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Logistic Regression Analysis of Mortality Among Fishermen in the Riperian Counties of Lake Victoria, Kenya

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Abstract: Fishing as an economic activity has gainful implications to National Development. Mortality instigated by occupational hazards is a current subject of research significance globally. This study made attempts to assess the associations between categorical variables using Logistic Regression. Logistic regression analysis targeting 3058 deceased fishermen was carried out spanning 1998-2000. Associative relationships among categorical variables were determined using Statistical Analysis System (SAS). The findings reveal that the major causes of death were: HIV - related infections (33.8%), drowning (14.3%), pulmonary tuberculosis (12.4%), and malaria (10.4%). Factors influencing HIV - related mortality were: age group (p = 0.0025), Counties of residence (Busia, Kisumu, Migori and Siaya) all of which had similar p value (0.0001). The risk factors associated with deaths due to drowning were: age group (p =<0.0001), use of a combination of sails and paddles (p = <0.0001), use of paddle (p = 0.0003), Secondary education (p = <0.0001) and drinking of alcohol (p = 0.0012).The study concluded that the probability of death occurrence was closely related to HIV infections over the area of study.

Keywords: Fishermen, Mortality, Lake Victoria, Logistic Regression

1. Introduction

There is growing scientific evidence of mortality associated with HIV/AIDS among fishing communities. Logistic regression can be used to study risk of HIV infection on a given population [1]. The method has also been used to study HIV testing behaviour [2]. A study carried out on fishremen in Karchi revealed that majority had in-appropriate knowledge (93.6%), negative attitude (75.8%) and less adherent sexual practices (91.6%) [3]. However, no significant association of socio-economic characteristics with knowledge, attitude and practices were observed in multivariate analysis. Lack of access to information by fishermen has exposed them to HIV/AIDS risk [4]. The Uptake of HIV prevention and treatment services is still very low in some african Countries [5]. A study carried out among 446 fishermen in Sihanouk Ville, a port and fishing area in Cambodia revealed an association between risk factors and HIV/AIDS infections [6]. Mortality of Fishermen associated with HIV/AIDS among fishing communities has been observed to be between 4-14 percent of the National Average [8]. Certain risk factors are contributory to HIV prevalence among fishermen and include homosexuality, commercial sex, lack of commitment to marriage, alcohol, type of trade, migration, drug use and abuse among others [7]. Fish for sex has been a precursor to HIV/AIDS infections in sub-Saharan Africa [8]. Enhanced HIV/AIDS prevalence in fishing communities together with challenges in access to information and Ant-Retroviral therapy services have been identified as drawbacks that need accelarated policy action [9]. Fish for sex is not only influenced by tradition but due to changing economic opportunities associated with poverty [10]. Factors that contribute to enhanced HIV/AIDS prevalence among fishing communities include age of sexual activity, migratory behavior of fishermen, cultural believes that lead to HIV risk denial, socio-economic marginalization, irresponsible drinking behavior, inadequate prevention; treatment; mitigation measures and limited access to sexual health services [11]. There are far reaching economic and health consequences associated with fishing that cuts across generations [12]. According to mojola [13], a changing ecological environment of Lake Victoria, gendered economy, contributes to fisherfolk's sexual relationships and sexual mixing patterns in ways that were consequential for their HIV risk. Sex for fish has been investigated in the ugandan part of Lake Victoria and the findings of the investigation can be described as "fishing for living to catch HIV" [21]. HIV/AIDS, drowning, Tuberculosis and malaria as major causes of mortality among Fishermen in Lake Victoria [14]. Consequently, there is need to establish statistical relationships between the risk factors that contribute to mortality among fishermen globally and specifically, Lake Victoria, Kenya.

2. Methodology

2.1. Area of Study

Lake Victoria is the second largest fresh water body after The Great Lakes of America, but the largest in Africa with an area of 69,000 km". The lake is shared by Tanzania (49%), Uganda (45%) and Kenya (6%). It is situated between 31° E and 35^{0}E longitude, ION and 3° S latitude. The Kenyan waters which is 4,128 km^2 extends from Sio Port in Busia County on the North through Bondo, Kisumu, Nyando, Rachuonyo, Homa Bay, Suba and Migori to the South. "The shoreline is approximately 400 km with 307 gazetted beaches [15]. It had a total of 23,000 fishing vessels with approximately 70,000 fishermen of whom 50% were not registered by the respective beaches in the year 2004 [16]. The riparian Counties had 4,436,093 people by the year 2009 [17]. The riparian Counties are inhabited by the Luhya tribe in Busia County to the north, Abasuba in Homa Bay County while the rest are occupied by Luo tribe. Figure 1 below shows the map of the area of study.

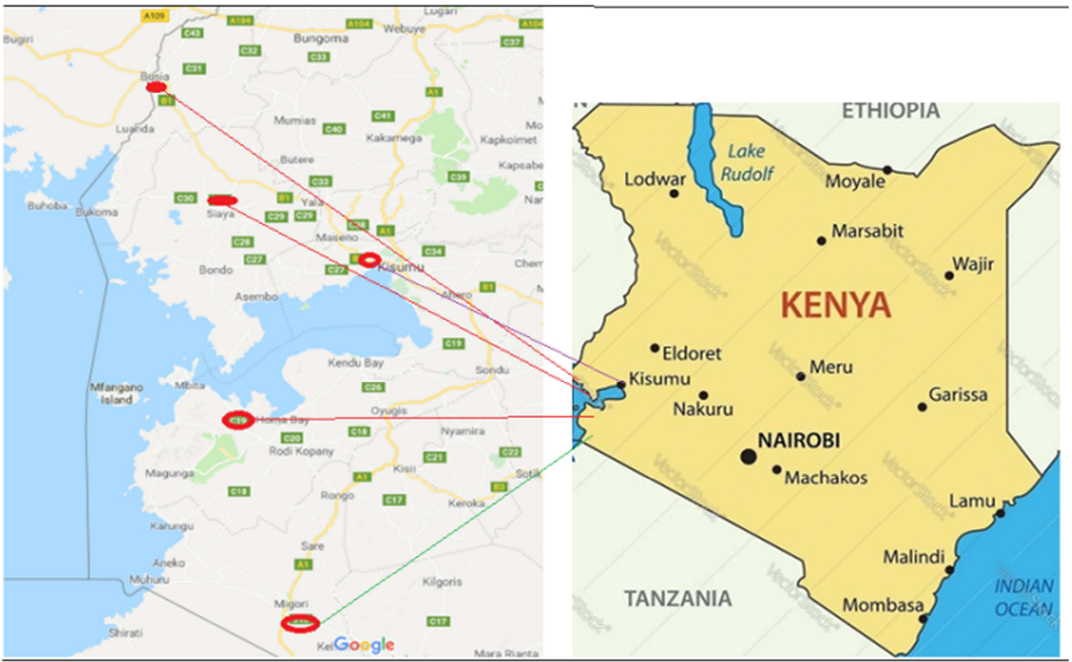

Figure 1. *Map of the area of study.*

2.2. Sampling Methods

2.2.1. Sampling of the Beaches

The study covered fishermen in the study area who worked in either of the beaches within the sub-counties between August 1998 to July 2000, and during which they met their deaths. selected sub-counties were included in the study to form clusters and to address possible variations of the risks and risk factors that contributed mortality among the fishermen. The number of gazette beaches and registration of vessels and fishermen per district guided the selection. Stratified sampling method using an interval of four beaches was used. The vessels where fishermen worked before death were identified through snow ball sampling, and random sampling using the registration numbers of boats in the sampled beaches. It is at this level that those who were close to the deceased were identified and interviewed.

2.2.2. Sample Size Calculation

Sample size was calculated according to the criteria given by [18].

Thus;

$$N = \frac{Z^2 pqD}{d^2}$$

Where:

N = Sample size

Z = Standard normal deviate (1.96 which correspond to 95% confidence, interval)

p = Proportion of the target population estimated to have particular characteristics. Since prevalence is unknown, therefore, 50% was used.

Q = l-p

d = Degree of accuracy (0.05).

D = Design effect = the 8 riparian districts

Therefore

$$N = \frac{1.96^2 \times 0.5 \times 0.5}{0.052} = 384.16$$

Approximately 400 respondents were interviewed for each riperian county by 2.5 field interviewers. Verbal autopsy questionnaires were issued to 6 research assistants per beach. The interviewers were identified through the beach leaders. The interviewers who were Form four leavers with a minimum qualification of Grade C were trained for two days by the researcher on how to conduct the verbal autopsy interviews. They were members of the community and were fluent in the local language, the first language of the interviewee. The training included: the use of appropriate vernacular, techniques of talking to the bereaved families and the implementation of the VA questionnaire. The team interviewed caretakers or close friends of the deceased fishermen. Once the deaths were reported to the researcher through the beach leaders, the researcher allocated the deaths to the VA team for follow up for detailed description of events surrounding the death in order to validate the event. Efforts were made to conduct the interviews within two years of the fisherman's death.

2.3. Ethical Consideration

Data security procedures to protect the identity of the deceased and the respondents were implemented during VA interviews. Respondents were fully informed of these confidentiality issues at the outset of the interview.

The respondents were given detailed description of study prior to commencement and it was explained to them that their participation was voluntary, and that no information given would be divulged to anyone other than the research staff. The interviewers were also trained on how to show empathy to the bereaved relatives during the interviews in order to reduce the level of stress as such interviews remind respondents of their departed loved ones. In the event of any signs of distress during the interview, the interviewers were instructed to refrain from further questioning and only proceeded if the respondent desired. The participants were also informed that there were no direct benefits from the study. Permission for the research was given by Ministries of Education, Science and Technology.

2.4. Verbal Autopsy

A modified version of Verbal Autopsy (VA) used [19]. The sections that were retained in the questionnaire included: demographic data of the deceased, circumstance of death, summary of the main sign 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 lifestyle, type of vessels, fishing gears and type of propulsion questions were included in the questionnaire after consulting with the Fisheries Department. The questionnaire was then translated into Luo and Bunyala. This paper focuses on the categorical outcomes of the VA data and their analysis..

2.5. Logistic Model

The probability of death (pi) is the dependent variable and thus predicted the likelihood of death having occurred due to a cause . The categorical outcomes were determined from results of verbal autopsy data by clinicians. The outcomes were deduced as to whether the death occurred or did not occur due to drowning, HIV related infections and malaria. The following concept was adopted from [20].

P= 1 (Death occurrence due to a certain cause), P= 0 (otherwise).

This was described as:

$$Pi = F (0 + iVi) + t$$

Pi is probability of death occurrence due to an independent variable

F is cumulative distribution function assuming normal distribution

Vi is the vector of independent variables

0 is the intercept

i are respective variable coefficients

The model that was used was specified as:

$$pi = 0 + 1Dr + 2HIV + 3Mal + t$$

Where

“Dr”, “HIV”, “Mal” are deaths due to drowning, HIV and Malaria respectively and 1, 2, 3 are variable coefficients 1, 2, 3 respectively.

3. Results and Discussion

3.1. Demographic and Socio-Economic Factors Associated with Cause-Specific Mortality Among Fishermen

Further analysis on the association between demographic and socio-economic factors related to cause-specific mortality was done using logistic regression. 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. On the other hand, PTB-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 l.3 - 2.1) and use of driftnet as fishing gear and schistosomiasis (OR: 3.6; 95% CI 2.0 - 6.8). The association between smoking and lung conditions (OR: 1.2; 95% CI 1.0 - 1.5) which included pneumonia, lung cancer, PTB and bronchitis was however weak (p = 0.07).

In logistic regression controlling for the Sub-County of residence, the odds of dying from HIV related infections among fishermen age 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. Again controlling for Sub-County of residence,

The odds of dying from other accidents which excluded drowning for the same age group was 1.4 times compared with the rest of the age groups. The odds increased by 0.2 when all accidents were included.

Table 1. *Logistic regression analysis of cause-specific mortality among fishermen in Lake Victoria by demographic and socio-economic characteristics.*

Outcome	Explanatory variable	Yes	No	%	OR	95% CI	P value
Malaria*	Night fishing	182	136	57.2	1.7	1.3 - 2.1	<0.0001
Schistosomiasis*	Driftnet	13	65	16.7	3.6	2.0 - 6.8	<0.0001
Lung conditions*	Smoking	247	145	63.0	1.2	1.0 - 1.5	0.07
HIV related infections#	Age group 20 - 34	521	513	50.4	0.8	0.7 -0.9	0.0025
Accidents excluding drowning#	Age group 20 - 34	81	49	62.3	1.4	1.0 - 2.1	0.05

Accidents/injuries Age group 359 208 63.3 1.6 1.4-2.0 <0.0001 # 20 - 34
* Controllmg for age.
# Controlling for Sub-County where death occurred.

3.2. Comparison of Deaths Attributed to HIV - Related Infections by Age Group Using Age Group 15 - 19 Years as Baseline

Compared with age group 15 - 19 years, which had the lowest proportion of deaths attributed to HIV related infections (24.6%), the odds of dying from the same infections was 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). Marginal significant differences were noted among fishermen aged between 30-39 and 50 - 54 years (P = 0.06). No significant difference in the odds of dying from HIV related infections was seen in the proportion of deaths among those aged 20- 24 and 25 - 29 years.

Table 2. *Logistic regression analysis of HIV -related infections as a cause of death among fishermen in Lake Victoria by age group.*

Explanatory variable*	OR	95% CI	p-value
20-24	1.2	0.8-2.0	0.428
25-29	1.5	0.9-2.3	0.108
30-34	1.6	1.0-2.5	0.065
35-39	1.6	1.0-2.6	0.057
40-44	2.3	1.4-3.7	0.001
45-49	1.9	1.2-3.2	0.010
50-54	1.6	1.0-2.7	0.061

3.3. Mortality Causes in Relation to County of Residence

The association between deaths attributed to HIV -related infections and County of residence

The study also examined the association between deaths attributed to HIV-related infections and the deceased fishermen's Sub-County of residence and hence the County of residence compared with the rest of the County. Busia (OR: 0.5; 95% CI 0.4 - 0.6) and Kisumu (OR: 0.6; 95% CI 0.5 - 0.8) Counties were both significantly associated with lower proportions of mortality due to HIV -related infections. Homa Bay (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, again controlling for age. No association was, however, noted in the remaining riparian counties.

Table 3. *Logistic regression analysis of HIV - related infections as a cause of death among fishermen by town of residence.*

Outcome	Explanatory variable	Yes	No	%	OR	95% CI	p value
HIV related infections	Budalangi	81	953	7.8	0.5	0.4-	<0.0001
HIV related infections	Bondo	140	894	13.5	1.1	0.9-1.4	0.3
HIV related infections	Kisumu East	100	934	9.7	0.6	0.5-0.8	<0.0001
HIV related infections	Nyando	120	914	11.6	0.9	0.7-1.1	0.3
HIV related infections	Rachuonyo	120	914	11.6	0.9	0.7-1.1	0.3
HIV related infections	Mbita	129	905	12.5	1.1	0.9-1.4	0.3
HIV related infections	Suba	170	864	16.4	2.0	1.5-2.4	<0.0001
HIV related infections	Migori	174	860	16.8	1.7	1.3-2.0	<0.0001

3.4. Risk Factors Associated with Drowning Among Fishermen in Riparian Sub-Counties Along Lake Victoria - Kenya

In a logistic regression model controlling for Sub-County, there was a significant (p < 0.0001) association between those aged 20 - 34 years and the attribution of cause of death to drowning. The odds of dying from drowning controlling for Sub-County of residence in boats being propelled by sail/paddle was 1.6 times higher than in other boats propelled by sails, paddles and outboard motors (OR: 1.6; 95% CI 1.3 - 2.0; p = < 0.0001). The odds of dying as a result of drowning, again controlling for Sub-County of residence, was however 30% lower in boats propelled by paddle alone. In a similar analysis but now controlling for age and Sub-County of residence, day fishing was significantly associated with drowning. Surprisingly, the study results revealed that secondary education after controlling for age and Sub-County, was an important risk factor in drowning (OR: 1.4; 95% CI 1.1 - 1.8). The results suggest that fishermen with secondary education may not have had enough time to master swimming and therefore more likely to drown. Further logistic regression analysis controlling for age revealed that the alcohol drinking was significantly associated with drowning (p = 0.001).

Table 4. *Logistic regression analysis on drowning among fishermen in riparian Sub-counties along Lake Victoria – Kenya.*

Outcome	Explanatory variable	Yes	No	%	OR	95%	CI	p value
Drowning*	Age group 20 - 34	278	159	63.6	1.6	1.3-	2.0	<0.0001
Drowning*	Paddle	197	240	45.1	0.7	0.6-	0.8	0.0003
Drowning*	Sail/Paddles	179	258	41.0	1.6	1.3-	2.0	<0.0001
Drowning#	Day fishing	228	209	52.2	1.6	1.3-	2.0	<0.0001
Drowning¢	Drinks alcohol	283	154	64.8	1.4	1.2-	1.8	0.0012

4. Conclusion

The findings of this study reveal that the major causes of death were: HIV - related infections (33.8%), drowning (14.3%), pulmonary tuberculosis (12.4%), and malaria (10.4%). Factors influencing HIV - related mortality were: age group (p = 0.0025), Counties of residence (Busia, Kisumu, Migori and Siaya) all of which had similar p value (0.0001). The risk factors associated with deaths due to drowning were: age group (p =<0.0001), use of a combination of sails and paddles (p = <0.0001), use of paddle (p = 0.0003), Secondary education (p = <0.0001) and drinking of alcohol (p = 0.0012). Consequently, it was concluded that the probability of death occurrence was closely related to HIV infections over the area of study.

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