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# The Knowledge about the Potential Health Risks of Illegal Bushmeat Activities among Local Communities Adjacent to Western Nyerere National Park, Tanzania

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## Abstract

Establishing knowledge of local communities regarding the potential health risks of illegal bushmeat hunting and its related practices is among the essential means to developing effective conservation and public health programs. To reveal the understanding of the local people regarding the potential health risks of bushmeat consumption and handling of wildlife products, we used a semi-structured questionnaire to survey 261 households in eight villages located adjacent to the western part of Nyerere National Park. Also, we interviewed eight key informants, including conservation personnel and veterinary officers, in the study area. The proportion of local people who were unaware that handling of wildlife products and bushmeat consumption were risky behaviours towards acquiring zoonotic diseases was slightly higher (57%) than the proportion of respondents who were aware of the likely risks of zoonotic diseases from the practices. After all, the majority (83%) of local people admitted having come into contact with wildlife products, while over 70% reported having consumed bushmeat. We found that local communities living closer to the park boundaries (<15 km) have a higher likelihood of contacting wildlife products, and that community members who have lived in the area for more than ten years have experienced more contact with wildlife products than immigrants. Moreover, the age of inhabitants and length of stay were found to be the most significant factors in determining the likelihood of bushmeat consumption. Most people seemed to prefer bushmeat to

domestic meat, arguing that bushmeat is far more flavorful, tender, not tainted with chemicals, and has less fat, making it safer. Our study demonstrated that local communities participate in risky practices without contemplating the health consequences that could emerge should a zoonotic disease outbreak occur. Among other strategies, we recommended conservation and public health institutions to increase awareness campaigns on the possible health risks of zoonotic diseases associated with wildlife.

## Keywords

Local Communities, Bushmeat Consumption, Wildlife Products, Zoonotic Diseases, Awareness

## 1. Introduction

The consequences of illegal bushmeat hunting and trade extend beyond the ecological and socioeconomic zones of biodiversity conservation [1], and it has been well documented that increased human interaction with wild animals through illegal hunting and bushmeat trade is one of the factors that increases the risks of zoonotic transmission to humans [2] [3] [4]. While disease prevalence is more likely in tropical locations with rich biodiversity [5] [6], the socioeconomic effects are far-reaching. Wildlife-borne zoonotic infections are known to threaten health of the public as well as the economy on a local and worldwide scale [7] [8] [9].

In Tanzania, the potential health risks due to pathogenic diseases derived from wildlife are as relevant as in other parts of the world [10]. This is justified by the substantial number of studies in parts of the country that indicate the presence of pathogens derived from wildlife products, including bushmeat [11] [12] [13] [14]. The possibilities of contacting zoonosis are further evidenced by continuous social and cultural behaviours that are also connected to zoonosis [15] [16] [17]. Yet, most of the local communities still engage in unlawful bushmeat hunting [18], without realizing that such practices may increase the chances of contacting zoonosis [3] [19].

So far, various studies have acknowledged the issue of zoonosis and call for research study to explore the knowledge of local people about diseases linked to wildlife [2] [20]. It has been shown that understanding people's knowledge is critical for developing effective measures to limit the spread of zoonosis [21]. Moreover, [22] [23] emphasized that the knowledge gap should also include socio-demographic characteristics as it is essential to know the area of concentration during the design of an awareness program. While the anticipated health consequences connected with illicit bushmeat have been recorded [24] [25] [26], data on people's understanding of zoonotic diseases is sparse among community members adjacent to Nyerere National Park, Tanzania.

Therefore, the present study assessed the knowledge of zoonosis from local

communities bordering the western part of the Nyerere National Park (WNNP). We anticipated that the findings of this study will contribute towards developing the conservation and public health interventions to address the issues of zoonosis as well as reducing the negative impacts associated with illegal bushmeat hunting and trade. Specifically, the study assessed 1) the knowledge of local communities regarding the zoonotic diseases originating from wild animals 2) the extent to which local communities consume bushmeat and/or contact with wildlife products 3) the preference behavior towards bushmeat consumption 4) the demographic and spatial factors influencing variation of local communities' responses concerning the activities related to handling of wildlife products and bushmeat consumption.

## 2. Materials and Method

### 2.1. Study Area

Nyerere National Park (NNP) is located between 7.75˚S and 10.5˚S and between 36.0˚E and 38.7˚E (Figure 1). The park was formed after the Selous Game Reserve (SGR) was divided into two parts, one part retaining the name of SGR while the second largest part was re-named "Nyerere National Park". Administratively,
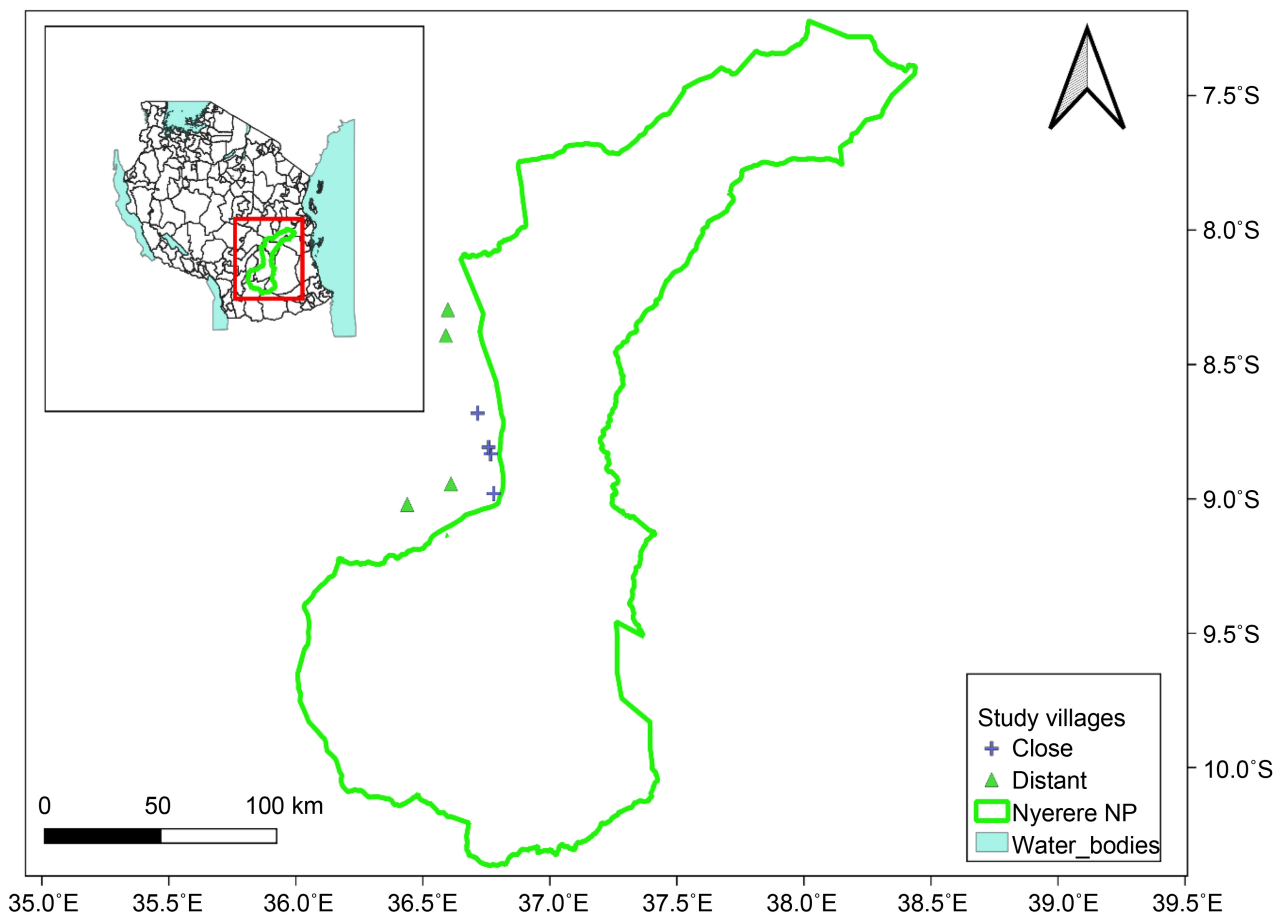


**Figure 1.** Map showing location of Nyerere National Park and the adjacent villages where this study was conducted.

the park is bordered by Mikumi National and Udzungwa Mountains National Parks, Kilombero Game Controlled Area (KGCA), wildlife management areas, and open areas [27]. The NNP is currently the largest national park in Africa with an area of 30,893 km$^2$ [28] and holds a variety of wild animal species in comparatively large numbers, such as the African Savanna elephant *Loxodonta africana*, African Cape buffalo *Syncerus caffer*, Hippopotamus *Hippopotamus amphibius*, a variety of antelopes, an endangered African wild dog (*Lycaon pictus*) and several other predators [29]. The area consists of extensive miombo woodland dominated by *Brachystegia spp*, *Julbernadia spp*, *Isoberlinia spp*, *Afzelia quanzensis* and *Pterocarpus angolensis*.

This study was conducted in eight villages around the western part of the park, henceforth referred to as Western Nyerere National Park (WNNP). The selected study villages are located within the Ulanga District and border other protected areas including Iluma Wildlife Management Area and Kilombero Game-Controlled Area. The area consists of multi-ethnic groups with the Pogoro tribe being the major ethnic group [30]. The ecosystem encompassing the study area also has historic records of diseases affecting both humans and wild animals such as *Anthrax* [31]. The villages were purposively selected based on their proximity (close/far) to Nyerere National Park and occurrences of illegal bushmeat activities. The names of villages were anonymized to ensure that respondents remain unknown as information was gathered on the basis of illegal bushmeat practices in the area.

## 2.2. Sampling Design

We employed purposive sampling to select four villages less than fifteen kilometres (close villages) and the other four villages located greater than fifteen kilometres (far) from the boundaries of WNNP. Preliminary information received from anti-poaching officers was also used to choose the villages. As a result, in addition to selecting villages based on their closeness to protected areas, we also considered that the selected villages experience illicit bushmeat hunting and trade activities. We selected households randomly from the village's register records using online random number generator [32].

## 2.3. Data Collection

The data were collected from January to March, 2020 through semi-structured questionnaires administered to household respondents, and semi-structured interviews (with the aid of interview guide) that were administered to key informants. However, prior to data collection, we pre-tested our research instrument to respondents from two villages that were not included in the sampled villages. Pre-testing involved 32 respondents to ensure that our research tool for households addresses all questions as required [33]. During the main survey, a total of 261 household respondents (≥18 years old, and three-quarters being males) were reached during the household survey. Also, we interviewed eight key informants,

including District Livestock Officers (02), District Game Officer (01), and conservation personnel (05) from the wildlife management area in order to gain insight into the current and historical background of zoonotic as well as conservation and health-related issues. All surveys were conducted with the informed consent form and respondents were assured of anonymity and confidentiality. The questionnaires were prepared in English and then translated into the national language *i.e.*, Swahili.

The semi-structured questionnaire was employed to 137 and 124 respondents from four villages located near (<15 km) and other four villages located far (>15 km) from WNNP, respectively. To ensure that respondents were comfortable answering questions, we slowly introduced questions related to illegal bushmeat practices. Thus, the first part of the questionnaire collected basic information concerning the socio-demographic properties of the respondents (gender, age, ethnicity, period of residence, level of education and occupation). The second part of the questionnaire explored information on the practices and behavioral risks exposing respondents to possible zoonosis. We asked respondents to state if they experienced any contacts with wild animals and/or their products (bushmeat, skin, blood, carcass etc.) Also, respondents were asked to state if they had consumed bushmeat. For those who reported to consume bushmeat, we asked them about their protein consumption preferences (bushmeat vs domestic meat) and the likely reason for their choice. We then explored the knowledge of the respondents regarding the chance of getting zoonosis through bushmeat consumption and/or handling of wildlife products. Furthermore, we conducted a semi-structured interview with conservation officials to gather information related to conservation and public health programs, if any. Additionally, we obtained secondary data on the zoonotic cases from the district medical records.

### 2.4. Data Analysis

We compiled data in Microsoft Excel and conducted a statistical analysis using R software [34]. We used the 2 test to assess the differences in the number of respondents regarding the; knowledge concerning the likelihood of getting zoonosis through handling of wildlife products and bushmeat consumption, the extent to which local people contact wildlife products and/or consume bushmeat, and bushmeat preferences to domestic meat. Also, we employed a Generalized Linear Model (GLM) with binomial error distribution to assess how distance from the park boundary affected response probabilities of local communities who responded either "Yes" or "No" based on bushmeat consumption, preference, and handling of wildlife products. Moreover, we performed GLM binomial model to determine important demographic factors influencing respondents' responses towards handling of wildlife products and/or bushmeat consumption. The explanatory variables included in the model were age, residence period, education level, gender, household size, and park proximity (close, far). All GLM binomial models were performed by selecting the family of binomial model distribution.

In the GLM, the binomial model that involved multiple demographic factors, step Akaike Information Criterion (AIC) function from the MASS package was used to determine adequate or final model that was plausible (<4 delta AIC) and had the lowest AIC score.

## 3. Results

### 3.1. Knowledge of Local Communities on Zoonotic Diseases

About 57 percent of local communities were not aware of the possibility of getting zoonotic diseases from consumption of bushmeat and/or handling of wildlife products. However, such difference was not statistically significant among respondents (2 = 2.0164, df = 1, p = 0.1556). When we assessed differences in terms of knowledge of zoonosis based on the proximity to the park boundary, there was no significant difference between local communities living closer (<15 km) and those living far (>15 km) from the park boundary (GLM, Estimate = 0.1122 ± 0.2504 SE, Z = 0.448, p = 0.654). Additionally, according to District Livestock Officer, rabies, brucellosis and anthrax are among zoonotic diseases often recorded in the villages. The occurrence of zoonosis particularly anthrax was also supported by conservation officials of the study area. Furthermore, key informants reported that most of the conservation programs adjacent to western Nyerere National Park were mainly conducted to raise awareness on issues pertaining to the benefits accrued from conservation, and wildlife laws.

### 3.2. Extent of Local Communities Contacting Wildlife Products

There was a significant high proportion (83%, 2 = 43.56, df = 1, p < 0.0001) of respondents who had contacted wildlife products (**Figure 2(a)**) or had consumed bushmeat (79%, 2 = 33.64, df = 1, p < 0.0001, **Figure 2(b)**). When assessed in
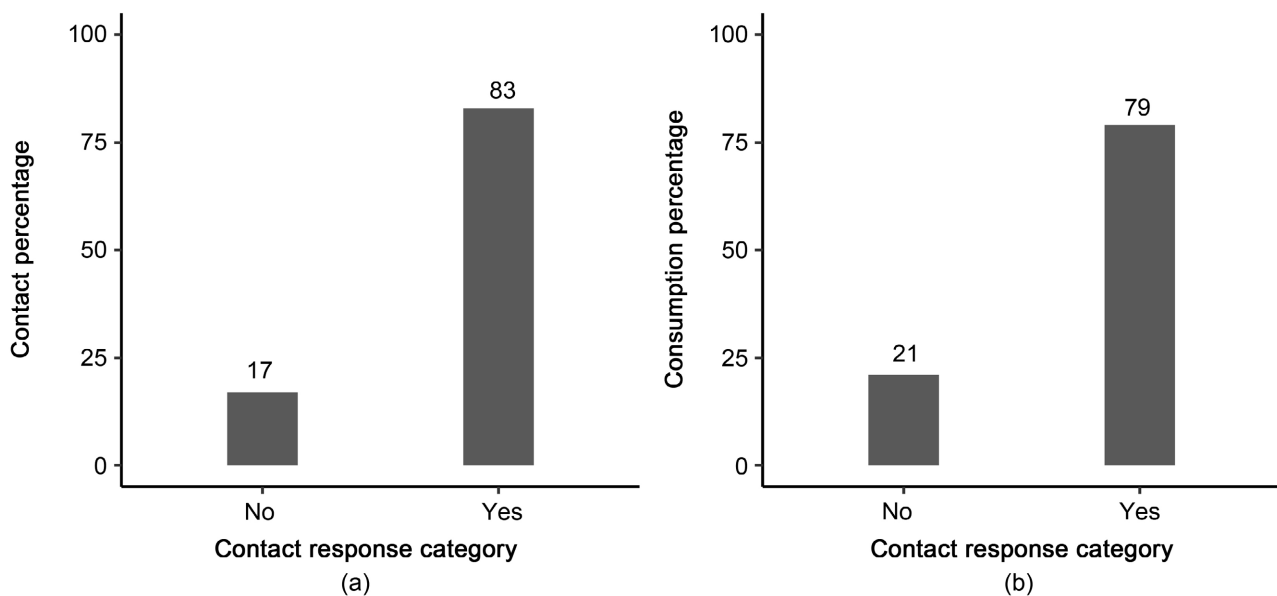


**Figure 2.** Proportion of local community that had contacted wildlife products (a) or consumed bushmeat (b).

relation to park proximity, the study found a marginal significant decrease of contact probability with an increase of distance from park boundary (GLM, Estimate = −0.7532 ± 0.3856SE, Z = −1.953, p = 0.051, **Figure 3(a)**), while no significant difference was revealed in relation to bushmeat consumption (GLM, Estimate = −0.4072 ± 0.3074SE, Z = −1.325, p = 0.185, **Figure 3(b)**).

### 3.3. Local Communities' Meat Preference

There was a significant difference of respondents' frequency proportions towards protein preference (2 = 58.95, df = 2, p < 0.0001). About 70 percent (n = 183) of local communities preferred bushmeat to domestic meat (**Figure 4**).
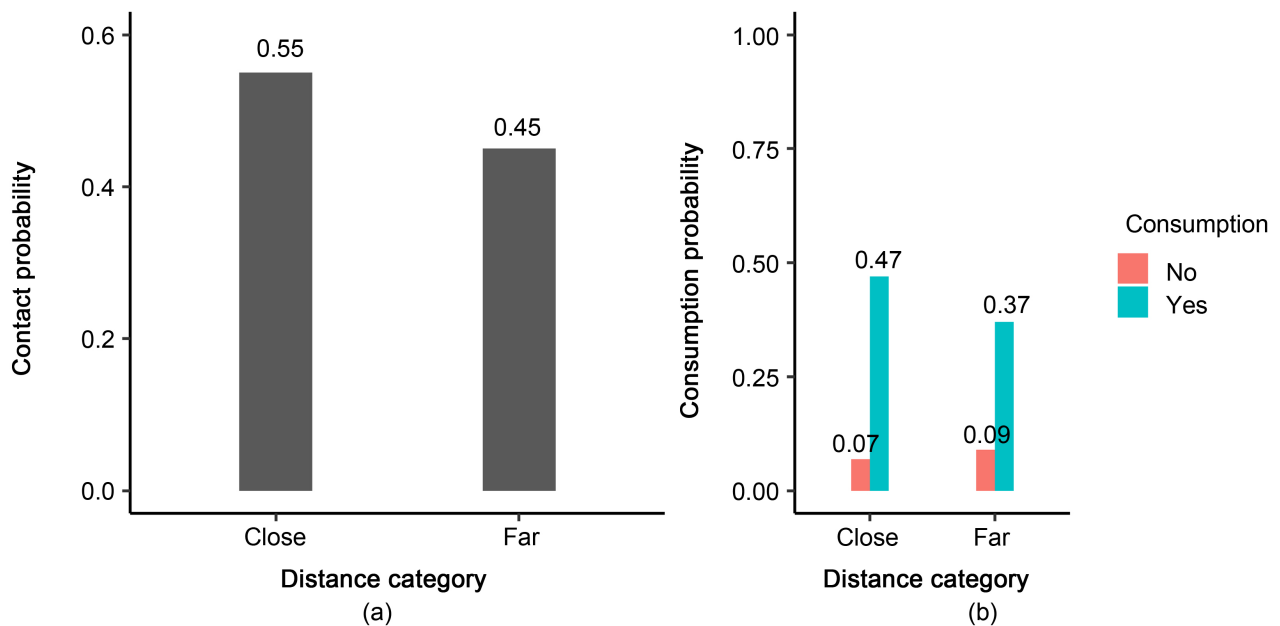


**Figure 3.** Relationships between contact probability of local community to contact wildlife products (a) or consume bushmeat (b) with the distance from the park boundary.
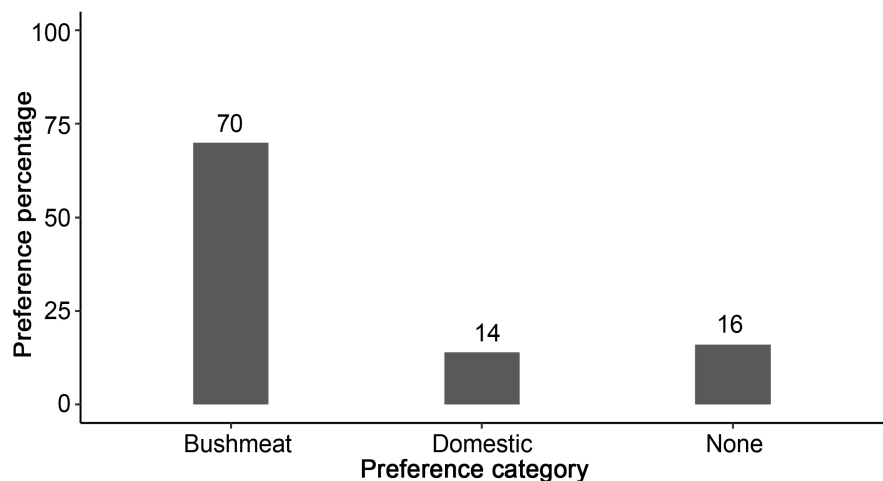


**Figure 4.** Proportion of frequencies of local community showing the preference to bushmeat, domestic meat or none.

Respondents who showed preference to bushmeat argued that the meat; has good taste, contains high nutrients, has a medicinal effect, not induced with any chemical, soft and free of diseases. When bushmeat preference was assessed in relation to park proximity, the difference was not statistically significant between the villages located closer to, and those distant from the park boundary (GLM, Estimate = −0.0448 ± 0.3438SE, Z = −0.130, p = 0.8963), suggesting that bushmeat consumption is wide spread irrespective of distance gradient to source.

### 3.4. Demographic and Spatial Factors Influencing Contact or Bushmeat Consumption of Wildlife Products

The final model for the factors influencing local communities' response variation over the contacts with wildlife products revealed that residence period was only a significant factor that influenced respondents' behavior. Local residents were more likely to have contacted wildlife products than immigrants (GLM, Estimate = 1.868 ± 0.566SE, Z = 3.299, p = 0.0009, Figure 5). Furthermore, the final model for factors determining the rate of bushmeat consumption among local people revealed that age and residence were the most significant factors. It appeared that the likelihood for respondents to consume bushmeat increased with an increase of age (GLM, Estimate = 0.0585 ± 0.0208 SE, Z = 2.815, p = 0.0049, Figure 6(a)) and that residents were more likely to consume bushmeat than immigrants (GLM, Estimate = 1.5583 ± 0.5929 SE, Z = 2.628, p = 0.0086, Figure 6(b)).

## 4. Discussion

Results of the current study demonstrated that a slightly higher proportion (57%) of local people were unaware of potential health risks associated with bushmeat consumption and handling of wildlife products, and that the likelihood of people contacting wildlife products is higher for communities living close to park boundaries. This means a high chance of zoonotic spill-over in the
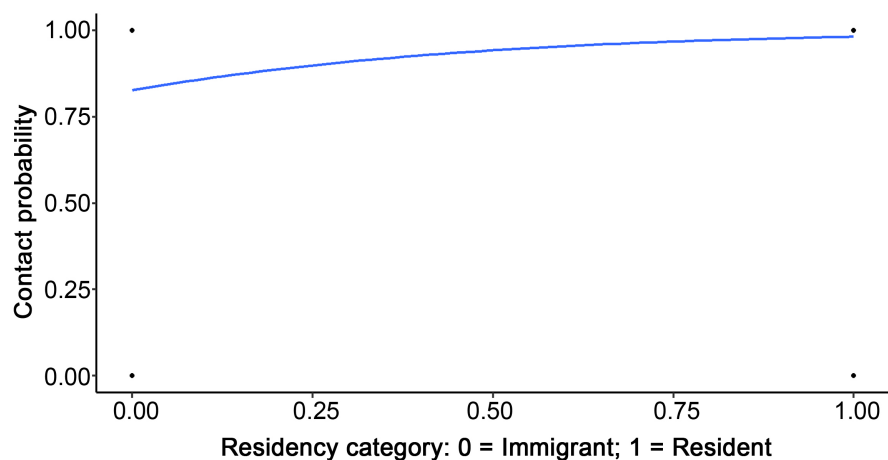
**Figure 5.** Relationships between local community probability of contacting wildlife products with the respondent residence time.
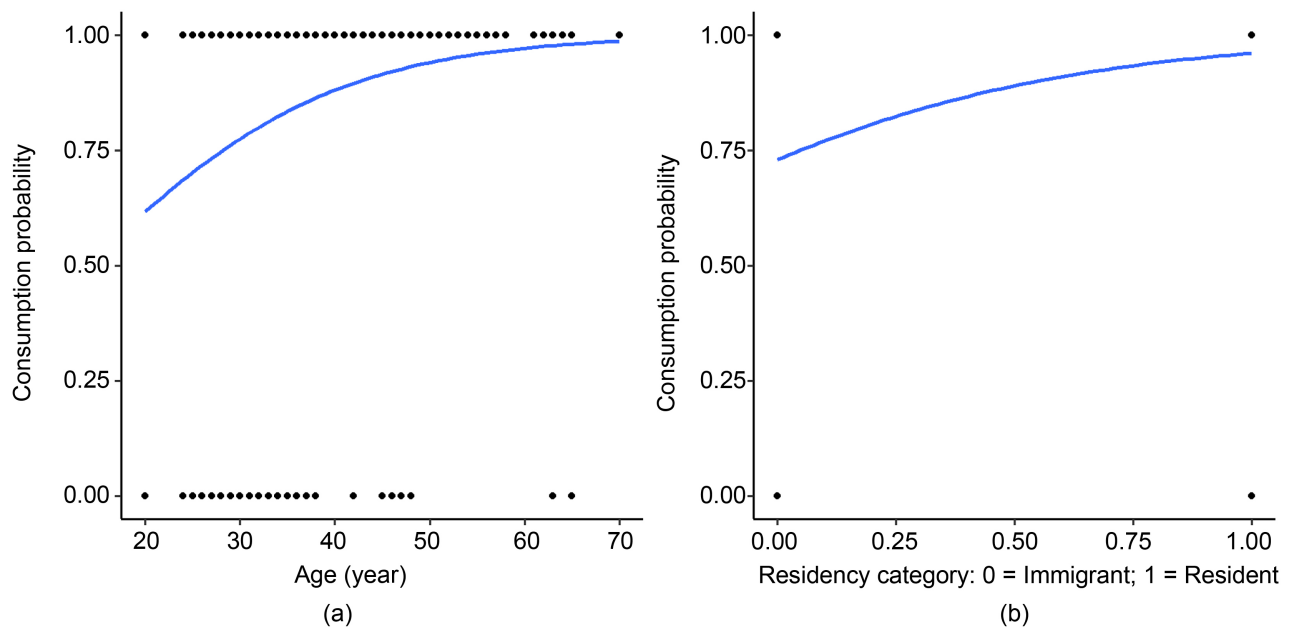
**Figure 6.** Relationships between local community probability of bushmeat consumption with the respondent age (a) and residence (b).

villages if an outbreak occurs because of the risky behavioural practices among respondents. Moreover, it appeared that local residents >40 years of age were at higher risk of getting zoonotic disease through bush-bushmeat consumption.

### 4.1. Knowledge of Possibilities of Wildlife Zoonotic Infections

Our findings revealed a mixed proportion of local people regarding zoonotic diseases originating from wildlife, whereby nearly half of them were aware of the chance of getting zoonotic diseases through bushmeat consumption and handling of wildlife products, and the other group unaware of any such concerns. This is in contrary to other research findings in which the majority of the local people were ignorant of the potential risks of zoonotic disease [35] [36]. Despite our findings indicating the existence of knowledge among local community members about potential health risks associated with bushmeat, further measures should be taken to increase awareness. This is signified by district records in the study area, which document livestock and human cases of diseases associated with wildlife. Awareness raising about such diseases should be an ongoing process as the study area is also recognized to be a stretch of re-emerging zoonosis [37].

### 4.2. Extent of Contacting or Consuming Wildlife Products

Our research found that a large proportion of local communities (approximately 80%) consumed bushmeat and have contact with wild animal products. According to research studies, various actions that bring humans into contact with wildlife products may trigger zoonotic transmission [2] [9] [21] [38]. The fact that significant number of local people experience contact with wildlife products

such as blood, carcasses, skin, tails, and feces imply that they are at risk of contracting zoonotic diseases. On the other hand, we found that local communities residing near park boundaries were more likely to come into contact with wildlife products and consequently get zoonotic infections than those located far away. These findings support [39] [40] who found similar behaviour among local communities living close to parts of the Rungwa-Katavi ecosystem and the western part of Serengeti National Park, respectively. Interestingly, our studies also revealed that the level to which locals consume bushmeat is consistent independent of distance from park boundaries. This implies that despite higher contact probability for communities living near the park perimeter, bushmeat consumption covers a large area. This signals that remote groups could as well be infected through bushmeat consumption in the event of an outbreak. Overall, our findings regarding bushmeat consumption and the handling of wildlife products are indicative of local community engagement in risky health practices that may trigger zoonotic transmission. In this particular concern, it is essential for conservation and public health programs to increase awareness in the community by emphasizing how interaction with wild animal products through handling and consumption of unlawful bushmeat may be detrimental to human health.

### 4.3. Meat Preference by Local Communities

Our findings showed that local communities preferred bushmeat to domestic meat. Other research studies [41] [42] [43] demonstrated comparable preference behaviour among groups. It has been well documented that consumption of bushmeat increases the chances of pathogenic transmission of zoonotic diseases [3] [16] [23] [44] [45]. Apparently, most local people felt that because wild animals live in their natural environment and were not vaccinated, they were disease-free and hence safe to consume. Such an incorrect notion about the safety of bushmeat assumes that locals will continue to consume it despite being aware of its possible health concerns. This misunderstanding may enhance bushmeat preference behavior and hamper efforts to reduce unlawful bushmeat eating. Therefore, along with other approaches such as diversifying sources for acquiring proteins and income [46] [47] [48], we encourage conservation effort to focus on transforming people's behaviour towards bushmeat preference and consumption. This might be efficiently accomplished by collaborating with public health institutions during conservation awareness initiatives.

### 4.4. Demographic and Spatial Distance Factors Influencing Respondents' Behaviour

Our study demonstrated that local people who have lived in the village for more than ten years had a higher a higher contact probability with wildlife products than immigrants. Similarly, we found that both residents and adults aged 40 years and above were more likely to have consumed bushmeat. The higher contact probability and bushmeat consumption among residents and adults could

indicate that they are the ones who regularly engage in bushmeat-related activities engage in activities. Our findings, however, suggest that public health efforts aimed at raising zoonotic disease knowledge should place a greater emphasis on residents and adults, since they may have a greater influence on bushmeat intake. Targeting a specific group has been shown to be one of the most effective ways for combating zoonotic concerns [36] [49] [50].

## 5. Conclusion

The present study revealed that local people adjacent to Western Nyerere National Park are more likely to be infected with zoonotic pathogens through bushmeat consumption and/or handling of wildlife products. Nevertheless, the chance seems to be higher among adults >40 years of age. Designing public health programs to ensure that residents, mostly adults are well informed on the likely risks of zoonosis could be among effective means to increase knowledge and awareness and subsequently reduce the likely risks in the future.

## 6. Recommendations

Firstly, improving conservation education programs through introducing issues related to zoonotic disease. This might be accomplished by undertakings awareness campaigns that focus on alerting people regarding the potential health risks related to the handling of wildlife and consumption of bushmeat originating from illegal or uncertain sources. However, we further recommend that the conservation authorities of the area also involve personnel from public health institutions during their awareness campaigns to ensure that the issue of zoonotic disease is addressed accordingly.

Secondly, given the current global concern about the potential health risks posed by wildlife, Tanzania's education curricula should be revised and improved such that zoonotic diseases are covered beginning in primary school. This will help to raise people's understanding and awareness, regardless of how distant their villages are from the park's boundaries.

Thirdly, enhancing public health knowledge with the goal of transforming people's habits and beliefs regarding bushmeat consumption and preference behaviour should be made a pertinent agenda. It has been noted from our findings and other literature that people prefer bushmeat because of the belief that "wild animals are safer than domestic animals since they live in an uncontaminated environment." This notion may be misleading and encourage people to consume bushmeat in spite of the known possible human health consequences. Thus, alerting people to the potential risks associated with wild meat might be an effective means to reduce consumption and preference.

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## Authors Contributions

YRF designed, conducted the study and developed the manuscript; SNH guided development of research proposal, execution of field work and reviewed the manuscript; RTJK and CPM reviewed the manuscript; and MHK helped with statistical data analysis.

## Conflicts of Interest

The authors declare no conflict of interest.

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