



ZOO NOTIC DISEASE AWARENESS AMONG VETERINARY AND MEDICAL STUDENTS IN GHANA: IMPLICATIONS FOR PUBLIC HEALTH

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ABSTRACT: This study examined Ghanaian veterinary and medical students' knowledge and perception of zoonoses' public health impact. This cross-sectional survey utilised online structured questionnaires which were completed by 384 students (174 veterinary and 210 medical students) from 4 Ghanaian state universities. SPSS version 25 was used to analyse the data obtained using mean scores, Pearson Chi-square, and regression analysis. The study found that 78.6% of medical and veterinary students in Ghana have decent understanding of zoonoses, with a mean response of 4.88 ± 1.049 . Veterinary students (42.9%) knew more about zoonosis than medical students (35.7%). 83.6% of medical and veterinary students had a strong opinion of the public health importance of zoonoses, with a mean of 3.99 ± 1.017 . Medical students (45.8%) had a higher view of zoonosis than veterinary students (37.8%). Students' awareness of zoonosis was not substantially associated to religion ($P=0.694$) or institution ($P=0.06$), but was significantly related to gender ($P=0.044$), school ($P=0.031$), and year of study ($P=0.004$). Students' perceptions of zoonoses' public health significance were not significantly related to gender, religion, institution, or school ($P>0.05$), but were significantly related to their year of study ($P<0.001$). Ghanaian medical and veterinary students had strong awareness and perceived public health importance of zoonoses, especially the clinical students. In view of these findings, policy debate is needed to evaluate medical and veterinary pre-clinical education to include the teaching of zoonoses. To understand their role in zoonoses control, medical, veterinary, animal, and environmental science students should be encouraged to attend workshops that focus on zoonoses and their control.

Keywords: Zoonoses, Knowledge, Veterinary, Medical, Perception, Students

INTRODUCTION

Zoonoses are important causes of human and animal morbidity (Rahman *et al.*, 2020, Chowdhury *et al.*, 2021, Ateudjieu *et al.*, 2023). Of the known pathogen species implicated in human disease, 61% are zoonotic (Rahman

et al., 2020, Abede *et al.*, 2020). Comparatively, neglected among this vast group of pathogens are endemic zoonoses, which, despite their low profile within the global health agenda, have tremendous health and economic implications in the developing world (Zinsstage *et al.*, 2023). Many endemic zoonoses not only cause considerable human disability but also impair livestock productivity, imposing multiple burdens on low level communities (Maudlin *et al.*, 2009, Mpouam *et al.*, 2021). Zoonoses are infectious diseases that are naturally transmitted from vertebrates to humans and vice versa. They include brucellosis, rabies, human African trypanosomiasis, bovine tuberculosis, cysticercosis, echinococcosis and anthrax (WHO, 2006). These infections account for more than half of human infections worldwide, with most cases reported in developing countries like Ghana (Amissah-Reynolds, 2020). Zoonoses are a major public health problem with a significant burden on national and global economies. Compared to industrialized countries, animal health and human health in developing countries are disproportionately affected by zoonotic pathogens, as these countries are often located in the tropics and thus in infection-prone areas (Underwood *et al.*, 2015). In addition, people's dependence on livestock, the high prevalence of bush meat consumption, lack of food and water safety and security, and frequent interactions with wildlife can expose many segments of the human population to zoonotic pathogens (Espinosa *et al.*, 2020, Peros *et al.*, 2021, Friant *et al.*, 2022). Zoonoses have several impacts on the society and this impact can be socio-economic in nature as well as of public health significance. According to research, the public health concerns and economic impact of zoonoses (cost of controlling zoonotic diseases among other costs) have been identified to be on the rise in many countries and in such countries, the implementation of suitable methods for livestock and zoonotic diseases protection is extremely uneasy (Smith *et al.*, 2019, Rahman *et al.*, 2020, Erkyihun and Alemayehu, 2022, Bernstein *et al.*, 2022). Even though the zoonotic diseases are having great impact on human health, most of them are less well-diagnosed, causing enormous suffering and death of thousands of children and adults annually (WHO, 2006). This unfortunate phenomenon requires a much rigorous and robust approach of control and prevention.

In a general view, zoonoses cannot be controlled without an interdisciplinary approach which should include public health education and community involvement as well (Jagadeesh Babu *et al.*, 2015, van Herten *et al.*, 2019). Nevertheless, in most of the under developed and developing countries, low education level, culture and eating habits, presence of reservoir population, inadequate disease control programmes and lack of information about disease burden have been reported to be associated with persistence of zoonotic diseases (John *et al.*, 2008, Asbjør, 2009). In a broader perspective, public health activities involve a diverse range of functions within the public, which reflects the broad community interest between veterinary and human medicine (King and Khabbaz, 2003). A “one health” approach to zoonotic disease control demonstrates closer cooperation between human and animal health resulting in benefits that are not achieved through the two medicines working independently (Narrodd *et al.*, 2012). In countries like Malaysia, the National zoonoses committee between Ministry of Health (MOH) and Department of Veterinary Services (DVS) was set up during the Nipah virus outbreak in 1999. In Philippines, coordinating mechanism has been established in a tripartite interagency committee named Philippines Interagency Committee on Zoonoses (PhiCZ) which was successfully used to address the Ebola Reston outbreak in 2009 and subsequently other outbreaks such as anthrax and leptospirosis (Ong & Hussni, 2015). According to submission by Narrodd *et al.* (2012), most developing countries have their surveillance of zoonotic diseases not recognized as a “onehealth” collaboration between veterinary medicine and human medicine. This however creates a gap in the interdisciplinary approach of zoonotic diseases control.

University students, particularly veterinary and medical students, play key roles in the current and future application of zoonotic prevention and control principles (Wilkes *et al.*, 2019). According to Khatun *et al* (2019), the issue of inadequate support for building public health and veterinary core capacities in zoonoses especially

the lack of training and education in various medical and veterinary institutions in the world is a major contributing factor to increase in zoonotic disease occurrence. This shows that in a holistic approach to controlling zoonoses, there is the need for inter-disciplinary capacity building especially with the medical and veterinary institutions. In literature, studies on knowledge, perception and attitude towards zoonoses in Ghana has focused on poultry farmers (Ayim-Akonor *et al.*, 2020) but not on veterinary or medical students who are the key communicators of information on zoonotic diseases and their control to farmers and the community at large after their educational training. This research therefore served as a preliminary study aimed at gaining insight into the knowledge base of medical and veterinary students when it comes to their knowledge of zoonoses and their perception of the public health significance of zoonoses.

MATERIALS AND METHODS

Research Design and Study Area: This study was designed as a cross-sectional survey to assess the knowledge and perceived public health significance of zoonoses among veterinary and medical students in Ghana. The study area was focused on the four main Public Universities in Ghana. These were the Kwame Nkrumah University of Science and Technology (KNUST) in Kumasi, University of Ghana (UG) in Accra, University of Development Studies (UDS) in Northern region, and University of Cape-Coast (UCC) in Cape-Coast. Amongst the selected universities, only KNUST and UG are currently running the Doctor of Veterinary Medicine programme as well as the Human Medicine programme whilst UDS and UCC were running only the Human Medicine programme. This however accounted for relatively higher number of medical students recorded in this study as compared to veterinary students.

Study Population, Sampling Technique & Sample Size: The study population in this current research comprised all the veterinary and medical students of the 4 selected public universities in Ghana. Characteristically, the student population comprised of different individuals with different socioeconomic backgrounds and from different ethnicities. The sampling technique employed for this study was the convenience sampling technique. This method of sampling technique was chosen because it is easy, cheap, efficient, and simple to implement. Sample size was determined using the Cochran's 1963 formula. The formula used for sample size determination was as follows;

$$N = Z^2 \frac{1-\alpha^2}{d^2} (PQ)$$

Where;

N = required sample size; α = level of significance (0.05),

Q = 1-p; $Z_{1-\alpha}$ = standard normal deviate within 95% confidence interval (1.96)

P = the proportion of individuals within the selected age range in the study area = (50%). d = level of precision at 5% (standard value 0.05)

$$N = (1.962 \times 0.5 \times 0.5) \div 0.052 = 384$$

A total of three hundred and eighty-four (384) students served as the sample size used in this study.

Data Collection Instrument and Procedure: In this study, a well-structured questionnaire which was designed by researchers and with the help of Google Forms, this served as the data collection instrument. The questionnaire was divided into 3 sections. The first section comprised questions on the demographic characteristics of the students (age, gender, institution, school, institution, religion and year of study). The second section comprised of 3 questions on the varied definitions of zoonoses including "Zoonoses are the diseases shared in nature between humans and other vertebrate animals", "Zoonoses include diseases shared in nature between humans and arthropods", "Zoonotic diseases remain a significant threat to public health". In addition, students were asked to indicate by selecting some specific zoonoses they have knowledge of including; rabies, toxoplasmosis, anthrax, brucellosis, salmonellosis, tuberculosis, hydatidosis, leptospirosis, fasciolosis, and Ebola. The third section of the

questionnaire comprised 6 questions on the perceived public health significance of zoonoses. The questions included; "Zoonotic disease is a more threatening problem in developing countries than in the developed regions", "The death toll due to zoonotic diseases is grossly underestimated", "Zoonoses have not been given the required priority it deserves in terms of preventive and control measures", "Certain people are more predisposed to zoonotic diseases than others, "Occupational exposure is a prime means of zoonotic disease spread", "Zoonoses do not kill". The questions on knowledge of zoonoses and perception of the public health significance of zoonoses were rated on a 5- point Likert scale which ranged from '1=strongly disagree' to '5=strongly agree'. Medical and Veterinary students were contacted via their Student Association WhatsApp platforms, informing them of the research study, its purpose. A link to the online questionnaire was sent to the students WhatsApp platform. A constant daily reminder of the questionnaire was submitted to the student WhatsApp platforms for a 3-months period to remind the students of the need to fill the online questionnaire. The responses to the questionnaires were retrieved from Google Forms in a Microsoft Excel format by the researcher after the three-month' time frame of data collection (from December, 2021 to March, 2022) had elapsed.

The validity of the study questionnaire used was ascertained through a pretest conducted on some selected students in one of the study areas. These students did not form part of the main study this was ensured by informing the students used in the pretest about not participating in the main study as well as indicating on the online form that students involved in the pretest are not part of this data collection. A total of 20 (10 medical and 10 veterinary) students were used for the pretest. These students were from the School of Medical Sciences and the School of Veterinary Medicine in KNUST. Based on the pretest conducted, the reliability of the developed questionnaire was checked using the Cronbach Alpha test of which α value of 0.78 was recorded which indicated the findings of the questionnaire used were reliable. The survey considered obtaining responses from 384 respondents based on the sample size calculation used. The questionnaire was administered to the entire student population of about 2428 medical and 310 veterinary students in the selected public universities and the number of responses submitted were monitored on Google Forms App until the 384 responses needed was obtained. The app was closed for not receiving any further responses after the 384 responses were obtained. Incomplete surveys were not obtained in this study after checking the responses obtained this was because the questionnaire was designed to ensure all questions were answered before submitting the questionnaire.

Data Analysis: Statistical data analysis performed on all the data collected using Statistical Package for Social Sciences (SPSS Version 25). Descriptive statistics were used to analyse the demographic characteristics as well as the students' knowledge and perception of the public health importance of zoonoses. Data was summarized using mean, standard deviation in quantitative data and using frequency and percentages for categorical data. Results of the study were described using the mean responses and the standard deviation and the interpretation was based on a scale. Mean score for strongly disagree ranged from 1.0 – 1.80, disagree ranged from 1.81– 2.60, neutral ranged from 2.61 – 3.40, agree ranged from 3.41 – 4.20 and strongly agree ranged from 4.21 – 5.00. The level of knowledge and perceived public health significance with respect to zoonoses were categorised using the mean values of which 1.0 – 1.80 = very low, 1.81– 2.60 = low, 2.61 – 3.40 = moderate, 3.41 – 4.20 = high and 4.21 – 5.00 = very high. The mean responses categorised as very low and low were grouped into "low level" whilst mean response of high and very high were grouped as "high level" whilst mean scores categorized as moderate was kept as "moderate". This was performed after the data analysis was performed to improve interpretability of the results. The mean score for knowledge was calculated based on the response given to the questions asked on the definition of zoonoses whilst the mean for perception was calculated based on the response given to the questions asked on the perception of the public health significance of zoonoses.

Pearson Chi-square test was used to determine the significant association between categorical variables which were grouped. Linear Regression analysis was also carried on to determine the relationship between the demographic characteristics of the students and their knowledge and perception of the public health significance of zoonoses. Statistical significance was tested at 5% significance level or 95% confidence interval which meant that p-values less than 0.05 were considered as statistically significant.

RESULTS

Results obtained for the demographic characteristics of the students are displayed in Table 1 below. The findings indicated that out of the 384 respondents, 183 students representing 47.7% were males as compared to 201 (52.3%) female students. Findings on the religious background of the respondents indicated that 66.1% were Christians whilst 33.9% were Muslims. In terms of the tertiary institution from which students involved in the study were sourced, the results indicate that 28.1%, 32.3%, 14.6% and 25.0% of the students were from UG, KNUST, UDS and UCC respectively. The findings showed that 45.3% of the students were from the School of Veterinary Medicine (SVM) whilst 54.7% were from the School of Medical Sciences (SMS). The findings further showed that majority (63.8%) of the respondents were clinical year students whilst the remaining 36.2% of the respondents were preclinical year students (Table 1).

Table 1:

Demographic characteristics of respondents

Variable	Categories	Frequency (n)	Percentage (%)
Gender	Male	183	47.7%
	Female	201	52.3%
Religion	Christianity	254	66.1%
	Islamic	130	33.9%
Institution	UG	108	28.1%
	KNUST	124	32.3%
	UDS	56	14.6%
	UCC	96	25.0%
School	SVM	174	45.3%
	SMS	210	54.7%
Level of study	Pre-clinical	139	36.2%
	Clinical	245	63.8%

Knowledge of Zoonoses: Results on the knowledge of students on zoonoses were displayed on Table 2 below. The results indicate that the overall knowledge of zoonoses among veterinary and medical students is good with a mean response of 4.88 ± 1.049 .

In reference to the responses to the individual questions, 324 (85.4%) of the students agreed that “zoonoses are the diseases shared in nature between humans and other vertebrate animals” have heard of the term ‘zoonoses’ whilst 60 (15.6%) of the students were neutral. Majority of the students, 235

Table 2:

Students’ response to survey questions on knowledge of zoonoses

(61.2%) were affirmative that “zoonoses includes diseases shared in nature between humans and arthropods”. The majority of the respondents 364 (94.8%) were affirmative and of the view that “zoonotic diseases remain a significant threat to public health” as indicated in Table 2 below.

Knowledge of zoonotic diseases: Results obtained on the knowledge of the students on some zoonotic diseases known to them are displayed in Figure 1 below. The findings indicated that 80.5% of medical students know Ebola as a zoonotic disease as compared to 68.9% of the veterinary students. 57.50% of the veterinary students mentioned fasciolosis as a zoonotic disease as compared to 10.5% of medical students. 96.6% of the veterinary students mentioned anthrax as a zoonotic disease as compared to 4.7% of medical students. 32.8% of the veterinary students mentioned Leptospirosis as a zoonotic disease as compared to 3.8% of medical students. 58.6% of the veterinary students mentioned Toxoplasmosis as a zoonotic disease as compared to 3.8% of medical students. With respect to Tuberculosis, 86.8% of the veterinary students mentioned tuberculosis as a zoonotic disease as compared to 86.2% of medical students. 60.3% of the veterinary students mentioned hydatidosis as a zoonotic disease as compared to 39% of medical students. 56.3% of the veterinary students mentioned Salmonellosis as a zoonotic disease as compared to 37.6% of medical students. 56.9% of the veterinary students mentioned Brucellosis as a zoonotic disease as compared to 4.8% of medical students. 97.1% of the veterinary students mentioned Rabies as a zoonotic disease as compared to 76.2% of medical students.

<u>Statement</u>	<u>SD</u>	<u>D</u>	<u>N</u>	<u>A</u>	<u>SA</u>	<u>Mean Response</u>
Zoonoses are the diseases shared in nature-between humans and other vertebrate animals	(0.0%)	(0.0%)	60 (15.6%)	124 (32.3%)	200 (52.1%)	4.34 ± 0.948
Zoonoses include diseases shared in nature between humans and arthropods	15 (3.9%)	29 (7.5%)	105 (27.4%)	165 (43.0%)	70 (18.2%)	3.02 ± 1.507
Zoonotic diseases remain a significant threat to public health.	(0.0%)	(0.0%)	20 (5.2%)	60 (15.6%)	304 (79.2%)	4.28 ± 0.693
Overall Mean Response						4.88 ± 1.049

SD- Strongly disagree, D- Agree, N- Neutral, A- Agree, SA- Strongly agree

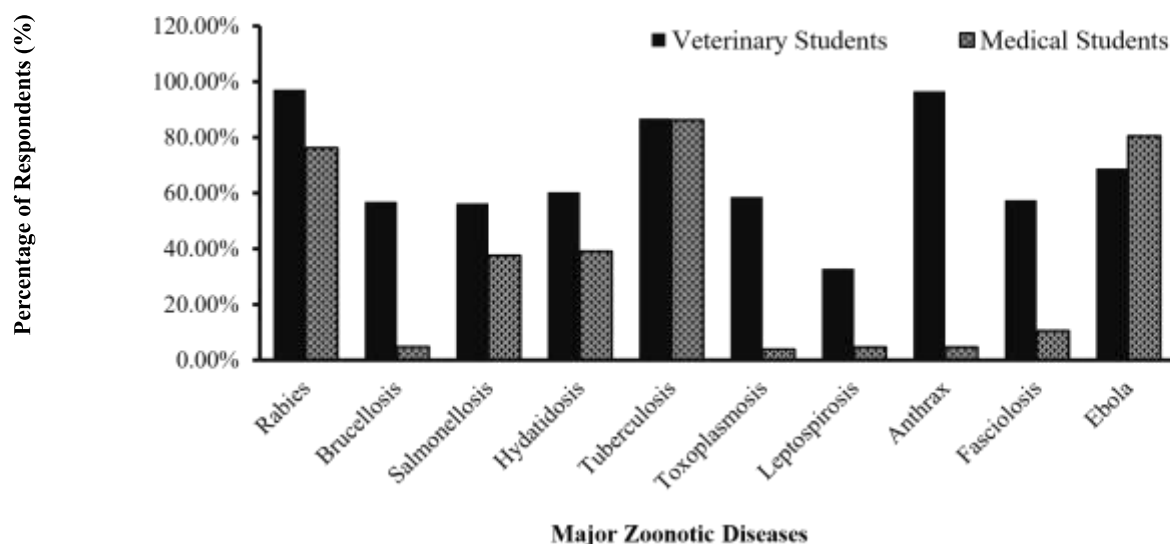


Figure 1: Veterinary and Medical Students' knowledge of some major zoonotic

diseases in Ghana **Table 3:**

Students' response to survey questions on perceived public health significance of zoonoses

Perceived public health significance of zoonoses: This study examined the perceived public health significance of zoonoses of veterinary and medical students. The findings as shown in Table 3 indicated that the medical and veterinary students had an overall good perceived public health significance of zoonoses with a mean of 3.99 ± 1.017 .

The recorded mean response for zoonotic diseases being more threatening problems in developing countries than in the developed regions was 4.04 ± 1.059 . The mean responses indicate clearly that the students perceive zoonotic disease in developing countries such as Ghana as more threatening. With respect to the death toll due to zoonotic diseases being grossly underestimated, a mean response of 4.98 ± 0.854 indicated that majority of the students strongly agreed that death toll due to zoonoses is underestimated. With a mean response of 3.87 ± 1.145 , majority of the students in this study agreed that zoonoses has not been given the required priority it deserves in terms of preventive and control measures. With a mean response of 4.7 ± 1.026 , majority of the students in this study strongly agreed that certain people are more predisposed to zoonotic diseases than others. With a mean response of 4.8 ± 1.196 , majority of the students in this study strongly agreed that occupational exposure is a prime means of zoonotic disease spread. With a mean response of 1.6 ± 0.821 , majority of the students in this study strongly disagreed that zoonoses is not a killer. This shows that most of the students perceived zoonoses as diseases that have very high potential of claiming lives (Table 3)

Level of Knowledge and Perceived Public Health Significance of Zoonoses: The results on the overall knowledge and perception of veterinary students with respect to zoonoses are displayed in Table 4 below. The findings showed that, 302 (78.6%) of the students had a high-level knowledge of zoonoses whilst 82 (21.4%) had low level knowledge of zoonoses. High level knowledge of zoonoses was seen in 165 (42.9%) of the veterinary students as compared to 137 (35.7%) of the medical students.

Demographic Characteristics and Knowledge of Zoonoses: Findings on the relationship between the demographic characteristics of the veterinary and medical students on their knowledge of zoonoses were displayed on Table 5 below. Generally, the knowledge level was high level; however, the knowledge level of zoonoses among the students was not significantly ($P > 0.05$) related to their religion ($P = 0.694$), and institution ($P = 0.06$), but was statistically significant ($P < 0.05$) with the gender ($P = 0.044$), department/school ($P = 0.031$) and year of study ($P = 0.004$) of the students.

With respect to gender, more female students (44.8%) had a high-level knowledge of zoonoses as compared to the male students (33.9%). Furthermore, more students in veterinary school (42.9%) had high level knowledge in zoonoses as compared to the students in medical school (35.7%). According to the year of study, more clinical students (60.9%) had high level knowledge of zoonoses as compared to the preclinical students (17.7%).

Table 6:

Relationship between student demographics and perception of public health significance of zoonoses

Variable	Category	Level of Perception of Public Health Significance of Zoonoses			P-value	
		High level	Moderate	Low level		
Gender	Male	140 (36.4%)	20 (5.2%)	23 (8.6%)	18.54	0.174
	Female	181 (47.1%)	10 (2.6%)	10 (2.6%)		
Religion	Christianity	205 (53.4%)	24 (6.3%)	25 (6.5%)	12.96	0.063
	Islam	116 (30.2%)	6 (1.6%)	8 (2.1%)		
Institution	UG	95 (24.7%)	8 (2.1%)	5 (1.3%)		

	KNUST	96 (25.0%)	10 (2.6%)	18 (4.7%)	25.37	0.524
	UDS	44 (11.5%)	7 (1.8%)	5 (1.3%)		
	UCC	87 (22.7%)	5(1.3%)	4 (1.0%)		
School	SVM	145 (40.3%)	18 (4.7%)	11 (2.9%)	19.30	0.087
	SMS	176 (45.8%)	12 (3.1%)	22 (5.7%)		
Year of Study	Preclinical	110 (28.7%)	25 (6.5%)	4 (1.0%)	21.55	0.000*
	Clinical	211 (54.9%)	5 (1.3%)	29 (7.6%)		

- *p-value is significant at 5% significance level

Effect of demographic characteristics of students and perceived public health significance on knowledge of zoonoses

Variable	R	R2	Beta	P-value	Confidence Interval
Constant	0.180	0.033		0.000	
Age			0.046	0.636	0.896 – 1.488
Gender			0.239	0.037*	1.446 – 2.045
Religion			0.210	0.622	0.998 – 1.130
Institution			0.106	0.243	0.287 – 0.571
School			0.507	0.032*	1.112 – 1.723
Year of Study			0.631	0.004*	1.541 - 2.271
Perceived public health significance			0.253	0.087	0.768 – 1.102

****p<0.05; Dependent Variable: Knowledge of Zoonoses***

The findings on the relationship between demography and knowledge on perceived public health significance of zoonoses is displayed in Table 8. The R2 value of 0.066 in Table 8 shows that there was a variation of 6.6% on perception of public health significance of zoonoses due to changes in the demography and knowledge. The R value of 0.258 shows that there was a relatively weak but positive relationship between the study variables.

It was noticed from Table 8 that it was noticed that the year of study affected the level of students' knowledge on zoonoses whilst the effects of age ($p=0.227$), gender ($p=0.140$), religion ($p=0.889$), school ($p=0.258$), institution ($p=0.556$) and knowledge ($p=0.087$) on the perception of the public health significance of zoonoses were not statistically significant. The highest variation in level of perception of the public health significance of zoonoses was caused by year of study with a beta of 0.810 ($p<0.05$).

Table 8:

Variable	R	R ²	Beta	P-value	Confidence Interval
Constant	0.258	0.066		0.000	
Age			0.109	0.227	1.510 – 1.953
Gender			0.213	0.140	0.358 – 1.045
Religion			-0.014	0.889	0.925 – 1.287
Institution			-0.048	0.556	1.147 – 1.853
School			0.056	0.258	0.153 – 0.608
Year of Study			0.810	0.019*	1.124 – 1.571
Knowledge					

zoonoses

0.253 0.087 1.532 – 2.041

* $p < 0.05$; Dependent Variable: Perception of Public Health Significance of Zoonose

DISCUSSION

This current study examined the knowledge and perceived public health significance of zoonoses among Ghanaian veterinary medical students. The findings revealed that students enrolled in medical and veterinary schools in Ghana have relatively high-level knowledge of zoonoses with a mean response of 4.88 ± 1.049 which represented 78.6% of the students of which 42.9% were veterinary students and 35.7% were medical students. The overall high-level knowledge of zoonoses in this study corroborates the findings of Tanko (2016) who reported a high level of knowledge of zoonoses amongst 90.2% and 92.4% of medical and veterinary students from Malaysia and Nigeria respectively. The relatively higher percentage of students having high level knowledge of zoonoses in the study conducted by Tanko (2016) as compared to this current study could be attributed to differences in the academic discourse in the different countries. In this study however, the differences in the level of knowledge of zoonoses with respect to veterinary and medical students in this study was found to be statistically significant ($p = 0.031$). This finding agrees with the findings of Tanko (2016) who also found out that the faculty from which students were coming from predicted their knowledge of zoonoses with regards to students from Malaysia. He reported higher knowledge in zoonoses for veterinary students as compared to medical students. This finding indicates that the differences in the level of knowledge of veterinary and medical students with respect to zoonoses could be attributed to possible differences in their educational curriculum. According to Kakkar *et al.* (2011), the relatively lower percentage of medical students with high level knowledge in zoonoses in India, could imply that some zoonotic diseases are being covered to some extent in the medical curriculum, but have not been understood clearly.

In this study, high ranking zoonotic diseases such as rabies, anthrax, tuberculosis and Ebola were selected by a relatively greater majority of the veterinary students. This is in agreement with the findings of Molineri *et al.* (2015) where rabies and tuberculosis were mentioned by university students reading veterinary medicine in Argentina. A similar survey was conducted in 13 Universities in Argentina, where most students recognized zoonotic diseases to be ringworm, brucellosis and toxoplasmosis 18. The differences in the findings could be as a result of differences in the zoonotic disease ecology in the study area of Argentina as indicated by Robin *et al.* (2012), whilst in this current study conducted in Ghana, rabies has been noted as a major zoonotic disease known to the populace (Suu-Ire *et al.*, 2021). This finding shows that rabies which have been given major attention in the country in terms of public education is well-known to both veterinary and medical students. Nevertheless, it is suggestive that the more public health educational programmes on other zoonotic diseases aside rabies is eminent and will have a positive impact on the knowledge of students with respect to certain zoonotic diseases aside rabies.

Although it was observed that there is a relatively high level of knowledge on zoonoses amongst the medical and veterinary students sampled in this study, this finding was also statistically significant ($p < 0.05$) with the gender ($p = 0.043$) and year of study ($p = 0.025$) of the students. The significant differences in the knowledge of zoonoses as related to the gender could be attributed to the fact that more female students filed the questionnaire as compared to the males hence the disparity in the findings. The high-level knowledge of zoonoses exhibited by the clinical students (60.9%) than preclinical students (17.7%) could be as a result of the exposure of the clinical students to medical and veterinary clinical practices as well as access to extensive lectures on public health, veterinary public health and zoonotic disease and therefore have extensive knowledge in zoonotic diseases. This corroborates the findings of Tanko (2016) who also found that the year of study predicted the knowledge of zoonoses among medical and veterinary students in Nigeria. In Ghana, pre-clinical students are highly burdened with basic sciences course such as physiology, anatomy, microbiology, biochemistry and parasitology and hence they have limited access to information on zoonotic diseases. The development of knowledge in zoonoses in preclinical years is important in ensuring adequate understanding of the dynamics involved in ensuring the effective control of zoonotic diseases in the country.

In this study, the perceived public health significance of zoonoses of veterinary and medical students with respect was high with a mean of 3.99 ± 1.017 represented by 83.6% of the students in this study. The relatively high-level perception of students with respect to the public health significance of zoonoses is evidential in 91.2% of the students indicating that zoonotic diseases are more threatening problems in developing countries than in the developed regions. This further corroborates the findings of John *et al.* (2008) who indicated that zoonotic diseases in developing countries are less reported hence the disease burden not properly known. According to the year of study, more clinical students (54.9%) had high level knowledge of zoonoses as compared to the preclinical students (28.7%). This finding could be as a result of the exposure of the clinical students to medical and veterinary information on zoonoses as well as access to extensive lectures on public health, veterinary public health and zoonotic disease and therefore influencing their outlook and perceived public health significance of zoonotic diseases. This study was limited to only public university veterinary and medical students. This study did not incorporate students from the environmental science and animal science disciplines hence focused only on the medical and veterinary disciplines only. The questionnaire was also limited to asking the students about specific zoonoses known in Ghana. The issue of social desirability bias on the part of the respondents could also be a limitation to this study as the questionnaire was administered online without the physical presence of the researchers. Based on the outcome of this current study, it was concluded that the veterinary and medical students in Ghana at large exhibited high level knowledge of zoonoses; however more veterinary students exhibited high level knowledge of zoonoses as compared to their counterparts in medical school. The students considered in this study also possessed a high level perceived public health significance on zoonoses with more medical students possessing it the most. The gender, school and level of study had significant effects ($p \leq 0.05$) on level of knowledge of zoonoses among veterinary and medical students whilst the clinical year students exhibited relatively higher perception on the public health importance of zoonoses as compared to the pre-clinical year students.

Call for curriculum review to include teachings on zoonoses in the pre-clinical years of both medical and veterinary schools through policy dialogue is necessary. Workshops on zoonoses should include medical, veterinary, animal and environmental science students so that their future role in the control of zoonoses will be understood. Further studies should consider incorporating students from other private universities in order to obtain a nationwide view of the knowledge and perception of students in Ghana. Further studies should also consider students from the animal science and the environmental science in order to obtain a holistic view of their

knowledge on zoonoses. This will help identify which disciplines to incorporate extensive zoonotic education to help in obtaining the interdisciplinary approach of the onehealth initiative.

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