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KNOWLEDGE, ATTITUDE AND PRACTICES AMONG PASTORALISTS AND ANIMAL HEALTH WORKERS ON TICK-BORNE SPOTTED FEVER GROUP RICKETTSIOSIS IN PLATEAU STATE, NIGERIA

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ABSTRACT

Tick-borne Spotted Fever Group Rickettsioses (SFGR) is a serious disease reported in low income communities of many developed countries. The dearth of information on the existence of SFGR in most developing countries particularly in Sub Saharan Africa (SSA) including Nigeria, has been attributed to many factors chiefly amongst which are; poor knowledge of the disease, limitation of diagnostic capacity, leading to misdiagnosis and under reporting of some infectious zoonotic diseases such as SFGR. The aim of this study was to evaluate the pastoralists (livestock farmers) and animal health workers' knowledge, attitudes and perceptions/practices towards ticks and tick-borne SFGR affecting livestock in 3 Local Government Areas (LGA): i.e., in Plateau State, Nigeria and including Jos the Capital City of the State. A total of 141 semi-structured questionnaires were administered to respondents including 90 pastoralists and 51 health workers from different veterinary clinics. Interestingly, the pastoralists expressed no knowledge about SFGR, although 61.36 % reported a history of tick infestation. Among the animal health workers, about 76.47 % expressed some knowledge about the disease, but lacked knowledge of the diagnosis of the disease. The findings indicate that there was the need for an increase awareness on SFGR and its predisposing factors among relevant stakeholders in the Plateau State, Nigeria.

Key words: animal health workers; Nigeria; pastoralists; plateau; SFGR; tick-borne

INTRODUCTION

Tick-borne rickettsioses are zoonotic infections caused by obligate intracellular bacteria of the genus *Rickettsia*. The infections are endemic in many African countries and represent a public health challenge [38]. Members of the genus *Rickettsia* can be classified into four phylogenetic groups for which Spotted Fever Group Rickettsioses (SFGR) is one of them [24].

Ixodid ticks are the main vectors and reservoirs of the SFGR and they transmit the infections to domestic animals, wild life and humans [32, 35]. Rickettsioses are considered zoonotic diseases because they are transmissible from animal to humans and are considered vector-borne zoonoses

because they are transmitted by the bite of various arthropods including ticks, lice, fleas and mites [8]. Also, rickettsioses have been viewed as emerging and re-emerging diseases with an almost worldwide distribution [23, 36]. Ungulates play a very important role as the primary hosts for the ticks while humans are accidental and dead-end hosts [6]. *Rickettsia* is a large genus encompassing at least 30 recognized species of which 19 are considered to be human pathogens [2, 24]. In some African countries, such as South Africa, four tick-borne SFG *Rickettsia* species have been implicated as the cause of human diseases, including *R. africae* which causes African Tick Borne Fever (ATBF), *R. conorii* which causes the Mediterranean Spotted Fever (MSF), *R. aeschlimannii* which causes innominate rickettsioses, and *R. sibirica* subsp. *Mongolitimonae*, which causes lymphangitis-associated rickettsiosis (LAR) [22, 28, 31]. In Nigeria, though, some of these zoonotic SFG Rickettsiae species (*R. africae, R. aeschlimannii, R. conorii* subsp. israelensis and *R. massilliae*) had been reported [12, 13, 18, 19, 20, 26, 27, 33] in ixodid ticks collected from animal hosts and vegetation, there hasn't been any record of *Rickettsia* species in humans. Generally, the information about the circulation and distribution of rickettsiae-infected tick species in Nigeria is scarce and fragmented.

Most people are exposed to ticks and tick-borne rickettsioses during occupational and recreational activities in rural areas, and the epidemiology of each tick-borne rickettsial disease is reflected by the geographic distribution and seasonal activity of the tick vectors [7, 15]. In Nigeria, the extensive or semi-intensive practice of the production system by livestock farmers, in which the animals are allowed to roam freely and fend for themselves occasionally, depending on the season, exposes the animals to tick infestation and tick-borne pathogens such as SFG rickettsioses.

SFG rickettsioses are considered second only to malaria and they also play an important role in public health as the most commonly diagnosed diseases in travellers returning from sub-Saharan Africa with systemic febrile illness [9, 11]. Common symptoms of SFG rickettsioses in humans may include fever, headache, intense myalgia, skin rash, occasional eschar formation at the site of the tick bite, with the capability of deadly consequence in acute cases if they are not treated [3, 29, 30, 39]. The early treatment of rickettsial infections can prevent complications from exacerbating, reduce the risk of dying, and shorten the recovery time. The use of antibiotics such as doxycycline (preferred) or chloramphenicol in the early treatment of rickettsial infections have been reported to be effective [10].

In spite of the abundance and wide distribution of the tick vectors, there is insufficient or scarcity of epidemiological information, limited diagnostic capacity, and poor knowledge of the SFG rickettsioses in rural communities of sub-Saharan Africa [29]. This could be attributed to the fact that most tropical rickettsioses are often misdiagnosed as malaria, typhoid or acute febrile diseases.

Domestic animals such as dogs, cats, goats and sheep can serve as important hosts of SFGR infections to humans due to their close relationship and associated activities with humans [28].

Despite the vast epidemiological and predisposing reported factors of SFGR, there is no available literature on the pastoralists/livestock farmers' and health workers' knowledge, attitudes and practices on ticks and tick-borne SFG rickettsioses in Nigeria. This study, therefore, sought to examine socio-demographic characteristics, knowledge, attitudes and practices of pastoralists (livestock farmers) and animal health workers towards SFGR and its vector ticks in Plateau State, North Central Nigeria.

MATERIALS AND METHODS

Ethical clearance

Approval for this study was granted by the Animal Use and Care Committee (AUCC), National Veterinary Research Institute (NVRI), Vom, Plateau State, Nigeria, No. AEC/02/62/18.

Consent was sought from pastoralists/livestock farmers before interviews using a language of their choice and alongside, animals were sampled for ticks after obtaining verbal consent from them. In the same vein, verbal consent was also sought from the veterinary personnel in the veterinary clinics before the interviews. They were all assured of the confidentiality of the information provided during the interviews.

Study area

The study was carried out in three Local Government Areas (LGAs) – Jos-South, Kanke, and Shendam, of Plateau State, Nigeria. Randomized sampling through balloting was used to determine the study areas.

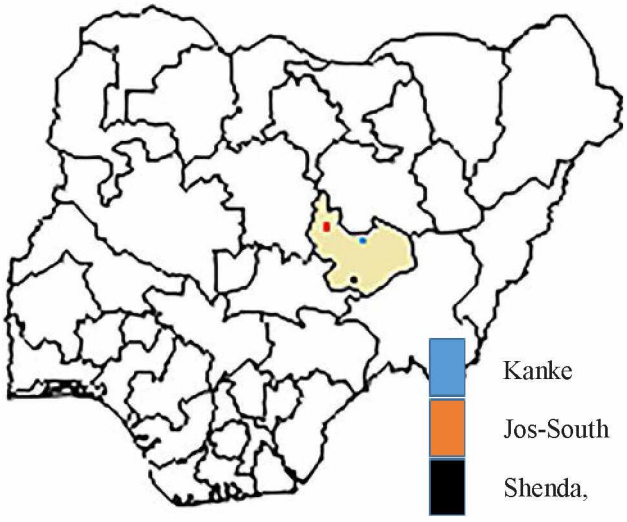

Fig.1. Map of Nigeria showing the study areas in Plateau State

Plateau State (9°00′–10°30′ N and Latitude 8°30′–09°30′ E) with an estimated population of about 5.5 million inhabitants, occupies an area of approximately 26,899 km^2 in the central part of Nigeria [1, 17]. Although they are situated in the tropical zone, a higher altitude of about 1238 m above sea level, means that Plateau State has a near temperate climate with temperature of between 13 and 22 °C. The mean annual rainfall varies between 131.75 cm (52 in.) in the southern part to 146 cm (57 in.) on the Plateau. The study was carried out in three LGAs representing the three Senatorial Districts of Plateau State, Nigeria, and including Jos the capital city of the state (Fig. 1). The different major languages spoken in these LGAs include the following: Jos-South (Berom), Kanke (Ngas, Myet, Boghom, Taroh and Badawa) and Shendam (Geomai).

Study design

The questionnaire was administered to two groups of people, the livestock farmers, and the health workers (veterinary personnel). The interviews were conducted on the livestock farmers in three LGAs, Jos-South, Kanke and Shendam representing the three Senatorial districts of Plateau State, including Jos capital city where big and established veterinary clinics are located in the state.

A total of one hundred and forty-one (141) semi-structured questionnaires were administered to respondents including 90 livestock farmers, 30 each from the three LGAs, and fifty-one (51) veterinary personnel from different veterinary clinics which include; National Veterinary Research Institute, Vom Clinic, ECWA Veterinary clinic, Bukuru, University of Jos Veterinary Teaching Hospital, Jos and MAAS Private Veterinary clinic, Jos.

Data collection

The administration of the semi-structured questionnaire was done with the help of research assistants who understand the local dialects of the livestock farmers for easy translation for those not conversant with the English language. The veterinary clinics' data collection commenced immediately after that of the livestock farmers' and all these were carried out between September and December, 2018.

The questionnaire focused on specific issues for each group of respondents. For the livestock farmers (pastoralists) these included; socio-demographic characteristics, knowledge of tick infestations and likely diseases transmitted/caused in livestock and man, diseases of importance shared with the livestock, zoonotic diseases including tick-borne especially SFG rickettsioses and their clinical manifestations (symptoms) and preventive measures taken against zoonotic infections. For the veterinary personnel, they included: socio-demographic characteristics, the types of animals received in the clinics, zoonotic tick-borne diseases found in the animals received, knowledge of SFG rickettsioses, clinical signs and animals diagnosed of SFG rickettsioses, drugs of choice, and laboratory diagnostic methods for SFGR.

Data Analysis

The data generated from the respondents were analysed using Epi-Info 2000 Software version 3.3.2, Excel spreadsheet (Microsoft Inc.) and SPSS version 25.0 (PASW Inc.). Percentages were calculated as the ratio between the pastoralists'/animal health workers' response to the interviews and the total number of pastoralists/animal health workers interviewed. The percentage of each response was calculated separately and presented in Tables. The associations of perception/practice with demographic variables were tested using Chi-square statistic. Values of $P \leq 0.05$ were considered significant.

RESULTS

Pastoralists

Socio-demographic information

Of the 90 pastoralists interviewed, 30 were from each LGA which include Jos South, Kanke, and Shendam.

Most of the respondents across the three LGAs were males with 81(90.0 %) while females were 9 (10.0 %). Also, the data show that most of the household heads were men with 77.7 % (70/90). Overall, across the three study areas, the largest group with 30/90 (33.33 %) of the respondents were aged 51–60, followed by ages 41–50 having 22/90 (24.44 %), while the least were those of ages less than 20 (1.11 %). The highest level of education attended by the respondents was secondary school with 39/90 (43.33 %), followed by primary school 33/90 (36.67 %) and the least were tertiary school level 9/90 (10.00 %). About 10.00 % had no formal education (Table 1).

Major livestock kept by the respondents in the study areas were sheep, goats and cattle. Of which, out of 90 households 76/90 (84.44 %) kept goats, 54/90 (60 %) kept sheep and 22/90 (24.44 %) kept cattle. In respect of

Table 1. Pastoralists: Socio-demographic information

	Frequency	Percent [%]
Sex of respondents		
Female	9	10.00
Male	81	90.00
Total	**90**	**100.00**
Position of respondents in household		
Head	70	77.78
Spouse	8	8.89
Son	11	12.22
Daughter	1	1.11
Total	**90**	**100.00**
Age of respondents		
< 20	1	1.11
21–30	9	10.00
31–40	19	21.11
41–50	22	24.44
51–60	30	33.33
> 60	9	10.00
Total	**90**	**100.00**
Educational qualification		
None	9	10.00
Primary	33	36.67
Secondary	39	43.33
Tertiary	9	10.00
Total	**90**	**100.00**

	Frequency	Percent [%]
Types of livestock kept		
Goats		
Yes	76	84.44
No	14	15.56
Total	90	100.00
Sheep		
Yes	54	60.00
No	36	40.00
Total	90	100.00
Cattle		
Yes	22	24.44
No	68	75.56
Total	**90**	**100.00**
Types of livestock kept in respect of LGA		
LGA/Goats		
Jos South	170	24.25
Kanke	275	39.23
Shendam	256	36.52
Total	**701**	**100.00**
Sheep		
Jos South	115	24.31
Kanke	132	27.91
Shendam	226	47.78
Total	**473**	**100.00**
Cattle		
Jos South	67	33.67
Kanke	57	28.64
Shendam	75	37.69
Total	**199**	**100.00**

LGA – Local Government Area

LGAs, goats were kept more by households in Kanke with 275 (39.32%), followed by Shendam 256 (36.23%) while Jos South was the least with 170 (24.25%). However, in Shendam LGA, sheep and cattle were found to be kept more by households than in Jos-South and Kanke, with sheep recording 226 (47.78%) and cattle 75 (37.69%), respectively (Table 1). Apart from sheep and goats, other livestock kept included rabbits, chickens, dogs, pigs, cats etc. by much proportion of the households except dogs that were kept by almost all the households especially in Kanke LGA, where dog meat is also used as their special delicacy.

Of the 90 respondents, 54 (61.36%) accepted that their animals were affected by ticks, while 34 (38.64%) didn't accept. Out of the 54 (61.36%) who accepted 12 (22.22%) were from Jos south, while 21 (38.89%) were from Kanke and Shendam each.

The respondents who were aware about tick-borne zoonotic diseases were few 27 (33.75%). They however listed diseases such as babesiosis, anaplasmosis, and even trypanosomosis that is not a tick-borne disease. In respect of LGA, 5 (18.52%) were from Jos South, 10 (37.04%), while Kanke and Shendam recorded the highest with 12 (44.44%).

Less than 50% of the respondents 32 (39.51%) across the three study areas admitted that they had been bitten by ticks. For example, seven (21.88%) were from Jos South, 8 (25.00%) from Shendam, and the highest 17 (53.13%) were from Kanke who admitted having been bitten by ticks. In addition, some revealed having been discomforted or felt itchy upon the bite by ticks.

Interestingly, out of the 90 respondents, across all the three LGAs, none had knowledge of the disease SFG rickettsiosis in livestock or humans (Table 2).

Some practices by pastoralists were identified as potential risk factors that can predispose them to SFG rickettsioses. These included: (i) sharing living accommodations with livestock by most households which can potentially facilitate transmission of diseases through tick bites; (ii) Self-treatment of livestock by most pastoralists due to limited or absence of veterinary facilities in the study areas (iii); keeping of dogs which have been reported around the world as the potential carriers of SFGR by almost all the households, etc.

The respondents were asked of the possibility of transmitting livestock diseases to humans through sharing of the same household with livestock. Out of the 33 that re-

Table 2. Respondents' knowledge, attitudes and practices/perceptions on ticks, tick-borne diseases (TBDs) and spotted fever group rickettsioses (SFGR)

	Frequency	Percent [%]
Are your animals infested by ticks?		
Yes	54	61.36
No	34	38.64
Total	88	100.00
LGA		
Jos South	12	22.22
Kanke	21	38.89
Shendam	21	38.89
Total	**54**	**100.00**
Are you aware of disease that ticks can transmit to livestock?		
Yes	27	33.75
No	53	66.25
Total	80	100.00
LGA		
Jos South	5	18.52
Kanke	10	37.04
Shendam	12	44.44
Total	**27**	**100.00**
Are there times when you are bitten by ticks?		
Yes	32	39.51
No	49	60.49
Total	81	100.00
LGA		
Jos South	7	21.88
Kanke	17	53.13
Shendam	8	25.00
Total	**32**	**100.00**
Have you heard of the disease called Rickettsiosis?		
No	90	100.00
Total	**90**	**100.00**

LGA – Local Government Area

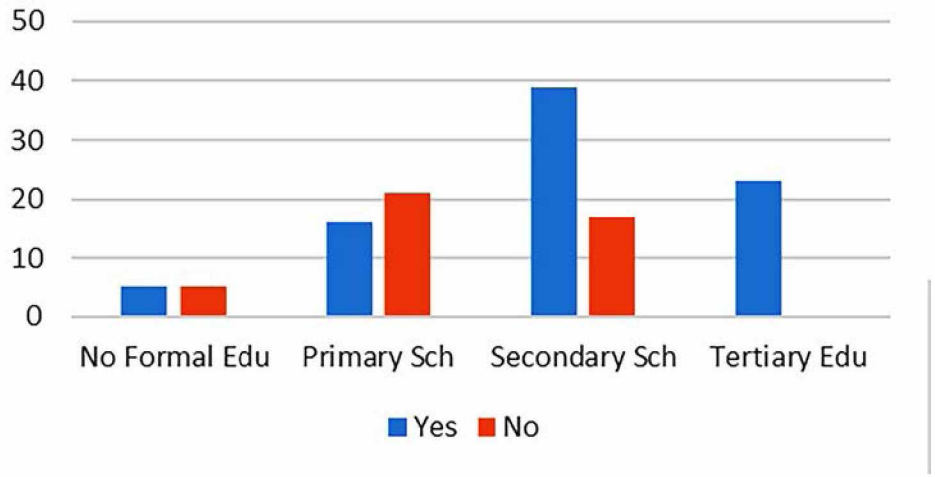

Fig. 2. Educational level and animal tick control practices

sponded, 18/33 (54.55%) agreed that sharing the same house with livestock can transmit livestock diseases to humans while 15/33 (45.45%) disagreed. The practice or perception of the respondents in seeking medical attention after observing some seemingly symptoms and signs of rickettsioses was not encouraging. Out of 26 that responded only 3 (11.54%) sought medical attention while the remaining 23 didn't seek medical attention. These 3 were from Jos South (2) and Kanke (1). The respondents were further asked if they ever considered taking measures to prevent tick bites on themselves (pastoralists). Out of 46 that responded 21 (45.65%) accepted taking measures to prevent tick bites while 25 (54.35%) had no consideration for that. On the other hand, some respondents also considered taking measures to prevent tick bites against their animals. Out of the 44 that responded, 29 (65.91%) expressed taking measures to prevent tick bites against their animals while the remaining 15 (34.09%) did not.

Though, there was no statistically significant association between educational qualifications and responses ($P>0.05$), those with higher educational qualification were more likely to consider taking steps to reduce tick infestation in their farms (Fig. 2)

Animal health workers (professionals)

Socio-demographic information

The semi structured questionnaire was administered to animal health workers in different clinics at different locations in the Plateau state. The clinics visited included the following: NVRI, Vom, Veterinary clinics, ECWA Veterinary clinics, Bukuru, Veterinary teaching hospital (VTH), Polo, Jos and MAAS Veterinary clinics, Jos.

Of the 51 health workers interviewed, 34 (66.67%) were males while 17 (33.33%) were females. Also, out of the 51 respondents, VTH had the highest number of respondents with 31 (60.78%), followed by NVRI, Vom Veterinary clinics with 11 (21.57%), ECWA Veterinary clinics 7 (13.73%) and the least was MAAS Veterinary clinics with 2 (3.92%).

Out of the 51 respondents interviewed, the majority of the workers responded were within the age range of 31–40 with 26/51 (50.98%), followed by the age range of 41–50 with 11/51 (21.57%) while the age range less than 20 had no respondent. Out of 51 respondents, 17 (33.33%) were veterinary doctors, followed by technologists 16 (31.37%), technicians 11 (21.57%), animal health officers 4 (7.84%), scientists 2 (3.92%) and others with 1 (1.96%).

Forty-nine out of 50 (98.60%) that responded said they encounter tick infestations on animals they receive, while only 1/50 (1.4%) respondent said no. From their responses 44/50 (88.0%) listed dog as the most commonly infested animal with ticks followed by sheep and goats with 2/50 (4%) each, and birds and geese the least with 1/50 (2.0%) each too. Out of the 51 respondents, 50/51 (98.04%) were aware of diseases that ticks transmit to animals (as they mentioned the diseases such as babesiosis, anaplasmosis, ehrlichiosis, borreliosis, etc.) while only 1/51(1.96%) was not aware. About 86.00% (43/50) of the respondents said that some of the listed diseases cause itching or discomfort to animals, while only 14% (7/50) answered no. At least more than half 76.47% (39/51) of the respondents had knowledge of rickettsiosis while 23.53% (12/50) had no information about it. Unfortunately, knowledge of that disease is not enough as almost all didn't know the diag-

nostic methods of it except one out of 38 (2.63%) that listed Enzyme Linked Immunosorbent Assays (ELISA). Furthermore, none of the respondents had come across the disease on the animals and let alone finding it necessary to confirm this disease in animals.

Comparing the responses between the pastoralists (livestock farmers) and animal health workers (professionals), however indicates that the professionals were much more aware of rickettsioses than the farmers (Fig. 3). There is statistically significant relationship between the two groups ($P \leq 0.05$) (Table 5).

Table 3. Socio-demographic data of animal health workers

	Frequency	Percent [%]
Sex of respondents		
Female	17	33.33
Male	34	66.67
Total	**51**	**100.00**
Clinic/Hospital		
ECWA Vet	7	13.73
MAAS Vet	2	3.92
VOM Vet	11	21.57
VTH Polo	31	60.78
Total	**51**	**100.00**
Age of respondents		
≤ 20	0	0.00
21–30	10	19.61
31–40	26	50.98
41–50	11	21.57
51–60	2	3.92
≥ 61	2	3.92
Total	**51**	**100.00**
Position of respondents in the clinic		
Veterinary doctor	17	33.33
Animal health officer	4	7.84
Scientist	2	3.92
Technician	11	21.57
Technologist	16	31.37
Others	1	1.96
Total	**51**	**100.00**

Table 4. Knowledge, attitudes and practices on ticks, tick-borne diseases (TBDs) and spotted fever group rickettsioses (SFGR)

	Frequency	Percent [%]
Do you encounter tick infestations on animals received?		
Yes	49	98.00
No	1	2.00
Total	**50**	**100.00**
If yes, which animal is most commonly infested?		
Birds	1	2.00
Dogs	44	88.00
Geese	1	2.00
Goats	2	4.00
Sheep	2	4.00
Total	**50**	**100.00**
Are you aware of any disease(s) that ticks can transmit to animals?		
Yes	50	98.04
No	1	1.96
Total	**51**	**100.00**
Does any of the diseases listed cause itching/discomfort to animals?		
Yes	43	86.00
No	7	14.00
Total	**50**	**100.00**
Have you heard of the disease called rickettsiosis?		
Yes	39	76.47
No	12	23.53
Total	**51**	**100.00**

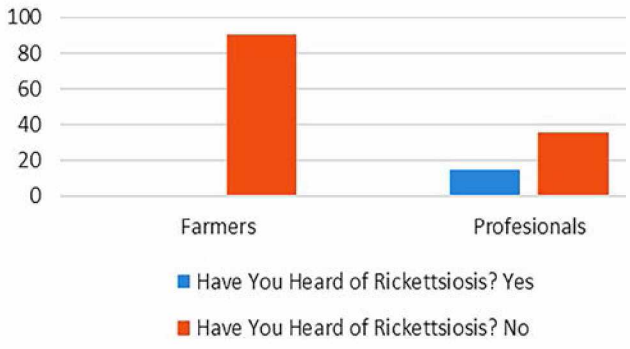

Fig. 3. Knowledge of rickettsiosis between pastoralists and animal health workers

Table 5. Association of knowledge of tick-borne rickettsioses between pastoralists and professionals

Response	Professionals (%)	Pastoralists [%]	Chi	P-value
Yes	39 (76.47)	0 (0.00)	91.4	2.2e-16
No	12 (23.53)	90 (100.00)	–	–
Total	**51 (100.00)**	**90 (100.00)**	–	–

DISCUSSION

This study demonstrated that among the pastoralists in the three study areas, males remain the livestock owners more than females. These findings are in line with previous reports that traditional livestock are usually owned by males as they can manage and face challenges such as feeding, handling and treatment of the animals better [14, 21, 25, 40]. Similar reports of the dominance of the livestock industry by males compared to females have been documented in South Africa [40], Zimbabwe [37], Nigeria [16] and Tanzania [5].

The majority of the livestock farmers in this study were above 50 years of age who seem to depend on farming as their source of income [4]. These findings can be compared with those of [40] and [34] who reported that elderly people are found more in the rural areas depending on farming for their source of income [21] while the younger people move to the urban areas for better job opportunities which are limited in the rural areas.

From this study, it is evident that there is no knowledge about SFGR amongst the livestock farmers/pastoralists, unlike the animal health workers who expressed knowledge about the disease, but, didn't have knowledge about the diagnostic methods of this disease apart from one veterinary doctor that listed Enzyme Linked Immuno-sorbent Assay (ELISA). These findings are comparable with those of Ndhlovu et al. [25] who reported low knowledge about SFGR amongst the pastoralists and health workers. These results of lack of knowledge about the SFG rickettsioses could be attributed to the low level of literacy amongst the pastoralists as the majority had only secondary 39/90 (43%) and primary 33/90 (36%) education level. This lack of knowledge about the diseases especially amongst the pastoralists raise concerns about the potential risks posed by the SFG rickettsioses to these livestock keepers. This lack of knowledge is in agreement with the findings of [25] and [37] who observed that more than 90% of the farmers participating in farming in Zimbabwe had secondary education level and [4, 21, 40] whose reports revealed farmers with only a primary education level that led to improper tick control. Owing to these facts, no doubt there is every possibility that this disease will be circulating unnoticed in the study areas between the animals and humans, since the facilities for investigation of the presence of the disease is not available in the veterinary hospitals and clinics visited. The disease could be amongst the "fevers of unknown origin" recorded in most medical facilities. The interview, according to some veterinary doctors created awareness or awaken their thoughts towards the disease and its diagnosis which had never been thought of in the past, as they promised to notify the relevant authorities.

Sharing living accommodations with animals among other things were identified as some practices that can predispose the pastoralists to zoonoses which include SFGR. Low level of knowledge towards many zoonotic diseases appears to be common in many African countries including Nigeria, raising concern about their under-diagnosis and under-reporting as also reported by [25]. Some, also were spotted even sharing their plate of food especially with dogs, and dogs have been incriminated in many research reports as one of the major hosts of the SFGR. Sharing living accommodations with livestock can promote transmission of SFGR as it can expose the livestock owners to tick-bites through close contact. This is also in agreement with the work of [25] and [40].

CONCLUSIONS AND RECOMMENDATIONS

The lack of knowledge on SFG rickettsiosis amongst the pastoralists raises concern about the potential risks of these zoonoses amongst local populations. This portends a

grave danger to both the pastoralist and his animals, who may contract and harbour the disease unknowingly, but focus on other maladies like malaria, typhoid etc. that have similar symptoms as rickettsiosis thus, causing more harm than good. In the same vein, the low knowledge on SFG rickettsioses and significantly no understanding of diagnosis of the said disease amongst the most respondents in the veterinary hospitals/clinics indeed raises alarm and calls for worry in Nigeria.

We therefore, recommend regular awareness about ticks and tick-borne diseases especially rickettsiosis to pastoralists/livestock farmers in the study areas. Also, inclusion of rickettsiosis as one of the differential diagnosis for fevers of unknown origin in the veterinary clinics or hospitals in Nigeria.

COMPETING INTERESTS

The authors declare that they have no competing interests.

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