



The 6th Asian Academic Society International Conference (AASIC)
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**AWARENESS AND RISK BEHAVIORS TOWARDS ZONOTIC DISEASE AMONG
ETHNIC MINORITY IN MOUNTAINOUS AREA OF CENTRAL VIETNAM.**

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Background: As a result of the population explosion and rapid urbanization, human activities have been causing negative impacts on the environment. The changing patterns of transmissible diseases among wild animals, livestock and human have been getting more and more complicated in the context of climate change. Ethnic community from mountainous and isolated areas undoubtedly are the most vulnerable, with the high risk of emerging and re-emerging zoonosis.

Objectives: To explore the awareness and risk behaviors of the residents in Nham commune, A Luoi district towards zoonosis transmission. To determine the factors related to the risk behaviors of the residents. **Methods:** A sectional-cross study was conducted among 230 residents whose ages range from 18 – 85, currently living in Nham commune, A Luoi district, adjacent to the Vietnam – Laos border. All participants were interviewed directly with a questionnaire including the following categories: demographics, household wealth, awareness of zoonosis, livestock management and behaviors related to wildlife animals. Descriptive analysis and multivariable logistic regression analysis were conducted to determine factors associated with risk behaviors.

Results: The proportion of respondents who have heard about zoonotic diseases was 40%. The majority of subjects raise free-range livestock (83,4%), especially on poultry and cow. The percentage of participants who consumed culled sick and dead animals accounted for 26%, over 30% of villagers slept in forest and more than 50% consumed bushmeat. Risk behaviors related to management livestock and wildlife were statistically significantly associated with gender, age of subjects, educational background, household wealth, information approach on zoonosis, and the number of livestock. **Conclusions:** The proportion of respondents who have heard about zoonotic diseases was 40%. The high-risk group falls on those who consume dead domestic animals, wildlife animals and sleep in the forest. Behaviors of human-wildlife contact and zoonosis are quite common with the Nham locals, which emphasizes the necessity for intervention programs in zoonotic disease control.

Keywords: zoonosis, ethnic minority, animal, mountain, behavior.

1. BACKGROUND

As a result of the population explosion and rapid urbanization, human activities have been causing significantly negative impacts on the environment as well as increasing likelihood of transmission of pathogens between human and livestock and wildlife. Emerging infectious diseases from animals have posed significant threats to human health on a global scale [7]. Approximately 60% of all human diseases are thought to be of zoonotic origin, and up to 75% of newly emerging infectious diseases may be of zoonotic origin [8]. For the top 13 zoonosis are responsible for an estimated 2.2 million human deaths and around 2.4 billion cases of illness a year. [2][3]. In sub-Saharan Africa, bushmeat hunting and butchering are considered the primary as risk factors for human-wildlife contact and zoonotic disease transmission [7][11]. Especially, the changing patterns of transmissible diseases among wild animals, livestock and human have gradually become complicated in the context of climate change. Viet Nam is one of the countries identified as a "hotspot" for zoonotic emerging infectious diseases, including those with pandemic potential. While many zoonotic diseases may not pose a threat to global health security, they significantly



impact on the health and livelihood of rural poor communities in Viet Nam. [10]. The effective coordination between human and animal health sectors as well as wildlife conservation organizations are recognized as essential for controlling zoonotic disease and addressing to “one health” goal. Unfortunately, the issues have not been noticed in some areas, particularly in A Luoi district where majority of locals are low literacy minorities consuming livestock and bushmeat frequently. Hence, we carried on the study which included two objectives:

1. To explore the awareness and risk behaviors of the residents in Nham commune, A Luoi district towards zoonosis transmission.
2. To determine the factors related to the risk behaviors of the residents in Nham commune, A Luoi district towards zoonosis transmission.

2. METHODS AND MATERIALS

2.1. Study Design and Data Collection

The study was carried out between March and July 2018 in Nham commune. Nham is a poor commune which is adjacent to Vietnam – Laos border, 70.9 km from south-west of Hue city. The area covers about 37.85 km² and has about 2206 residents. Data for this survey was collected by using a cross-sectional questionnaire survey. Interviewers were the final year of students of Hue University of Medicine and Pharmacy and the collaborators who are the locals at Nham commune. The questionnaire sorted included biographical data characteristics (such as age, education, family position, marital status and employment), knowledge and perception regarding zoonotic diseases, livestock management (types and numbers of livestock, livestock raising experience), risk behaviors related to domestic animals and wildlife. The process of collecting data performed during the time of “Charity care program” within 7 days at Nham Commune. The convenient sample method was implemented to select the subjects. Selected villagers were those best meeting the following three criteria: the villagers living at Nham commune were representative of household between 18 and 85. Verbal consent was obtained prior to commencing the interview with each individual. The total number of 230 respondents was included.

2.2 Data Management and Analysis

Survey data were proofread and cleaned before entering data into SPSS version 18 for Window. Descriptive statistics were calculated to define demographic characteristics, knowledge and awareness regarding zoonotic diseases and livestock management. Chi-square test was used to explore the relationship between risk behaviors related to livestock as well as wildlife and demographic characteristics (such as age, education, family position, and employment) and knowledge regarding zoonotic diseases. All variables were further analyzed by a multivariable logistic regression analysis to investigate factors associated with risk behaviors towards livestock and wildlife.

A wealth index is based on asset ownership (e.g., owning motorbike, television, cellphone) and house characteristics (e.g., roof construction, house construction). The principal components analysis was used to determine the weights for an index of the asset variables. Respondents with the listed asset variables were given a score of one for each of 7 variables. To get a final indicator each variable was then multiplied by a weighting factor. The final wealth index was calculated as the sum of all indicators [1].

3. RESULTS

3.1 Demographic characteristics and socio-economic position of households

There were 230 respondents, the percentage of females accounted for over 60% , twice as much as that of males. The mean age of surveyed respondents was 38.5 (SD ±16.7). A majority (more than 80%) of subjects were farmer. 31.3% of respondents was illiteracy. Besides, the predominant ethnic group was “Ta Oi”, constituting of over 93%.



3.2 Knowledge and perception of zoonosis

Table 1: Knowledge of zoonotic infections among residents in Nham commune.

Knowledge of zoonotic infections		n	%
Heard about the disease spread from animal to human	Yes	92	40
	No	138	60
The disease could be spread from animal to human	Yes	133	57.8
	No	97	42.2
Named one zoonotic disease	Rabies	113	85.0
	Avian influenza	110	82.7
	Fasciolosis	29	21.8
	Streptococcus suis	28	21.1
Named animals as reservoir of zoonotic diseases	Dogs	122	91.7
	Chicken	122	91.7
	Ducks	80	60.2
	Pigs	63	47.4
	Cows	54	40.6
	Buffaloes	38	28.6
Listed modes of transmission between animals and humans	≥ 3 transmissions	105	78.9
	< 3 transmissions	28	21.1
Named measures to prevent animal-to-human transmission	≥ 3 Measures	105	78.9
	< 3 Measures	28	21.1
The sources of information on zoonosis	Broadcast television	102	76.7
	Medical staff	87	65.4
	Veterinarians	36	27.1
	Relatives	46	34.6

57.8% of interviewees acknowledged the potential transmission diseases between animals and humans. However, only 40% of those participants had heard about zoonotic diseases. According to the survey's results, the most well-known zoonotic diseases were rabies (85%), avian influenza (82.7%) whereas a few people mentioned fasciolosis and streptococcus suis. Among these zoonotic diseases, the most prevalent reservoirs of zoonotic diseases were dogs and chicken (91.7%) nevertheless, buffaloes were the least disease source researched (28.6%). Almost 80% of respondents knew about modes of zoonotic disease transmission and their precautions. In fact, the sources of information about zoonosis were from broadcast television and healthcare providers, with 76.7 % and 65.4 % respectively.

3.3 Rearing Practice:

Table 2: Rearing practice of livestock among residents in Nham commune.

Rearing practice		n	%
Cow and poultry rearing	Yes	147	63.91
	Stopped	12	5.22
Water source for livestock	Tap water	63	39.6
	Natural water (rain, river,	96	60.4



	stream...)		
Livestock shelters	Yes	117	73.6
	No	42	26.4
Purpose of rearing	For sale	88	56.1
	For food	57	36.3
	Others	14	8.9
Management of sick livestock	Leave isolated	37	23.3
	Cull for consumption	45	28.3
	Bury and burn	62	39.0
	Immunize	39	24.5
	Do nothing	10	6.3
Management of dead livestock	Dispose	44	27.7
	Cull for consumption	41	25.8
	Bury alive	81	50.9
	Immunize	19	11.9
Immunizations	Yes	74	46.5
	No	85	53.5

The number of individuals who had reared livestock was 159 (69.13%); and the families having livestock shelters accounted for more than 70%. The main source of water used for livestock was natural water (96.4 %) such as rain, river, stream. More than 56% of the residents reported that the purposes of breeding were mostly for sale, then for food (36.3%). When it comes to management of sick animals, 39% of respondents decided to bury and only 24% selected livestock vaccination, whereas the others believed that those livestock should be processed for consumption (28.3%) or left doing nothing (6.3%). The findings show that more than one fourth participants consumed dead livestock, while a half of participants buried them alive and nearly 30% selected disposal.

Table 3: Livestocks management of residents in Nham commune.

Characteristics of livestock management		Poulties		Pigs		Ruminants	
		n	%	n	%	n	%
No. of ruminants /pigs	0	-	-	147	92.5	110	69.2
	1 to 2	-	-	7	4.4	26	16.4
	3 to 5	-	-	2	1.3	12	7.5
	>=6	-	-	3	1.9	11	6.9
No. of poultries	0	25	15.7	-	-	-	-
	1 to 10	85	53.5	-	-	-	-
	11 to 20	23	14.5	-	-	-	-
	>=21	26	16.4	-	-	-	-
Personnel in charge of breeding	Female	107	81.1	10	83.3	23	46
	Male	25	18.9	2	16.7	26	52
Livestocks housing systems	Free-raised	49	36.8	0	0	7	14
	Combine free-raised and reared in cages	64	48.1	1	10	33	66
	Confine same species	20	15	9	90	10	20



Livestocks having immunized	Yes	56	42.4	8.0	66.7	29.0	59.2
	No	76	57.6	4.0	33.3	20.0	40.8

In general, chicken stocks were larger than cows and other kinds of livestock. Women were mainly responsible for poultry and pig raising, while men played more important role in rearing ruminants. In regard to livestock housing system, the combination of raising freely and rearing in cages was common way in order to keep poultries and ruminants whereas pigs were mainly raised in cages with the same species. Practicing vaccination specifically in pigs and ruminants was 66.7% and 59.2% respectively.

3.4 Risk behaviors of zoonotic disease

Table 4: Risk behaviors related to livestock and wildlife of residents in Nham commune.

Risk behaviors		Yes		No		
		n	%	n	%	
Domestic animals	Slaughtering domestic animals indoors	178	77.4	52	22.6	
	Using separate chopping boards or knives for preparing food	107	46.5	123	53.5	
	Allowing livestock entering kitchens	131	57	99	43	
	Washing hands with soaps before and after cooking	151	65.7	79	34.3	
	Washing hands with soap after handling livestock	132	57.4	98	42.6	
	Consuming raw meat	65	28.3	165	71.7	
Wildlife	Being injured by wild animals	23	10	207	90	
	Using wildlife as traditional medicines	19	8.3	211	91.7	
	Sleeping in the forest	75	32.6	155	67.4	
	Hunting wild animals in the forest	33	14.3	197	85.7	
	Consuming bushmeat	115	50	115	50	
	Sleeping in the forest	Day	15	20	-	-
		Night	28	37.3	-	-
		All day	32	42.7	-	-
	Consuming bushmeat often	> 1-2 times Year	26	22.6	-	-
		1-2 times Year	57	49.6	-	-
		< 1-2 times Year	32	27.8	-	-
	Types of bushmeat	Wild boar	35	30.4	-	-
		Jungle fowl	26	22.6	-	-
Rodents		33	28.7	-	-	
Another species		25	21.7	-	-	

(-): not applicable

The majority of people slaughtered cows and poultries indoors (77.4%). However, the percentage of people using knives, cutting boards separately for food preparation was not high (46.5%). Almost 60% of respondents reported that they allowed livestock entering their kitchens. The proportion of participants washing their hands with soap after contacting domestic animals before and after cooking was under 70%. Less than 30% of individuals consumed various products from raw meat such as “nem”, blood puddings.



The proportion of people injured by wild animals was at low levels (10.0%). A few residents used traditional drugs made from wild animals and hunt wildlife for food. However, over 50% of villagers consumed bushmeat occasionally about 1-2 times per year. Almost chicken, wild boars, jungle fowls and rodents were consumed by nearly 80% of these, with wild boars most frequently mentioned as a preferred meat (30.4%), followed by rodents (28.7%) and jungle fowls (16.5%). In addition, more than 30% of the participants spent all day sleeping in the forest.

3.5 Factors associated with risk behaviors towards zoonotic diseases

Table 5: Multivariable logistic regression models for factors associated with behaviors of residents towards livestock management

Factors		P	OR	95% CI
Vaccination for livestock	Household wealth	0.005	1.73	1.18 - 2.55
	Agricultural jobs	0.016	3.36	1.26 - 9.02
	Hearing about zoonotic diseases	0.006	2.65	1.33 - 5.31
	Raising ruminants	0.038	2.19	1.05 - 4.60
Consuming animals found dead	Information given by healthcare providers	0.000	4.84	2.00 - 11.71
	Raising ruminants	0.028	2.49	1.11 - 5.59
	Over 30 years old	0.041	2.51	1.04 - 6.05
Allowing livestock entering kitchen	Size flock of chicken < 20	0.012	3.23	1.29 - 8.06
	Raising without cages	0.023	3.76	1.20 - 11.78
Washing hands with soap after handling livestock	Literacy	0.019	2.60	1.17 - 5.79
	Keeping livestock confined	0.003	6.00	1.86 - 19.36
	Information given by healthcare providers	0.002	3.08	1.52 - 6.25

(CI: internal confidence)

It is suggested that being a farmer and having heard about zoonotic diseases were key elements affecting vaccination practice of villagers. Besides, this practice tended to be more common among the participants raising ruminants. Raising habits such as educational background, keeping poultries free ranging and receiving information from healthcare providers formed the differences in washing hands after handling domestic animals. The study also identified the association between approaching information provided by health care staff, raising ruminants and culling dead animals for consumption. Especially, the over 30 year-old group also tended to consume dead animals more frequently. In this study, the households raising less than 20 chickens were more likely to allow livestock entering food preparation areas.

Table 6: Multivariable logistic regression models for factors associated with risky behaviors of residents towards wild animals

Factors		P	OR	95% CI
Using wildlife as traditional medicines	Literacy	0.02	3.74	1.23 - 11.33
	Male	0.003	5.1	1.72 -



				15.08
	Having no awareness of the likelihood of disease transmission	0.035	3.6	1.09 - 11.89
Sleeping in the forest	Male	0.02	2.15	1.13 - 4.11
	Having no awareness of the likelihood of disease transmission	0.003	2.79	1.42 - 5.50
	Hunting wild animals	0.000	9.29	3.77 - 22.93
Hunting animals	Male	0.003	3.15	1.46 - 6.79
	Having no knowledge about zoonosis	0.026	2.76	1.13 - 6.76
Consuming bushmeat	Male	0.003	2.63	1.39 - 4.99
	Having no knowledge about zoonosis	0.001	2.92	1.58 - 5.41
	Hunting wild animals	0.000	16.51	4.61 - 59.06
	Household wealth	0.021	1.43	1.06 - 1.94

(CI 95%: internal confidence)

This study also found that respondents who were male, illiteracy and had no awareness of the likelihood of disease transmission between human and animal were more likely to use wild animals as traditional medicines. The factors significantly associated with increasing risk behavior of sleeping in the forest were male, hunting wild animals and having no awareness of the likelihood of zoonosis. It was noted that most hunting behaviors were among respondents who were male and had not heard about zoonotic diseases. Bushmeat consumption was associated with lacking of knowledge about zoonotic infections and was more commonly reported in male. Especially, the odd of hunters sleeping in the forest and consuming bushmeat was much higher than who did not.

4. DISCUSSION

Generally, the knowledge of Nham locals towards zoonotic diseases was quite low. There was approximately 40% of the respondents hearing about zoonosis, and the prevalence was higher than the result of Tebug S. F. (31.1%), whereas this figure was lower than result of Osbjjer K. (69,0%) [6][9]. However, this proportion increased to 57.8% when participants were asked whether or not the diseases could be transmitted between animals and human. The unfamiliar definition of zoonotic diseases could explain the difference. When discussing the awareness of zoonosis, the majority of respondents (over 80%) could name at least one zoonotic disease, for example rabies or avian influenza. The study of Tebug S. F. also found out the similar result (more than 90%) [9]. Among reservoirs of zoonotic diseases, the most frequent mentions were dogs and chicken (91.7%). Nevertheless, buffaloes, with 28.6%, were the least origin of diseases to be known. Lacking of knowledge of zoonotic reservoir could lead to locals' subjective judgment in prevention of zoonotic diseases. The proportion of respondents who named more than 3 modes of transmissions zoonosis accounted for nearly 80% and the most common mentioned modes were contaminated meat, close contact with animals and polluted water. The prevalent preventive measures known by majority of the respondents were consuming boiled water (84.2%), washing hands with soap before and after food preparation (85%). The results were consistent with the findings of Kazoora H.B. [9]. The main source of zoonosis information was provided by broadcast television and healthcare workers. This study found that Nham locals might not be quite familiar to definition of zoonotic diseases, however, the participants' awareness involved modes of transmissions and preventive measures was quite positive. These achievements were obtained thanks to the control and prevention of contagious diseases campaign of governmental and local



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authorities. The study found that most of households struggled to approach tap water because of socio-economic circumstance and geographical location. Consequently, natural water was the fundamental water supply for livestock that might increase hazardous transmission of waterborne pathogens. Besides, the result of our study showed that women took more responsibility for raising poultry, men for ruminants which is a most common division of labor in low-income countries [6]. In terms of livestock housing system, the combination of raising freely and cages rearing was a common way in order to keep mostly poultry and ruminants, with 84.9% and 80% respectively. It is clear that free-range animals were particularly vulnerable to zoonotic pathogens spreading from those of other households in the area as well as from wildlife. When it comes to sick animals, the rate of people following the proper managements such as burning, isolation and immunization was not high with 39.0%, 23.3%, 24.5% respectively. On the other hand, in the management related to dead animals, most people decided to bury alive (50.9%) or throw away (27.7%). Notably, more than a quarter of people culled sick or dead domestic animals for consumption. This percentage was consistent with that of Osbjør K. (28%) [6]. The results showed that a large number of respondents were not well aware of the proper managements and the hazards of consuming sick or dead livestock. Besides, the vaccination of livestock was not probably interested when just two thirds of breeding households practiced vaccination for their livestock. The study also identified that vaccination tended to be carried out by farm families and individuals who have heard of animal-to-human infections. Particularly, the participants raising ruminants, which are more valuable than other livestock, focused on this practice. Concerning risk behaviors related to domestic animals, while the proportion of respondents slaughtering cattle and poultry indoors was noticeably high at 77.4%; over 50% never used knives, cutting boards separately for food preparation. This percentage was not much different from that of Lien T.T.M (44.4%) [5]. Finding from this study provided evidences about poor practices of food hygiene and safety for local authorities as well as stakeholders to plan proper solutions. According to Osbjør K.'s study, 72% of respondents allowed their domestic animals entering the kitchens, and this figure in our study was lower, at 65.7%.[6] Behavior that allowed their domestic animals entering the kitchens was associated with household which size flock was less than 20 chickens and no livestock cages. In addition, the practice of washing hands after touching animals has not been paid attention (57.4%). The results of the table presented that factors such as literacy and information given by healthcare workers played important role in raising the people's awareness of the importance of hand-washing in the prevention of illness, thereby increasing compliance with hand washing after handling animals. Moreover, reducing free-range chicken also contributed to limit the number of direct contact with the poultry.

When it comes to risk behaviors related to wild animals, there was a low rate of residents engaged in a variety of behaviors that boosted contact with wild animals, including injured by wildlife, using wild species as traditional medicines and hunting animals. The educational programs of preservation policy were able to lead to these positive outcomes. Meanwhile, consuming bushmeat was quite common behavior among community, with the alarming rate of nearly 50%. The most preferred bushmeat was wild boars (30.4%), followed by rodents (28.7%) and jungle fowls (22.6%). This study also found that bushmeat consumption associated with some traits of respondents, consists of gender, hearing about zoonosis, hunting animals and wealth household index. The households with higher household wealth index tended to consume bushmeat. On the other hand, more than 30% of individuals slept in the forest. Particularly, nearly 43% of those slept in the daytime and nighttime. Noticeably, while subjects who engaged in hunting animals were much higher than others in the implementation of risk behaviors such as sleeping in the forest and consuming bushmeat. This figure was quite low in group hearing about zoonotic infections. It is necessary to provide the intervention programs of transmissions between human and wildlife for this community in order to raise their awareness and reduce risk practices in the near future.



As a result of convenient sample, it was difficult to assure the representative feature of the sample. To overcome this challenge, our team cooperated with local authority to establish a pre-identification list of sample then we distributed invitations of health checkup to participants. Notably, over 90% of respondents was ethnic minority that need more attention to training interviewers. Collaboration with local staff was a vital approach to restrict the language barrier and guarantee data collection as accurately as possible.

5. CONCLUSIONS:

The percentage of residents hearing zoonotic diseases was 40%. The study explored the risk behaviors of respondents including culling sick or dead animals for consumption, keeping livestock free ranging, consuming wild animals and sleeping in the forest. The significant factors associated with the risk behaviors of livestock and wild animals were gender, age, educational background, household wealth, approaches to zoonotic diseases information, livestock housing systems and quantity of livestock. Behaviors of human-wildlife contact and zoonosis are quite common with the Nham locals, which emphasizes the necessity for intervention programs in zoonotic disease control.

6. ACKNOWLEDGMENTS

We thank the farmers as well as locals who participated in the study. We also extend our thanks to the commune healthcare staff, local authorities and practitioners of Hue University of Medicine and Pharmacy in participating regions for assistance during the field work and to the field teams for collection of data. The work was financially supported by Hue University of Medicine and Pharmacy.

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