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Comparative awareness on zoonoses between residents at the Human-Wildlife Interface Zone and inhabitants of the non-Wildlife areas of Meru County, Kenya

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ABSTRACT

Introduction: Zoonoses are infections transmitted from vertebrate animals to humans. Persons with low knowledge, exposure to wildlife or domestic animals are at risk of zoonoses. Research, surveillance and response through One Health framework is necessary for prevention. We compared the knowledge on zoonoses between residents at the wildlife-interface of Meru National Park, and non-wildlife areas of Tigania West Sub County, Meru Kenya.

Methods: Data were simultaneously collected using a structured questionnaire in both zones and compared. Descriptive statistics were used to summarize the data for differences between variables in the two areas.

Results: The non-wildlife zone residents of Tigania West Sub-County had statistically significantly better knowledge of zoonoses than their counterparts next to Meru National Park: χ^2 (1, N=525) =84.965, p< .001.

Conclusion: The scanty knowledge on zoonoses of residents of Igembe Central posed greater risk of zoonoses because their proximity to the wildlife conservancy. Awareness creation through one health strategy is necessary as a deterrent measure.

Introduction

A zoonosis is an infectious disease caused by a bacterium, parasite, a virus or a prion that has jumped from a non-human animal to a human[1]. Emergence of zoonotic diseases may result from environmental anthropogenic influence and factors such as human interaction with domestic animals and wildlife through trade, hunting and changes in agriculture and livestock keeping.[2] Climate change and destruction of wildlife habitat is the seventh known major cause of zoonotic diseases[3]. Spread of zoonoses is exacerbated by changes in intrinsic factors of hosts, pathogens and vectors, causing the spillover of zoonotic pathogens to human hosts.[4] Sixty-one per cent of the pathogens infecting man are of animal origin.[5]

Globally, morbidity and mortality from zoonotic diseases is estimated at one billion cases and millions of fatalities annually.[1] Close interaction with animals has been blamed on zoonoses. Bats

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for example often invade and live in houses and feed on fruits in human settlement areas due destruction of animal habitats.[6] This close proximity of bats to people is potentially dangerous. Bats are known to carry infectious agents capable of causing severe human diseases.[7] In fact the source of Corona Virus has been associated with bats.[8]

Previous studies have linked more than 200 RNA viruses to bats. This significant number of RNA viruses occur because of the viruses' adaptability to changing environmental conditions through higher genetic variability.[9]Apart from viral infections, bacterial zoonotic microorganisms are known to have emerged. Bartonellosis for instance, is a globally emerging zoonotic disease that has been identified in several domestic and wild animals including bats.[10] However, lack of awareness and failure to address human-animal conflicts in local communities has the most potential to cause zoonotic diseases[11]. In order to control zoonoses, there must be complete multidisciplinary approach which includes health education and community participation[12].

Zoonotic diseases occur in populations and places of low awareness and poor preventive and control measures.[12] Lack of awareness, combined with poverty, can lead to risky behavior resulting in vulnerability of populations to disease. Risky behaviours relate to unhygienic animal management and food consumption trends that put communities at risk of zoonoses.[12] Lack of awareness further leads to delayed assessment of the impact of diseases, untimely response and economic losses.[12]

Nevertheless, awareness in itself is not enough. People may still engage in risky behaviour despite awareness. During the Ebola outbreak in Congo for instance, communities knowledgeable of risks of infection through consumption and handling of carcasses of fruit bats, chimpanzees, gorillas, monkeys, forest antelopes or porcupines continued to feed on dead animals exacerbating the spread of Ebola.[12] In addition to awareness creation, intense continuous inter-disciplinary health education and empowerment is necessary to prevent and control zoonoses[12].

In spite of the foregoing, limited multi-disciplinary efforts including research and awareness creation useful in the detection, prevention and control of zoonoses globally, has not been given the attention it deserves.[13] In this regard, policymakers and stakeholders may not fully understand the social and environmental conditions that may fuel cross-species pathogen spill-over and transfer. This study compared the knowledge of zoonoses between people who live and experience risks at close proximity to wildlife on a daily basis and those who live far away from wildlife interface zones. The information would be useful in mitigating against risk to infection with regards to zoonoses.

Methodology

This was a comparative cross-sectional study of awareness of zoonoses between household members living at the Wildlife-Human settlement interface of Meru National Park and those living in the non-wildlife-human settlement areas of Tigania West Sub-County, Meru County, Kenya. The aim of the study was to compare the knowledge on zoonoses between the two populations and *establish their ability to recognize zoonoses which makes it easier to institute preventive measures.* The two study areas; Igembe Central and Tigania West Sub-Counties have similar climatic conditions and socio-economic conditions safe for Igembe Central's proximity to Meru National Park. A total of 276 and 256 households in Igembe Central Sub-County and Tigania West Sub-County respectively were interviewed.

A sample frame of the household heads in each of the locations was created from the Community Strategy Register of the Ministry of Health. The calculated samples were proportionately distributed to the population size of each village in the chosen study locations in each area. Systematic sampling was employed to identify households where the questionnaires were administered. Names of household heads and the information gathered through the questionnaire were kept anonymous.

Data were collected using structured demographic information questionnaire and analyzed using SPSS. Summaries were done through descriptive statistics and presented in tables and

Characteristic	Category	Igembe	Tigania
Gender	Female	90 (32.8%)	86 (34.3%)
	Male	184 (67.2%)	165 (65.7%)
Marital status	Single	23 (8.4%)	24 (9.6%)
	Married	216 (78.8%)	175 (69.7%)
	Widowed	10 (3.6%)	35 (13.9%)
	Divorced	25 (9.1%)	17 (6.8%)
Religion	Catholic	40 (14.6%)	155 (61.8%)
	Protestant	229 (83.6%)	69 (27.5%)
	Others	5 (1.8%)	27 (10.8%)
Education	No formal education	18 (6.6%)	44 (17.5%)
	Primary	199 (72.6%)	154 (61.4%)
	Secondary	46 (16.8%)	47 (18.7%)
	Post secondary	11 (4%)	6 (2.4%)
Occupation	Peasant	252 (92%)	222 (88.4%)
	Civil servant	3 (1.1%)	12 (4.8%)
	Entrepreneur	16 (5.8%)	9 (3.6%)
	Casual	3 (1.1%)	8 (3.2%)
Awareness on zoonoses	No	226 (82.5%)	110 (43.8%)
	Yes	48 (17.5%)	141 (56.2%)

Table 1: *Sociodemographic characteristics of the respondents in Igembe Central and Tigania West*

graphs. The hypothesis about the knowledge on zoonoses was tested using Chi square at 95% confidence level.

Results

A total of 274 and 251 were interviewed in Igembe Central and Tigania West respectively. In the two areas, more males 67% (n=184) and 65% (n=165) than females answered to the questionnaire in Igembe Central and Tigania West correspondingly. (See Table: 1). This was occasioned by cultural expectations where adult males must approve answering to any strangers before females and children in a homestead in the Meru community, where the study was conducted. Besides, most men were at home due to the Corona pandemic restrictions as most businesses had closed down.

Most of respondents were married in both areas 78.8% (n=216) and 69.7% (n=175) in Igembe Central and Tigania West respectively, as seen in Table: 1. However, 13.9% of respondents in Tigania West were widowed Compared to 3.6% in Igembe Central is indicated in Table: 1. This could

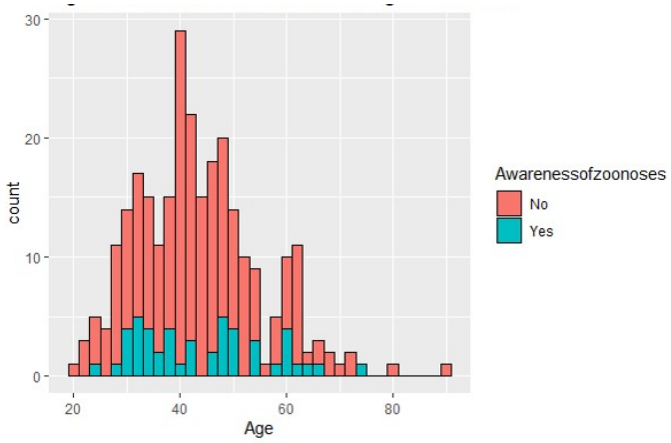

Figure 1: *Awareness of zoonoses in Igembe Central*

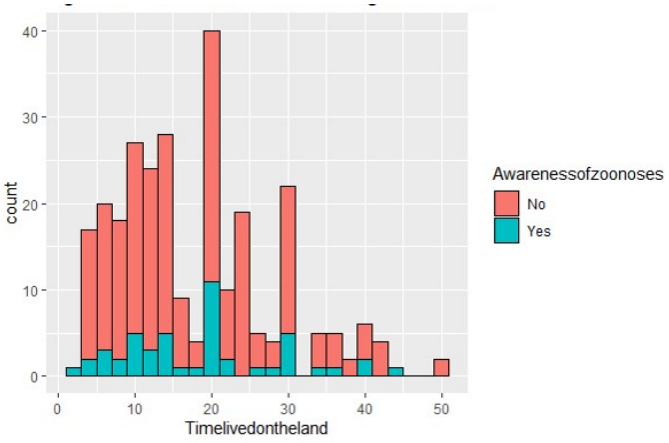

Figure 2: *Time lived on the land in Igembe Central*

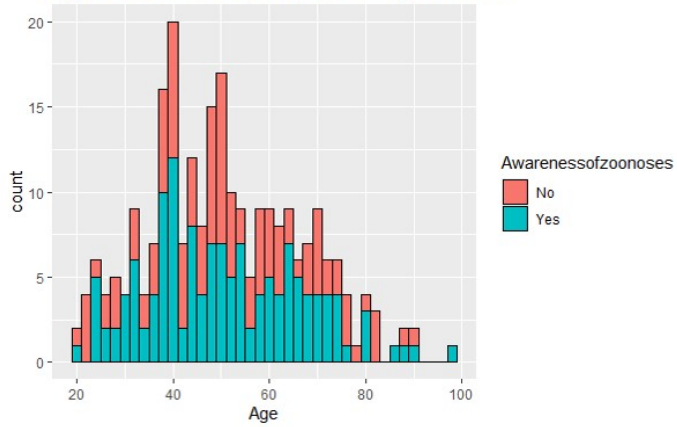

Figure 3: *Awareness of zoonoses in Tigania West*

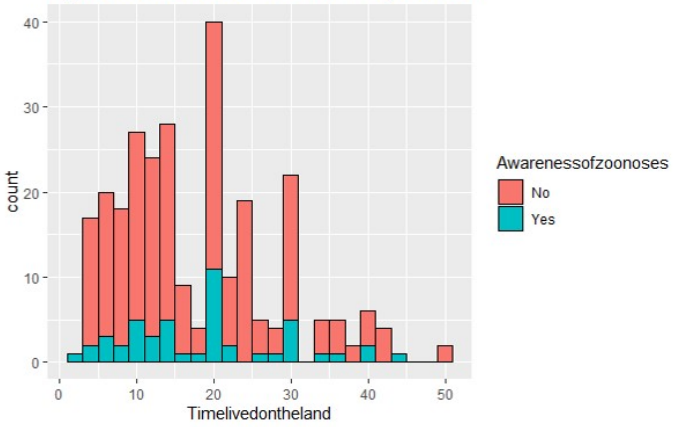

Figure 4: *Time lived on the land in Tigania West*

have been as a result of natural attrition of male spouses. Cpmaratively. Tiganaia West Sub County had older populations compared to Igembe Central.

Sub-County	Mean age of Respondent	Mean time lived on land	SD
Igembe Central	43.84	17.97	12.11
Tigania West	50.99	38.39	16.25

Table 2: *Age of respondent and time lived on current land*

Majority of those interviewed in the two areas were Christians. Nonetheless, respondents in Igambe Central were dominated by protestant Christian faithfuls at 83.6% (n=229), while most of the respondents in Tigania West were Christian Catholic believers at 61.8 % (n=155) as seen in Table:1. This can be explained by the location of Tigania Catholic Mission Parish within the Sub County.

More than two thirds of the interviewees in both
study areas were of primary level of education at 72.6% (n=274) and 61.4 (n=251) in Igembe Central and Tigania West sub counties respectively. Other levels of education tended to be low and the same in the two areas. (Refer to Table: 1). There was no statistically significant difference in the level of education between the two areas: χ^2 (3) = 17.15, p = 0.001. However, education attainment significantly differed between levels within the two areas: χ^2 (3) = 17.15, p = 0.001.

Almost all the respondents in the two areas were peasants at 92% (n=274) and 88.4% (n=251) in Igembe Central and Tigania West Sub-Counties respectively (See Table: 1).

The proportions of the respondents who were aware of zoonoses in Tigania West was 56.2% (n=251) and 17.5% (n=274) in Igembe Central respectively (Table 1). Knowledge on zoonoses differed significantly between the two areas χ^2 *(1, N=525) =84.965, p< .001*

Age of the respondent and time lived on the land were positively but not strongly associated with awareness on zoonoses p= -.027 and p= .023 respectively (Figure; 1 2, 3 and 4), OR = 1.038 (1.008, 1.0380) correspondingly.

On average, the residents of Tigania West relatively comprised of older populations. The mean age was 50.99 (SD 16.25) years.

Discussion

Approximately 8% of the Kenya's land mass is earmarked and protected for wildlife conservation. The protected zones comprise of various ecosystems namely: forests, wetlands and savannah, marine, arid and semi-arid lands. These ecosystems are demarcated into 23 terrestrial National Parks, 28 terrestrial National Reserves, 4 Marine National Parks, 6 Marine National Reserves and 4 National Sanctuaries.[14]

This study was done at the brink of Meru National Park, a place characterized by Savana type of ecosystem, typical of wildlife conservancy environments in Kenya[15]. The residents of Igembe Central at the wildlife-human interface zone comprised of households whose mean age was 43.84 (SD 12.11) years and had lived on their land for a mean period of 17.97 (SD 10.09) years. On the other hand, the mean age of the inhabitants of Tigania West was 50.99 (SD 16.25) who had lived

in their current pieces of land for a period of 38.39 (SD 20.30) years (Table 2). The residents of Tigania West had lived longer in their settlements and had better knowledge of zoonoses (Figure 3).

Igembe Central therefore, is a relatively new settlement area at the foot of Nyambene Range on the lower Nothern side. Tigania west is situated on the North-Western part of Nyambene Hills. The inhabitants at the human-wildlife interface zone of Igembe Central were mainly immigrants of the upper zones of Igembe Sub County or other parts of Meru County. The Sub Counties of Igembe Central and Tigania West enjoy similar climatic conditions and border Isiolo County to the North.

The upper zones of Igembe Central have better climatic conditions characterized by deep fertile volcanic soils and bimodal pattern of adequate rainfall to support agriculture and dairy production. However, agricultural land has been diminishing in size over the years. This probably led to migration of people towards the National Park where there were unoccupied larger tracts of land suitable for agriculture and livestock keeping.

This finding is consistent with a study done in Nepal.[13] Occupation of land next to the wild life conservancies creates greater interaction with wildlife and constitutes higher risk of zoonoses to the residents[16]. The movement of the residents into the new settlements is an illustration of human encroachment into wildlife conservation environments which results to human-wildlife conflicts and possible spillover of zoonoses[17]. There is a likelihood of occurrence of these phenomena in this area, and thus surveillance is a necessity.

The study reported human-wildlife traffic in and out of the park during certain times of the year and season. Broken fences in the park fueled animal movements into community land while human illegal activities in the park exacerbated human traffic into and out of the park. This was caused by decrease of pasture and water for wildlife in the park. Human movement into the park resulted from illegal hunting for game meat and livestock grazing.

There was no significant difference on gender, marital status, religion, education, and occupation with regard to proximity to the park and knowledge on zoonosis:

The study compared the awareness of zoonoses between residents of Igembe Central Sub-County at the wildlife-human interface and residents of non-wildlife-human interface of Tigania West Sub-County. The study found low awareness of zoonoses in Igembe Central at 17.5% (n=274) compared to their non-wildlife-human zone counterparts of Tigania West at 56.2% (n=251). The residents of Tigania West had significantly better knowledge of zoonoses than Igembe Central residents χ^2 *(1, N=525) =84.965, p< .00001.* This was irrespective of Igembe Central peasants' closer proximity to the park and existing human-wildlife conflicts, posing greater risk of zoonoses. Overall, there was no association between formal education and awareness on zoonosis.

The few who hand knowledge on zoonoses in Igembe Central were aware of anthrax, T.B and brucellosis. However, they had scanty knowledge on the correct modes of transmission of the diseases. The most common method of transmission reported was ingestion of animal products at 4.4% (n=274), compared to 0.4% and 0.7% for contact with bodily fluids and direct contact respectively

Despite negligible knowledge on zoonoses, in Igembe Central, the respondents of that area bordered the park at a distance of 1km to 10 km away. Majority used their land for farming and livestock keeping. The residents who kept livestock were exposed to more daily risk of zoonoses at the human-wildlife interface of Meru National Park than their colleagues in Tigania West.

This study is consistent with the findings of low knowledge on zoonoses found among small scale farmers at the livestock-wildlife-human interfaces in Nepal and Uganda.[13,18] It also agrees with the findings of low knowledge of 12% on zoonoses among cat and dog owners in Qatar.[19] Zoonotic diseases tend to occur in places of low awareness of the disease where poor prevention and control measures are employed.[20] The study also corroborates the findings of another in Ethiopa where substantial knowledge gaps and low level of the desired attitude with regards to zoonotic diseases were found. The same consistency was

reported in Nigeria and Ghana among dog and cat owners.[21–24] However, the study contradicts the findings on awareness, knowledge, and risks of zoonotic diseases among livestock farmers in Punjab which found 92.4% of livestock farmers aware of zoonotic diseases.[25]

Most wildlife ecosystems are protected by the government. Despite restrictions into wildlife conservancies, a lot of Kenya's wild animals may be found outside the protected areas.[15] Our study found that herbivore wildlife moved in and out of Meru National Park in search of food and water, although it is a protected zone. Herbivores were reported to have destroyed crops and predator carnivores killed and fed on livestock outside of the park in the villages. This may enhance the transmission of zoonoses, yet people are not largely aware. These findings agree with the results of another study done in Kajiado Kenya, on Human-wildlife conflicts.[26] Seasonal variations may aggravate an already worse situation. Storm water and wet conditions result in increased storm water runoff. Such is likely to contaminate unprotected water sources with infective parasites and zoonotic disease causal organisms. The risk of transmission of Zoonoses is higher in populations that are unaware of the diseases.[20]

Movements in and out of wildlife conservancies carry zoonotic disease transmission risks in both directions. We recommend awareness creation in order to prevent and control zoonoses as observed in other studies.[20]

The study reported human-wildlife interactions. Respondents gave information on crop damage, killing of livestock by predators and illegal hunting for game meat. Charcoal burning, fetching of firewood in the park and loss of human life. Our study agrees with others where similar incidents happened around wildlife conservancies[27,28]. These interactions may enhance transmission of zoonotic diseases.

Zoonotic diseases are common in Kenya. Between August 2016 and October 2020, a total of 55 unique events related to anthrax, RVF, and rabies were identified through research.[29] Sub Saharan African countries reported rabies and Highly Pathogenic Avian Influenza (HPAI), anthrax and brucellosis as prevalent in that order, but in the same region, response score to zoonoses was very low.[30]

Conclusion

This study reports low knowledge of zoonoses among peasant residents with close proximity to wildlife conservancy of Meru National Park in comparison to their counterparts in the non-human-wildlife zone of Tigania West Meru County, Kenya. This may enhance the potential of spillover of zoonotic causal agents from wildlife to humans and vice vasa. It calls for one health collaborative efforts to avoid suboptimal healthy status in humans, animals and the environment.

Authors' contributions: *GM conceived and wrote the study proposal and acquired funding, collected the data and wrote the manuscript. IM carried out the data analysis. CK supervised data collection, reviewed did referencing of the manuscript. A N guided and reviewed the manuscript for publication.*

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Competing interests: *None declared.*

Ethical approval: *Ethical clearance was obtained from Meru University of Science and Technology Institutional Ethical Review Committee (MIRERC)*

Data availability: *The dataset for this study is available on request*

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