



Research article

Multistakeholder's knowledge, attitudes and practices on poultry zoonoses in the provinces of Leyte and Southern Leyte, Philippines

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Abstract

This paper aims to determine the level of knowledge, practices and attitudes (KAP) on poultry zoonoses among poultry meat and egg retailers, consumers, and smallhold poultry raisers in Leyte and Southern Leyte provinces and identify the factors associated with the KAP scores of the study population. A survey was participated by 451 stakeholders composed of 153 poultry product consumers, 128 poultry raisers, 124 poultry raiser-retailers and 46 retailers. The KAP questions were about poultry zoonoses signs, prevention, control and treatment. Information on respondent's age, gender, educational attainment, employment and sources of information concerning poultry zoonoses were also gathered to determine its association with the KAP scores of the respondents. Multivariable linear regression analysis was conducted to determine the factors associated with the level of knowledge, attitudes and practices of stakeholders on poultry zoonoses. The stakeholders have a moderate knowledge level with high attitudes and practices. Knowledge scores tends to be lower in males ($\beta=-0.599$, $p=.027$) and among non-poultry raiser groups (retailer-consumer [$\beta=-6.382$, $p=.001$] and consumer [$\beta=-5.797$, $p<.001$]). Attitude scores tend to be higher among consumers ($\beta=6.013$, $p=.004$). Practice scores tend to decrease with respondents who are single ($\beta=-3.105$, $p=.017$). There is a significant positive association between knowledge with attitude ($\beta=6.572$, $p=.030$) and practice ($\beta=2.010$, $p<.001$) scores. Despite the current levels of attitude and practices among stakeholders, there is still a need to enhance knowledge levels among stakeholders to correct misconceptions and improve attitudes and practices concerning poultry zoonoses.

Keywords: Poultry zoonoses, KAP study, Zoonoses awareness

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INTRODUCTION

With the increasing demands for poultry products, a corresponding farming intensification increases chicken density in farmhouses. In the Philippines, poultry products from free-ranged production are also becoming popular (Philippine Statistics Authority, 2020). Nonetheless, smallhold poultry raising has long been practiced in the country (Chang, 2007). The increase in the number of intensive poultry production farming increases the risk of poultry workers' exposure to poultry-borne zoonoses (World Society for the Protection of Animals, 2013). On the one hand, smallhold farming has a higher risk of zoonoses because of a higher frequency of human-poultry contact and poor implementation of biosecurity measures, and the mode of transmission is more on direct contact (Hafez and Hauck, 2015).

Aside from those people working closely with poultry (farm owners/workers, veterinarians, slaughterhouse workers and inspectors, those with exposure to wild birds), several people in the community are also at risk, which includes those who are below five years old, 65 years old and older, immunocompromised and pregnant women (Behraves, 2018). Stakeholders must be aware of poultry-borne zoonoses, and those working closely with poultry can detect diseases in poultry.

Poultry-borne zoonoses include salmonellosis, campylobacteriosis and *E. coli* infection which are food-borne (Dale and Brown, 2013; World Society for the Protection of Animals, 2013; Behvaresh et al., 2014; Hafez and Hauck, 2015). Salmonellosis and campylobacteriosis rarely cause clinical disease in poultry; however, they can cause diarrhea in humans. Other diseases are transmitted via other modes such as direct contact, including avian influenza (AI), Newcastle disease (ND), avian tuberculosis, avian chlamydiosis, and erysipelas (Dale and Brown, 2013; Hafez and Hauck, 2015). Of the 19 avian diseases listed by the World Organization for Animal Health (OIE) (2021), four are considered zoonotic- avian chlamydiosis, avian tuberculosis, diseases caused by avian influenza viruses and highly pathogenic AI viruses, and ND.

One of the measures to reduce the spread of zoonoses is through comprehensive health education, including education campaigns, especially concerning hygiene and behavioral interventions (World Health Organization, 2020). This measure should be based on the gaps in knowledge, attitude, and practices, especially among those at risk. Hence, this paper focused on poultry meat and egg retailers, consumers, and smallhold poultry farmers in Leyte and Southern Leyte provinces. This study aims to determine the level of knowledge, practices and attitudes (KAP) on poultry zoonoses among stakeholders in the provinces of Leyte and Southern Leyte, Philippines and identify the factors associated with the KAP scores of the study population. The results of this study will help in designing intervention strategies in improving the KAP of the stakeholders concerning poultry-borne zoonoses.

MATERIALS AND METHODS

There were 451 stakeholders (153 poultry product consumers, 128 poultry raisers, 124 poultry raiser-retailers and 46 retailers) who participated in this study, which were randomly selected from Leyte and Southern Leyte provinces.

A semi-structured standardized survey questionnaire was used in this study. The questionnaire was composed of four parts: respondents' demographics and questions on knowledge, attitudes, and practices. Respondent's demographics include age, gender, educational attainment, employment, and sources of information concerning poultry zoonoses. Open-ended questions were used for the knowledge and practices section. Questions with a 5-point Likert scale were used for the attitude assessment. The KAP questions were about poultry zoonoses signs, prevention, control, and treatment.

The questionnaire was constructed and translated to the local dialect (Cebuano and Waray) where the survey was conducted. Because of the COVID-19 pandemic-related travel restrictions, the survey was administered through personal interviews or a Google form sent to the respondent's email address. Ethical clearance was issued by the Research Committee of the College of Veterinary Medicine of the Visayas State University prior to the conduct of the study. An informed consent was provided to the respondents prior to the conduct of the interview. Only those who provided consent were included in the study.

For the knowledge and practices questions, correct responses were scored 1 for correct answer or 0 for incorrect answer. Questions for attitudes and practices were specific for a group of stakeholders. The attitude score percentage was computed by getting the sum of all the responses based on the 5-point Likert scale, divided by the total number of questions, multiplied by 5 (highest ideal score per attitude question), and multiplied by 100. Thus, for the practices, the percentage of the correct scores was computed by getting the sum of all the correct answers divided by the total number of questions multiplied by 100.

The demographic variables were the explanatory variables, and the KAP score or percentage score will be the outcome variable. The explanatory variables and KAP scores were summarized using descriptive statistics. The unconditional association of each demographic variable with knowledge, attitudes, and practices scores was determined using univariable linear regression. The multivariable linear regression analysis included the variable with a p-value $\leq .20$. All variables in the multivariable linear regression model with a p-value $\leq .05$ will be considered factors significantly associated with the KAP scores of the respondents.

RESULTS

Respondents Characteristics

The age of the respondents ranged from 18-79 years old, with a mean of 36.68 ± 13.10 years. The majority of the respondents are 18-26 years old. There is an almost equal distribution in the number of male and female respondents. There is an almost equal distribution in the number of single respondents (220, 48.78%) and married (206, 45.68%). Two hundred seventy (59.87%) of the respondents finished tertiary education. A large portion of the respondents are employed (310, 68.74%). Employment can be at the government or private offices or self-employment. Most of the respondents (159, 35.41%) obtain information concerning poultry zoonoses from more than one information source. The primary source of information concerning poultry zoonoses is print and broadcast media (television, radio, and/or newspaper) (104, 32.20%) (Table 1).

One hundred fifty-two (60.32%) of the raisers raised chickens in less than a year to 8 years. The mean year raising chickens is 7.86 ± 9 years, ranging from less than a year to 53 years. Among the raisers, the majority (196, 77.78%) raised only one chicken type among native chickens, broilers, layers, and game fowls and are not raising other livestock other than poultry (176, 70.12%). Among retailers, the mean number of years in retailing poultry products is 6.34 ± 8.50 , with a range of <1 to 54 years. The majority (121, 71.18%) have poultry retailing experience between less than a year to 8 years (Table 1).

Table 1 Demographic characteristics of respondents

Demographic Characteristics	Frequency (n=451)	Percent
Age, years (36.68±13.10, 18-79)		
18-26	142	31.49
27-35	85	18.85
36-44	81	17.96
45-53	73	16.19
54-62	37	8.20
63-71	14	3.10
72-79	4	0.89
Prefer not to say	15	3.33
Gender		
Male	215	47.67
Female	228	50.55
Prefer not to say	8	1.77
Civil Status		
Single	220	48.78
Married	206	45.68
Divorced/Separated	5	1.11
Widow/Widower	9	2.00
Prefer not to say	11	2.44
Educational Attainment		
Elementary	13	2.88
High School	73	16.19
Vocational	23	5.10
College	270	59.87
Post-Graduate	36	7.98
Prefer not to say	36	7.98
Employment Status		
Employed	310	68.74
Not employed	74	16.41
Prefer not to say	67	14.86
Sources of information		
Print and Broadcast Media	104	32.20
Social media and the internet	89	27.47
Seminars/ Trainings/ School/ Research	56	17.34
Friends/ Coworkers	28	8.67
Veterinarians/ Doctors/ Agriculturists	20	6.17
Combination of two or more sources	159	35.41
Years in raising chickens (7.86±9, <1-53)		
<1-8	152	60.32
9-17	34	13.49
18-26	27	10.71
27-35	5	1.98
36-44	2	0.79
45-53	2	0.79
Prefer not to say	30	11.90
Number of chicken types raised		
1	196	77.78
2	38	15.08
3	10	3.97
4	3	1.19
Prefer not to say	5	1.98
Raising other livestock other than poultry		
Yes	75	29.88
No	176	70.12
Years in retailing chicken products (6.34±8.50, <1-54)		
<1-8	121	71.18
9-17	22	12.94
18-26	12	7.06
27-35	3	1.76
36-44	1	0.59
45-53	1	0.59
Prefer not to say	10	5.88

Respondents' Knowledge on Poultry Zoonoses

Table 2 shows the number of respondents with the correct answer for each knowledge question. Most of the respondents were able to provide the correct answers for questions on the safeness of consuming poultry products from dead or diseased chickens (422, 93.57%), signs of sick chickens (324, 87.80%), and methods for proper disposal of dead chicken (380, 84.26%). Only 113 (25.06%) of the respondents provided the correct definition of poultry zoonosis.

There is an almost equal number of respondents with moderate and high knowledge levels on poultry zoonoses. However, the mean knowledge score at 6.76 ± 3.44 is classified as moderate. The knowledge score ranges from 1 to 14 (Table 3).

Table 2 Frequency of respondents with the correct answer for the knowledge questions on poultry zoonoses.

Knowledge questions	Frequency of correct answer	Percent
1. What is poultry zoonosis?	113	25.06
2. Have you heard of these diseases? (List is provided in the questionnaire)	325	72.06
3. Are you aware that there are diseases that can be transmitted from poultry and its products to humans?	275	60.98
4. Are you aware that these poultry zoonoses can cause serious conditions (sometimes fatal) to humans?	187	41.56
5. In what ways can humans acquire diseases from poultry and products?	312	69.33
6. What do you know about the proper handling of poultry products (meat, eggs, and others)?	243	54.00
7. Are poultry and/or poultry products die from/infected with these diseases safe to eat?	422	93.57
8. What are the signs of a chicken that is not healthy?	324	87.80
9. What is ideal housing for poultry? Please describe.	272	60.31
10. What do you know about proper handling of (live) chicken?	155	34.37
11. What preventive/protective methods do you know that are applicable for zoonotic diseases in poultry?	184	40.80
12. What vaccination protocols do you know that are applicable for chicken?	148	32.89
13. What treatment protocol/s do you know for sick chicken?	223	49.45
14. What are the methods for proper disposal of dead chicken?	380	84.26

Table 3 Knowledge score levels of respondents on poultry zoonoses.

Knowledge Level	Frequency (n=451)	Percent
Low (1-5)	68	15.08
Moderate (6-10)	184	40.80
High (11-14)	199	44.12

Factors Associated with the Knowledge of Respondents on Poultry Zoonoses

The unconditional association of age, gender, civil status, educational attainment, sources of information with respondents' level of knowledge was assessed. Explanatory variables with a p-value of $<.20$ in the univariable analysis are included in the multivariable linear regression analysis (Table 4). Gender (male), educational attainment (vocational and college), stakeholder category (poultry raiser-consumer, poultry retailer-consumer, and consumer), and sources of information (print and broadcast media, seminars/training/ school/ research, veterinarians/ doctors/ agriculturists, and combination of two or more sources of information) are the explanatory variables (p -value $\leq .20$) that were included in the multivariable linear regression.

Table 4 Linear regression analyses for the knowledge scores on poultry zoonoses.

Independent Variables	Univariable Linear Regression			Multivariable Linear Regression			95% CI	
	Constant	Beta-coefficient	p-value	Constant	Beta-coefficient	p-value	Lower limit	Upper limit
				9.224				
Age	6.274	0.015	.233					
Gender (Male)	5.942	1.620	<.001		-0.599	.027	-1.128	-0.070
Civil Status								
Single	6.895	-0.265	.252					
Married	6.657	0.226	.488					
Divorced/ Separated	6.744	1.456	.348					
Widow/ Widower	6.787	-1.343	.247					
Prefer not to say	6.782	-0.873	.407					
Educational Attainment								
Elementary	6.778	-0.564	.547					
High school	6.770	-0.062	.889					
Vocational	6.822	-1.155	.109		-0.149	.803	-1.322	1.024
College	6.363	0.667	.043		0.490	.068	-0.036	1.017
Post-graduate	6.783	-0.283	.636					
Employment	6.547	0.211	.468					
Stakeholder's Category								
Raiser-Retailer	5.823	3.411	<.001					
Raiser-Consumer	5.991	2.712	<.001		-0.600	.076	-1.262	0.062
Retailer-Consumer	7.143	-3.752	<.001		-6.382	<.001	-7.324	-5.440
Consumer	8.104	-3.960	<.001		-5.797	<.001	-6.446	-5.148
Sources of Information								
Social media and the internet	7.111	-0.335	.444					
Print and Broadcast Media	6.807	0.597	.110		0.493	.108	-0.109	1.095
Seminars/ Trainings/ School/ Research	6.906	0.582	.191		0.006	.985	-0.672	0.684

Respondents' Attitudes on Poultry Zoonoses

The respondents' attitudes were assessed based on 16 questions on a 5-point Likert scale. Table 5 summarizes the frequency distribution of the respondents' answers to attitude questions. The majority of the respondents (363, 80.67%) showed an exemplary attitude on the importance of proper hygiene in handling poultry and poultry products. Only a few have the proper attitude concerning safety in contact with infected poultry and its products (176, 39.11%) and keeping poultry near the house or area of water and food preparation (85, 33.73%).

The attitude score levels of respondents were categorized into low, moderate, and high (Table 6). Almost all (426, 94.96%) respondents have the ideal attitude (76-100% attitude score) towards poultry zoonoses. The mean attitude score is $87.53 \pm 11.28\%$, ranging from 25.71-100%.

Table 5 Frequency distribution of respondents' answers for the attitude questions on poultry zoonoses.

Attitude Questions	n (%)				
	Strongly disagree 1	Disagree 2	Neutral 3	Agree 4	Strongly agree 5
1. It is not okay/safe to have in contact with infected poultry and its products	21 (4.67)	41 (9.11)	70 (15.56)	140 (31.11)	176 (39.11)
2. Children, the elderly, or immunocompromised individuals should not handle or touch poultry and its products.	44 (9.78)	33 (7.33)	43 (9.56)	99 (22.00)	231 (51.33)
3. It is unsafe to consume poultry and/or products affected by the disease.	23 (5.10)	9 (2.00)	26 (5.76)	89 (19.73)	302 (66.96)
4. It is harmful to sell poultry and/or products affected by the disease.	15 (3.33)	8 (1.77)	23 (5.10)	64 (14.19)	338 (74.94)
5. Preparing/cooking properly of poultry and/or products is essential in preventing zoonotic diseases.	14 (3.10)	7 (1.55)	29 (6.43)	105 (23.28)	292 (64.75)
6. Purchase of poultry and/or products should be from reliable source/supplier to prevent acquiring zoonotic diseases.	3 (0.67)	2 (0.45)	31 (6.90)	81 (18.04)	328 (73.05)
7. Proper hygiene is vital in handling poultry and products.	3 (0.67)	2 (0.44)	10 (2.22)	69 (15.33)	363 (80.67)
<i>For Raisers (n=245)</i>					
8. Live poultry should not be kept inside/near the house or anywhere near food or drink is prepared.	20 (9.94)	25 (9.92)	65 (25.79)	56 (22.22)	85 (33.73)
9. Live chicken should be confined inside a pen/cage to prevent disease transmission in the area.	17 (6.75)	16 (6.35)	31 (12.30)	59 (23.41)	264 (58.54)
10. Any equipment/material used by the poultry should not be cleaned inside the house to prevent potential contamination.	4 (1.59)	5 (1.98)	5 (1.98)	67 (26.59)	170 (67.46)
11. Proper disposal of dead chicken is vital in preventing the zoonotic disease from poultry.	14 (5.56)	6 (2.38)	7 (2.78)	32 (12.70)	192 (76.19)
12. Deep burying of dead chicken is considered as proper disposal.	6 (2.38)	6 (2.38)	10 (3.97)	60 (23.81)	169 (67.06)
13. When handling poultry, wearing a mask, gloves, and other protective gear is essential.	4 (1.59)	5 (1.98)	32 (12.70)	69 (27.38)	142 (56.35)
14. Following the vaccination protocol is essential to prevent the chickens from acquiring zoonotic diseases.	4 (1.59)	2 (0.80)	12 (4.78)	60 (23.90)	173 (68.92)
15. Sick chickens should be isolated or culled to prevent the spread of diseases.	7 (2.78)	3 (1.19)	7 (2.78)	47 (18.65)	188 (74.60)
16. A veterinarian should regularly examine raised poultry.	4 (1.59)	2 (0.80)	41 (16.33)	75 (29.88)	129 (51.39)

Factors Associated with the Attitudes of Respondents on Poultry Zoonoses

Linear regression analysis was used to assess the association of attitude level of respondents on poultry zoonoses. Explanatory variables with a p-value of $\leq .20$ in the univariable linear regression analysis include educational attainment (post-graduate and prefer not to say), stakeholder's category (raiser-retailer-consumer, retailer-consumer, and consumer), sources of information (social media and internet and print and broadcast media) and knowledge score. These independent variables are included in the multivariable linear regression analysis.

The multivariable linear regression model showed that being a consumer ($\beta=6.013$, $p=.004$) and knowledge score ($\beta=6.572$, $p=.030$) were significantly associated with attitude score (Table 7).

Table 6 Attitude score levels of respondents on poultry zoonoses.

Attitude Score Category	Frequency (n=451)	Percent
Low (25-50%)	5	1.11
Moderate (51-75%)	50	11.09
High (76-100%)	396	87.80

Table 7 Linear regression analyses for the attitude scores on poultry zoonoses.

Independent Variables	Univariable Linear Regression			Multivariable Linear Regression			95% Confidence Interval	
	Constant	Beta-coefficient	p-value	Constant	Beta-coefficient	p-value	Lower limit	Upper limit
				81.628				
Age	92.830	-0.141	<.001		0.143	.696	-0.578	0.865
Gender (Male)	89.094	-3.097	.003		-1.276	.309	-3.742	1.190
Civil Status								
Single	86.556	1.907	.011		0.228	.813	-1.667	2.123
Married	88.764	-2.704	.011		-0.915	.555	-3.963	2.133
Divorced/ Separated	87.600	-6.422	.206					
Widow/ Widower	87.455	3.695	.331					
Prefer not to say	87.589	-2.491	.470					
Educational Attainment								
Elementary	87.575	-1.504	.624					
High school	87.443	0.533	.714					
Vocational	87.685	-2.938	.215					
College	87.278	0.420	.699					
Post-graduate	87.285	3.052	.119		1.876	.330	-1.911	5.664
Prefer not to say	87.750	-2.770	.158		0.278	.905	-4.309	4.866
Employment (Employed/ Unemployed)	86.487	1.025	.281					
Stakeholder's Category								
Raiser-Retailer-Consumer	88.128	-2.180	.067		-0.764	.628	-3.862	2.334
Raiser-Consumer	87.927	-1.403	.234					
Retailer-Consumer	88.073	-5.340	.002		-2.351	.381	-7.621	2.919
Consumer	85.699	5.394	<.001		6.013	.004	1.956	10.070
Source of Information								
Social media and the internet	87.807	2.005	.128		0.357	.830	-2.916	3.630
Print and Broadcast Media	87.576	2.064	.066		0.706	.629	-2.166	3.579
Seminars/ Trainings/ School/ Research	88.152	0.872	.516					
Veterinarians/ Doctors/ Agriculturists	88.207	2.088	.393					
Friends/ Coworkers	88.324	0.064	.974					

Respondents' Practices on Poultry Zoonoses

The practices of the respondents concerning poultry zoonoses were assessed with open-ended questions. Table 8 summarizes the frequency distribution of the respondents' correct answers to practice questions. Most of the

respondents (>80%) have correct practices on culled/dead poultry consumption due to disease, consumption of raw poultry meat and/or products, checking poultry products before purchasing, correct disposal of poultry and its products, and management of sick chickens. Only a few respondents provided a correct answer on hygienic measures during handling or when in contact with poultry products.

The majority of the raisers asked for help when their flocks were affected by diseases; however, when the sources of help were examined, there were still several raisers who sourced their information in treating their flock from sources that are not authorized to prescribe drugs for the treatment of the diseases especially concerning antimicrobials. Only a few of the respondents pointed out the correct answer. On average, the respondents' practices are ideal though there are still practices that need improvement, especially in handling live poultry. The prudent use of antibiotics in animals is highly recommended to reduce the risk of mounting antimicrobial resistance, especially on zoonotic pathogens ([Commission Notice – Guidelines for the Prudent Use of Antimicrobials in Veterinary Medicine, 2015](#)).

The frequency distribution of respondents with low, moderate, and high practice scores is summarized in [Table 9](#). The practice score ranges from 12.50-100%, with a mean of 71.57±21.88%. Two hundred seventy-one (59.42%) respondents showed high practice score category, which ranges from 69-100%.

Table 8 Frequency of respondents with the correct answer for the practice questions on poultry zoonoses.

Practice questions	Frequency of correct answer	Percent	95% Confidence Interval	
			Lower Limit	Upper Limit
All respondents				
1. How do you handle poultry products (meat, eggs, and others)?	287	63.64	59.10	67.94
2. What hygienic measures do you do during handling or in contact with poultry and products?	103	22.84	19.20	26.93
3. What hygienic measures do you do after handling or in contact with poultry and products?	353	78.27	74.23	81.83
4. Do you practice biosecurity measures (in smallhold farm, market or kitchen)?	252	55.88	51.26	60.39
5. Do you eat culled/dead poultry due to a disease?	412	91.56	88.62	93.79
6. Do you eat raw poultry meat and/or products?	419	92.90	90.16	94.93
7. Do you check poultry products before purchasing?	395	87.58	84.22	90.31
8. Where do you seek help if you or anyone in the family got sick after handling/consuming poultry and its products?	265	58.76	54.16	63.21
For Raisers (n=245)				
9. What type of poultry housing do you have?	175	69.72	63.63	75.34
10. How do you handle (live) poultry?	212	84.13	79.02	88.41
11. How do you prevent poultry from acquiring/developing zoonotic diseases?	168	66.93	60.74	72.72
12. Do you vaccinate your chickens?	123	49.00	42.66	55.37
13. Do you treat sick chickens on your farm?	190	75.70	69.91	80.87
14. How do you dispose of poultry and its products?	213	84.52	79.46	88.76
15. How do you bury dead chicken?	178	70.92	64.87	76.46
16. What do you do when you have sick chickens?	209	83.27	76.65	86.64
17. Do you seek advice from a veterinarian in cases of sick poultry?	180	71.43	65.42	76.92

Table 9 Practice score levels of respondents on poultry zoonoses.

Practice Score Category	Frequency (n=451)	Percent
Low (5-36%)	25	5.54
Moderate (37-68%)	155	34.37
High (69-100%)	271	60.09

Factors Associated with the Practices of Respondents on Poultry Zoonoses

The explanatory variables with a p-value of $\leq .20$ in the univariable linear regression analysis include civil status (single and married), educational attainment (college and prefer not to say), stakeholder's category (raiser-retailer-consumer), source of information (seminar/training/ school/research and combination of two or more sources) and scores for knowledge and attitude. Multivariable linear regression analysis showed that being single ($\beta = -3.105$, $p < .017$) and knowledge score ($\beta = 2.010$, $p < .001$) are the two independent variables significantly associated with the practice scores of the respondents (Table 10).

DISCUSSION

Multivariable linear regression analysis showed that gender (male) ($\beta = -0.599$, $p < .027$) and stakeholder's category (retailer-consumer [$\beta = -6.382$, $p = .001$] and consumer [$\beta = -5.797$, $p < .001$]) were found to be significantly associated with the knowledge level of the respondents. The linear regression model explained 60.70% ($R^2 = 0.607$) of the variation in the knowledge scores.

Based on the linear regression model, males will likely have lower knowledge scores than females, as indicated by the negative beta coefficient (-0.599). The lower knowledge of males can be associated with less effort to access information sources such as social media than females (Sultana et al., 2022). Retailer-consumers ($\beta = -6.382$) and consumers ($\beta = -5.797$) are stakeholders that tend to have lower knowledge scores compared to those stakeholders that are involved in raising chickens (raiser-retailer-consumer or raiser-consumer). Having experience in raising chickens provides individuals with hands-on experience and more access to training provided by the government and non-government organizations. The higher knowledge score of those working closely with poultry agrees with the findings of Abbate et al. (2006) in Italy and Ayim-Akonor et al. (2020) in Ghana that working with or raising chickens has higher knowledge scores. Islam and Ahmed (2019) found out that employees working in the livestock department in Bangladesh were highly aware of zoonotic infection. In Ghana, livestock farmers living close to the cattle have good knowledge (Ziblim et al., 2021). However, Chen et al. (2015) have a contrasting finding where poultry workers have a lower understanding of avian influenza than non-poultry workers in China. Singh et al. (2019) also mentioned that people raising livestock know less about zoonotic diseases in India. Interestingly, the study of Kusumaningrum et al. (2022) on knowledge, attitudes, and practices associated with zoonotic disease transmission risk among hunters, vendors, and consumers related to the wildlife trade value chain in Indonesia found that knowledge was similar across participants. Nevertheless, most studies showed that people working closely with animals have a better understanding of zoonoses.

Table 10 Linear regression analyses for the practice scores on poultry zoonoses.

Independent Variables	Univariable Linear Regression			Multivariable Linear Regression			95% Confidence Interval	
	Constant	Beta-coefficient	p-value	Constant	Beta-coefficient	p-value	Lower limit	Upper limit
				40.847				
Age	72.217	-0.062	.373					
Gender	70.196	-1.523	.404					
Civil Status								
Single	70.688	-2.474	.057		-3.105	.017	-5.640	-0.570
Married	69.601	-0.383	.835					
Divorced/ Separated	69.405	1.919	.826					
Widow/ Widower	69.489	-3.149	.630					
Prefer not to say	69.329	4.001	.499					
Educational Attainment								
Elementary	69.586	-5.141	.329					
High school	69.326	0.630	.801					
Vocational	69.617	-3.594	.377					
College	67.429	3.348	.072		4.166	.055	-0.098	8.429
Post-graduate	69.524	-1.223	.717					
Prefer not to say	69.931	-6.329	.060		-2.730	.511	-10.883	5.424
Employment (Employed/ Unemployed)	66.034	3.340	.041		3.902	.027	0.442	7.361
Stakeholder's Category								
Raiser-Retailer-Consumer	67.366	7.492	<.001		0.224	.931	-4.828	5.275
Raiser-Consumer	69.566	-0.494	.808					
Retailer-Consumer	69.596	-1.661	.582					
Consumer	71.304	-5.537	.004		3.143	.265	-2.396	8.681
Source of Information								
Social media and the internet	70.902	1.075	.650					
Print and Broadcast Media	70.849	0.920	.649					
Seminars/ Trainings/ School/ Research	70.391	3.887	.106		5.772	.172	-2.534	14.077
Veterinarians/ Doctors/ Agriculturists	71.104	2.169	.622					
Friends/ Coworkers	71.137	0.519	.883					

Consumers tend to have a better attitude concerning prevention and control of poultry zoonoses than other respondents. The relationship of attitude and knowledge score was strong ($\beta=6.572$), indicating that those who know more (high knowledge score) about poultry zoonoses can improve their attitudes towards poultry zoonoses. However, a contrasting finding of [Kusumaningrum et al. \(2022\)](#) mentioned that survey participants with non-animal related business were less likely to be concerned about disease outbreaks.

Interestingly, the respondents' mean knowledge score (6.76 ± 3.44) is considered moderate, while the attitude score mean ($87.53 \pm 11.28\%$) is high. This result is similar to the study of [Çakmur et al. \(2015\)](#) among farmers on zoonotic diseases in Turkey. The respondents' low knowledge score but a high attitude score indicates that there was no translation of knowledge to the right attitude. The pattern indicates that the right attitude developed by the stakeholders towards

poultry diseases applies to zoonotic diseases as well, which does not apply to knowledge for poultry diseases in general and zoonotic diseases. On the contrary, the study of [Alemayehu et al. \(2021\)](#) in the rural communities in Ethiopia showed that knowledge level is significantly associated with positive attitude which indicates a possible translation of knowledge into positive attitude. [Moutos et al. \(2022\)](#) have a similar findings with their study with knowledge scores of ruminant livestock workers are positively associated with attitude scores. Thus, there is a need to provide the necessary information to stakeholders to increase their knowledge on poultry zoonoses, hopefully further improving the attitude of the stakeholders to higher level.

The practice score tends to decrease with respondents who are single (civil status) ($\beta=-3.105$). This observation was also noted by [Çakmur et al. \(2015\)](#), wherein married participants have better practice scores than single participants. Studies have pointed out that married people give protective importance to health because children are at higher risk than other age groups ([Stull et al., 2012](#); [Levallois et al., 2014](#)). [Abunna et al. \(2024\)](#) observed the relationship between knowledge and practice scores. Their study conducted in Ethiopia found that respondents with good knowledge scores have better practices in reducing the risk of exposure to zoonotic diseases.

Knowledge score is significantly associated with the practice score of stakeholders. Those with higher knowledge levels will likely have high practice scores ($\beta=2.010$). A similar result to the study by [Alemayehu et al. \(2024\)](#) in Ethiopia showed the association of respondents being provided with training and education associated with good prevention practices among farm owners and farm attendants. Similar findings among farmers and pastoralists in Ethiopia showed the association of good knowledge and good practices on zoonotic disease risks from livestock birth products. Furthermore, [Moutos et al. \(2022\)](#) revealed that a better knowledge score of ruminant livestock farmers in Greece was positively associated with practice scores.

It is noteworthy that stakeholders from different places have different levels of knowledge, attitudes, and practices regarding zoonoses. Thus, the information education campaign to improve stakeholders' knowledge, attitudes, and practices regarding zoonoses should be designed according to the stakeholders and location. Furthermore, increasing the knowledge level of the stakeholders will improve their practices, which can result in better control and prevention of zoonotic diseases from poultry.

CONCLUSIONS

The study shows that the stakeholders have a moderate knowledge level with high attitude and practice levels for zoonotic diseases from poultry. Interestingly, the pattern indicates that attitude and practices are not a reflection of the knowledge level of stakeholders.

Despite the moderate level of knowledge among stakeholders, there are knowledge questions that only a few of the respondents were able to provide correct answers, especially on poultry zoonosis definition (113, 25.06%), severe possible illness due to zoonoses (187, 41.56%), proper handling of chickens (155, 34.37%) and preventive (223, 49.45%) and vaccination protocols (148, 32.89%). Thus, there is a need to provide additional information on zoonoses and information on common poultry diseases.

The mean attitude level of the respondents is of high level; however, there is still a need to improve the stakeholders' attitude on the following aspects: contact with infected poultry and its products, contact of immunocompromised individuals to poultry and its products, keeping of poultry near the house and areas near food and water, wearing of personal protective equipment (PPE) and having

veterinarians visit the farm regularly to check for the health status of the flock. The high level of attitudes and practices means that stakeholders are doing what they think is suitable to control poultry diseases in general or without knowing the reason or the purpose of doing such measures to prevent and control zoonoses.

On average, the respondents' practices are ideal though there are still practices that need improvement, especially on the handling of live poultry. Only a few of the respondents pointed out the correct answer. The majority of the raisers asked help when their flocks were affected by diseases; however, when the sources of help were explored, there are still several raisers who source their information in treating their flock from sources that are not authorized to prescribe drugs for the treatment of the diseases especially concerning antimicrobials. The prudent use of antibiotics in animals is highly recommended to reduce the risk of mounting antimicrobial resistance, especially on zoonotic pathogens ([Commission Notice – Guidelines for the Prudent Use of Antimicrobials in Veterinary Medicine, 2015](#)).

With the moderate knowledge level with high levels of attitude and practices of stakeholders, efforts are still needed to increase stakeholders' awareness, especially those who are not working directly with poultry through the use of several means of information dissemination. As knowledge score is positively associated with increased attitude and practice scores, increasing the knowledge level of stakeholders will increase the attitude and practices to a higher level.

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CONFLICT OF INTEREST

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