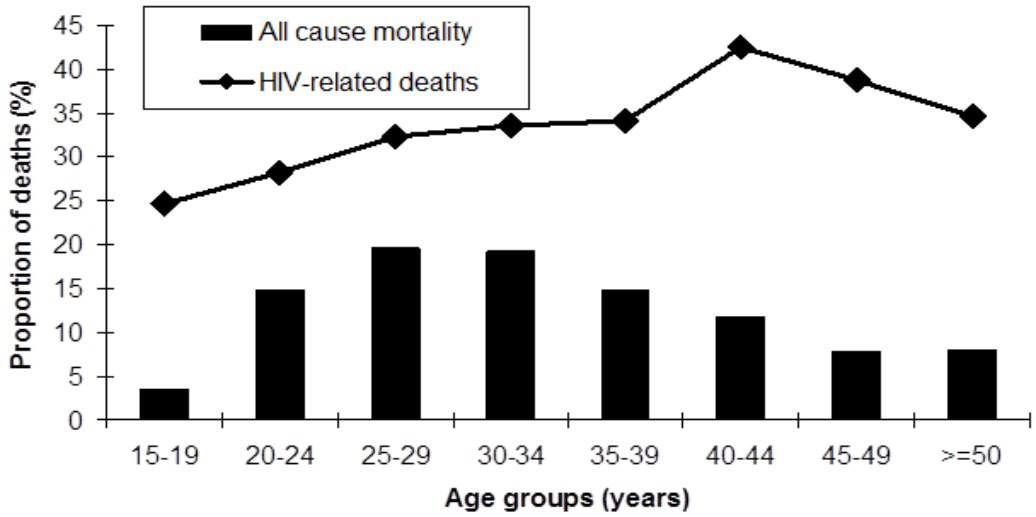
A total of 3058 of deceased fishermen were recorded as follows: 400 (Busia), 387 (Bondo), 399 (Kisumu), 369 (Nyando), 378 (Rachuonyo), 363 (Homa Bay), 362 (Suba) and 400 were from Migori. The age range was between 15 and 55 years with a mean age at death of 33± 9.5 years. Overall, most of

the deceased (68.8%) were married and over 90% of those married were living with their wives. More than two-thirds of the fishermen had attained primary level of education. Less than a fifth of the deaths were reported to the registrar of births and deaths as required by the government. About 70% of the deaths occurred at home, 15.6% in the lake, 9.0% in the health facility and 6.6% at the beach. Excluding deaths attributed to drowning, only 36.6% of those who died were hospitalized during the illness preceding death. Among deaths that occurred in the lake, 98.0% were as a result of drowning. Differences in the proportions of deaths per district were not statistically significant (χ^2 = 5.7, df 7, p = 0.57).

All-cause mortality by age group

There was a sharp increase in the proportion of deaths reported in the age group 15-19 reaching its peak among those aged 25 - 29 years, followed by a gradual decline as the age increased. Another increase was observed after the age group 30-34 with a peak at age group 40-44, this was followed by a gradual decline among the older age groups. The proportion of deaths among those aged 25 – 29 (19.8%) and 30 – 34 years (19.3%) was, however, comparable (Fig. 1).

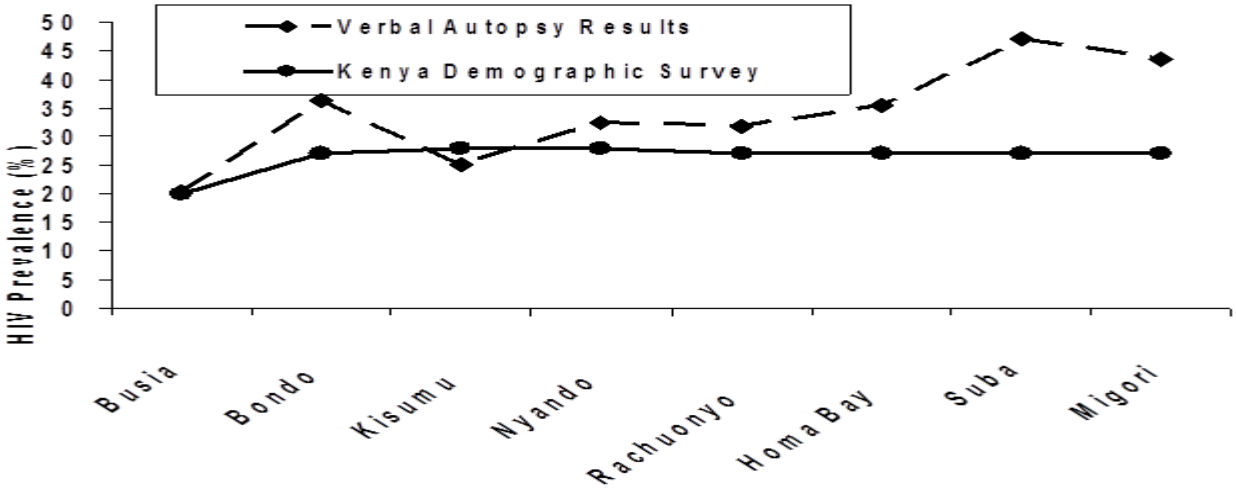
Figure 1. All cause and HIV/AIDS-related cause of death by age groups



Causes of death

Out of the 3058 recorded deaths, VA assigned 33.8% and 14.3% of the deaths to HIV-related infections and drowning, respectively .This was followed by pulmonary tuberculosis (PTB) (12.4%) and malaria (10.4%). The leading cause of death among the youngest age group (15 – 19 years) was drowning (27.3%), followed by HIV-related infections (24.6%). Among the rest of the age groups, the majority of the deaths were attributed to HIV-related infections with those aged between 40 and 44 claiming the highest proportion (42.5%). Other than the younger (15-19) and the older age groups (50-54), drowning was the second most important cause of death among the fishermen.

Figure 2. A comparison between the proportions of deaths reported through verbal autopsy and Government of Kenya HIV/AIDS prevalence survey in 2000 by district



Causes of death by district

Suba District reported the highest proportion of deaths (47.0%) that were attributed to HIV-related infections, followed by Migori (43.5%) and the least proportion was reported in Busia District (Fig. 2). Drowning was the leading ascribed cause of death in Busia (27.0%) and the least ascribed cause of death was in Nyando District (6.0%). Malaria was among the top four causes of death in all the districts with Kisumu reporting the highest proportion of deaths (14.5%) ascribed to malaria while the least malarial deaths were reported in Rachuonyo (7.9%), Bondo and Migori which reported 7.8% each (Table 1). The rest of the other districts had higher proportion of deaths attributed to the same cause of death.

Table 1: Cause-specific mortality by district among the fishermen in Lake Victoria, Kenya

Cause of death	District								Total (%)
	Busia (%)	Bondo (%)	Kisumu (%)	Nyando (%)	Rachuonyo (%)	Homa Bay (%)	Suba (%)	Migori (%)	
HIV related infections	81 (20.3)	140 (36.2)	100 (25.1)	120 (32.5)	120 (31.8)	129 (35.5)	170 (47.0)	174 (43.5)	1034 (33.8)
Drowning	108 (27.0)	66 (17.1)	34 (8.5)	22 (6.0)	55 (14.6)	57 (15.7)	41 (11.3)	54 (13.5)	437 (14.3)
PTB	28 (7.0)	72 (18.6)	90 (22.6)	93 (25.2)	34 (9.0)	28 (7.7)	12 (3.3)	22 (5.5)	379 (12.4)
Malaria	42 (10.5)	30 (7.8)	58 (14.5)	42 (11.4)	30 (7.9)	43 (11.9)	42 (11.6)	31 (7.8)	318 (10.4)
Cholera	19 (4.8)	16 (4.1)	16 (4.0)	8 (2.2)	22 (5.8)	33 (9.1)	39 (10.8)	28 (7.0)	181 (5.9)

Cause of death	District								Total (%)
	Busia (%)	Bondo (%)	Kisumu (%)	Nyando (%)	Rachuonyo (%)	Homa Bay (%)	Suba (%)	Migori (%)	
Gastro-enteritis	17 (4.3)	14 (3.6)	33 (8.3)	23 (6.2)	32 (8.5)	14 (3.9)	16 (4.4)	21 (5.3)	170 (5.6)
Pneumonia	24 (6.0)	14 (3.6)	23 (5.8)	20 (5.4)	16 (4.2)	19 (5.2)	19 (5.3)	17 (4.3)	152 (5.0)
Schistosomiasis	22 (5.5)	3 (0.8)	3 (0.8)	14 (3.8)	10 (2.7)	13 (3.6)	6 (1.7)	6 (1.5)	77 (2.5)
Heart conditions	13 (3.3)	10 (2.6)	9 (2.3)	1 (0.3)	10 (2.7)	2 (0.6)	0 (0.0)	3 (0.8)	48 (1.6)
Neoplasms	6 (1.5)	3 (0.8)	9 (2.3)	3 (0.8)	8 (2.1)	1 (0.3)	1 (0.3)	3 (0.8)	34 (1.1)
Injuries caused by animals	20 (5.0)	5 (1.3)	2 (0.5)	2 (0.5)	3 (0.8)	0 (0.0)	1 (0.3)	0 (0.0)	33 (1.1)
Meningitis	2 (0.5)	5 (1.3)	3 (0.8)	7 (2.0)	6 (1.6)	3 (0.8)	1 (0.3)	4 (1.0)	31 (1.0)
Typhoid fever	1 (0.3)	4 (1.0)	1 (0.3)	3 (0.8)	2 (0.5)	3 (0.8)	3 (0.8)	8 (2.8)	25 (0.8)
Assault	4 (1.0)	0 (0.0)	2 (0.5)	0 (0.0)	10 (2.7)	5 (1.4)	1 (0.3)	3 (0.8)	25 (0.8)
Road traffic accidents	2 (0.5)	2 (0.5)	3 (0.8)	4 (1.1)	1 (0.3)	3 (0.8)	1 (0.3)	4 (1.0)	20 (0.7)
Suicide	2 (0.5)	0 (0.0)	1 (0.3)	1 (0.3)	6 (1.6)	0 (0.0)	2 (0.6)	7 (1.8)	19 (0.6)
Others*	9 (2.3)	3 (0.8)	12 (3.0)	6 (1.7)	13 (3.4)	10 (2.8)	7 (2.0)	15 (3.8)	75 (2.5)
Total	400 (100)	387 (100)	399 (100)	369 (100)	378 (100)	363 (100)	362 (100)	400 (100)	3058 (100)

*Others include: epilepsy (5); snake bite (13); diabetes mellitus (9); poisoning (5); elephantiasis (2); renal failure (7); intestinal obstruction (1); fire/burns (9); hepatitis (9); paralysis due to space occupying lesion (2); peptic ulcer with renal failure (1); liver cirrhosis (3); asthma (1); gun-shot (1); rabies (2); lightening (3); septicaemia (1).

Broad classification of causes of death

The causes of death among the fishermen were broadly classified into communicable diseases, non-communicable diseases and accidents and injuries. The leading cause of death in all age groups in the riparian districts was communicable diseases (77.8%). Accidents and injuries followed with 18.5%. Unintentional injuries were the most important causes of death among the accidents and injuries with 17.9%. Intentional accidents, which were mainly suicidal in nature, accounted for less than 1% of the deaths. Non- communicable diseases accounted for only 3.7% of the total causes of death. In absolute numbers, reported deaths due to communicable diseases rose gradually from age group 15 – 19 reaching its peak among those aged 30 – 34 years. The reverse was true of deaths attributed to unintentional injuries with peak mortality in the age group 20 – 24. The proportion of deaths due to non-communicable diseases was highest (8.9%) among the older fishermen (50 – 54 years).

Risk factors associated with fishing

Almost 60% of the fishermen who died were smokers; 42.0% smoked cigarettes while 16.7% smoked bhang (*Cannabis sativa*). The proportion of smokers to alcohol consumers was comparable. Among the smokers, 79.3% also drank alcohol. Out of 25 cases of death attributed to assault, 18 were alcohol drinkers of varying quantities. Of the 19 suicide cases, 12 were either moderate or heavy alcohol consumers. There was no association between being married, single, level of education and dying from HIV-related infections. After controlling for age, malaria (OR: 0.1; 95% CI 0.1 – 0.2) and schistosomiasis infections (OR: 0.2; 95% CI 0.1 – 0.3) were significantly associated with lower proportions of death due to HIV-related infections. Pulmonary Tuberculosis related infections were significantly associated with higher proportions of HIV-related deaths, again controlling for age (OR: 3.9; 95% CI 3.3 – 4.6). Significant associations, controlling for age, were noted between night fishing and malaria (OR: 1.7; 95% CI 1.3 – 2.1) and use of driftnet as fishing gear and schistosomiasis (OR: 3.6; 95% CI 2.0 – 6.8).

In logistic regression controlling for the district of residence, the odds of dying from HIV-related infections among fishermen aged between 20 – 34 years was significantly lower (OR: 0.8; 95% CI 0.7 – 0.9) compared to the rest of the other age groups (p = 0.0025). Controlling for district of residence, the odds of dying from other accidents, which excluded drowning for the same age group was 1.4 times higher compared with the rest of the age groups (Table 2).

Table 2: A summary of the results of multiple logistic regression analyses on the proportion of deaths derived from verbal autopsy of deceased fishermen in Riparian Districts of Lake Victoria, Kenya

Type of risk factor	Risk factors	Ascribed cause of death	OR	95% CI	p value
Demographics	20–34 years	HIV–related infections	0.8	0.7 – 0.9	0.0025
		Accidents/Injuries (excluding drowning)	1.6	1.4 – 2.0	<0.0001
		Drowning	1.6	1.3 – 2.0	<0.0001
District of residence	Busia	HIV – related infections	0.5	0.4 – 0.6	<0.0001
	Kisumu	HIV – related infections	0.6	0.5 – 0.8	<0.0001
	Migori	HIV – related infections	1.7	1.3 – 2.0	<0.0001
	Suba	HIV – related infections	2.0	1.5 – 2.4	<0.0001
Socio–economic	Education	Drowning	1.4	1.1 – 1.8	<0.0001
Life style	Smoking	Lung disease	1.2	1.0 – 1.5	0.07
	Alcohol	Drowning	1.4	1.2 – 1.8	0.0012
Time of fishing	Day fishing	Drowning	1.6	1.3 – 2.0	<0.0001
	Night fishing	Malaria	1.7	1.3 – 2.1	<0.0001
Type of fishing gear	Driftnet	Schistosomiasis	3.6	2.0 – 6.8	<0.0001
Type of propulsion	Paddle	Drowning	0.7	0.6 – 0.8	0.0003
	Sails/Paddle	Drowning	1.6	1.3 – 2.0	<0.0001

Age group 15–19 which had the lowest proportion of deaths attributed to HIV–related infections (24.6%) was used as baseline to compare deaths attributed to HIV–related infections by age group using logistic regression analysis. The results indicated that the odds of dying from these infections were 2.3 times higher among fishermen aged 40 – 44 years (p = 0.001) and 1.9 times for those aged 45 – 49 years

(P = 0.01). Logistic regression analysis of HIV-related infections as a cause of death among fishermen by district of residence revealed that both Busia (OR: 0.5; 95% CI 0.4 – 0.6) and Kisumu (OR: 0.6; 95% CI 0.5 – 0.8) districts were significantly associated with lower proportions of mortality due to HIV-related infections. Suba (OR: 2.0; 95% CI 1.5 – 2.4) and Migori (OR: 1.7; 95% CI 1.3 – 2.0), on the other hand, were significantly associated with higher proportions of death due to the same infections, controlling for age. No significant association was noted in the remaining riparian districts.

Logistic regression analysis controlling for district, showed that the odds of a fishermen aged 15-19 years dying from drowning were significantly higher compared to the other age groups (OR: 1.6; 95% CI 1.3 – 2.1; p< 0.0001). Table 2 shows the results of multiple regression analyses on the proportion of deaths due to various causes of death ascribed through verbal autopsy.

Discussion

The fishing industry plays an important role in the economy of Kenya in terms of employment and foreign exchange earning [4]. However, very little is known about the health hazards associated with the fishing activities. The problem of lack of information on cause-specific mortality in developing countries is generally attributed to the levels of coverage of vital registration (especially in rural areas) and reliability of cause of death stated on the death certificate [14] or burial permits [11].Even though civil registration is a legal requirement in Kenya, coverage of the reported deaths in this study was low with less than one fifth of the deaths being issued with burial permits. Moreover, 90% of the deaths among the deceased fishermen followed up occurred outside health facilities, suggesting that cause-specific mortality based on health facility records are unrepresentative for those in the fishing industry in the riparian districts of Kenya. More than a half of all the deaths recorded (53.8%) were in the age group, 20-34 years. This compares with peak mortality reported in the late 1990s, where the highest proportion of deaths was in the same age group [15].

HIV-related infections were the leading cause of death among the deceased fishermen. Fishermen who were residents of Suba and Migori districts had significantly higher risk of dying from HIV-related infections while the opposite was true of fishermen residing in Kisumu and Busia districts. The government of Kenyan (GoK) survey on HIV prevalence by district [16] showed that Busia District had the lowest prevalence of HIV (20%), the rest of the districts had prevalence ranging between 27% – 28% with Kisumu and Nyando leading with 28%. Age-specific HIV prevalence showed that about 25% of the deaths occurred among those aged 15 – 19 years then rose gradually to a peak of 42.5% among those aged 40 – 44 years and then declined. The GoK [17] results of 8.8% confirmed peak HIV prevalence among the age group 40 –44 years.

The comparatively low HIV/AIDS proportion of deaths reported in Busia can be attributed to increased level of awareness and behaviour change, the district being closer to Uganda where HIV/AIDS prevalence is lower than that of Kenya. The beaches in both Migori and Suba are quite remote and may not have received adequate awareness campaigns on HIV/AIDS prevention. Moreover, Suba District has 75% of the beaches along the lake.

The present study has shown a relatively higher HIV prevalence probably because fishermen are among

the HIV high-risk group. The higher risk of dying from HIV-related infections among the fishermen could be explained by socio-economic dynamics of their profession. Although Lake Victoria is situated in malaria endemic region, the disease was ranked fourth among the major causes of death. Health facility for in-patient mortality showed that the leading cause of death in all the riparian districts in 1999 and 2000 was malaria [18]. Since the majority of the deaths were community deaths, health facility mortality surveillance may not reflect the true picture on causes of death among fishermen.

Apart from communicable diseases, other causes of deaths among the fishermen were intentional and unintentional accidents and injuries, which accounted for about 18.5% of deaths. Other than road traffic accidents and dog bites (rabies), 17.9% of the deaths were fishing-related indicating the permanent character of hazards pertaining to work in the vessels. Unintentional causes were due to drowning and animal injury. Intentional accidents and injuries were solely due to suicide. Similar findings have been reported in other studies in Poland where accidents and injuries were reported to be responsible for about 10% of deaths [19].

Conclusion

The results of the study reflect the need for speeding up HIV preventive activities among fishermen living in the riparian districts by the Ministry of Health, Ministry of Fisheries in conjunction with the existing Non Governmental Organizations operating along the riparian districts. Since 96% of the causes of death among the fishermen of the riparian districts around Lake Victoria are preventable, the above ministries urgently need to work on policy guidelines on the prevention of the predisposing factors to such mortalities. There are International Codes and Guidelines on occupational safety and health produced by ILO. These guidelines should be enforced by the Ministry of Fisheries including regulations governing the fishing industry in order to improve the standards of safety and health. The ministry responsible for fisheries through the Beach Management Units should sensitize fisher communities on the occupational health hazards associated with the profession.

Refrences

1. Konstapel K and Noort L. *Fisheries in developing countries: towards sustainable use of living aquatic recourses; sectoral policy document of development co-operation.* Ministry of Foreign affairs, The Hague, Netherlands, 1995.

2. GoK. *Fisheries Annual Statistical Bulletin* Fisheries Department, Ministry of Tourism and Wildlife, Nairobi, Kenya, 1995.

3. Bokea C and IKiara M. *The macro-economy of the export fishing industry in Lake Victoria (Kenya). Socio-economics of Lake Victoria Fisheries.*,7 UCN East Africa Program, 2000.

4. Aloo P A . The Fishing Industry in Kenya: Towards the Development of A National Policy. FAO and Ministry of Livestock an Fishery Development Publication. 110pp, 2006.

5. GoK. *2000 Fisheries Annual Statistical Bulletin.* Fisheries Department, Ministry of Livestock and Fisheries, Nairobi, Kenya, 2000a.

6. FAO. *Management of African inland fisheries for sustainable production* First Pan African Fisheries Congress and Exhibition, Nairobi, UNEP, 1995.

7. Myers N . Marine fisheries: Two Macro-constraints. Environment and Development. *Economics*, 1997;**2**:88-93.

8. US Bureau of Labor Statistics . *Census of fatal occupational injuries*, New Jersey, 2002.
9. ILO. *Safety and health in fishing industry* ILO, 1999.
10. Mungala V and Snow R. Death registration on Kenyan Coast. *The East African Medical Journal*, 1994;**71**: 747-750.
11. Arudo J, Gimnig J, Ter Kuile F, Kachur S, Slutsker L, Kolczak M, Hawley W, Orago A, Nahlen B and Howard-Phillips P. Comparison of government statistics and demographic surveillance to monitor mortality in children less than five years old in rural western Kenya. *American Journal of Tropical Medicine and Hygiene*, 2003; **68**: 30-37.
12. Kaufman JS, Asuzu MC, Rotini CN, Johnson OO, Owoaje EE and Cooper RS. The absence of adult mortality data for Sub-Saharan Africa: "A practical solution". *Bulletin of the World Health Organization*, 1997; **75**: 389-395.
13. Fisher AA, Laing JE, Strocker JE. Handbook for Family Planning, Operation Research Design in Sampling. *Population Council*. 40-45, 1998.
14. Chandramohan D C, Gillan H, Laura C, Rodrigues LC and Hayes RJ. Verbal autopsy for Adult deaths: their development and validation in a Multicentre study. *Tropical Medicine and International Health*, 1998; **3**: 436 - 444.
15. GoK . *Kenya Demographic Health Survey* Central Bureau of Statistics, Ministry of Planning and National Development, Nairobi, 1998.
16. GoK. *AIDS in Kenya: Background, projections, impact, interventions and policy, National Aids and STI Control.* National AIDS and STDs Control Programme [NASCOP], Ministry of Health, Nairobi, 2001.
17. GoK. *Kenya Demographic Health Survey* Central Bureau of Statistics, Ministry of Planning and National Development, Nairobi, 2003.
18. GoK. *Nyanza province Health Information System: Provincial Health Annual Report* Ministry of Health, Kisumu, 2002.
19. Jaremin B, Kotulak E and Starnawska M. Comparative study of the death diving sea voyages among Polish seamen and deep sea and boat fishermen. *Bulletin of the Institute of Maritime Tropical Medicine Gdynia*, 1997; **48**: 5-22.