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Seroprevalence of Coxiella Burnetti in Cattle and Its Risk Factors in Kaduna Metropolis, Kaduna State, Nigeria

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Abstract: *Coxiellosis (Q fever) is a zoonosis of public health significance. This study was aimed at determining the seroprevalence and the risk factors associated with Coxiella burnetti infection in cattle in Kaduna metropolis, Nigeria. A total of 539 blood samples from 42 cattle farms in the four Local Government Areas (LGAs) of Kaduna metropolis were tested using enzyme linked immunosorbent assay (ELISA), in addition to application of structured questionnaires on the farmers. The total prevalence rate and herd prevalence rates obtained were 78 (14.5%) and 24 (57.1%) respectively. The sex based prevalence rates showed no significant difference between females(14.5%) and males(14.1%). Age of cattle was not significantly associated with infection (OR= 1.13, 95% CI, 0.69-1.86). Prevalence was significantly higher in the local breed of cattle (17.1%) than cross breed (1.3%) (P<0.05). The questionnaire analysis showed prevalence rate was higher in herds with no ectoparasite control(100%) than in herds with ectoparasite control(56.1%).Cleaning and disinfection of equipment after use was found to have a significantly protective effect (OR= 0.15, 95% CI 0.03-0.79). The high prevalence rate of coxiellosis is of public health concern as this is a probable indicator of its presence in humans. It is also of importance as the disease can cause great economic loss among livestock population. A control programme involving good hygienic practices and public health education is recommended.*

Keywords*: seroprevalence, Coxiella burnetti, antibodies, risk factors, cattle, Kaduna metropolis.*

I. Introduction

Q fever (Coxiellosis) is an infectious disease caused by the bacterium *Coxiella burnetti*. Reproductive disorders such as abortions, stillbirths and delivery of weak and unviable newborns have been reported in livestock infected with *Coxiella burnetti* (Bildfell *et al*., 2006). The main sources of environmental contamination and infection of humans are parturient ruminants, dogs and cats infected with *Coxiella burnetti* (Woldehiwet, 2004). Cattle, sheep and goats are the primary reservoirs of *Coxiella burnetti* which is excreted in the urine, milk and feces of infected animals. Persons in contact with farm animals can be infected by inhalation of contaminated aerosols or dusts containing the micro organisms shed from infected animals. Oral transmission, by ingestion of contaminated raw milk or dairy products could lead to infection (Cutler *et al*., 2002; McQuiston *et al*., 2002; Rodolakis, 2006). Q fever is a polymorphic disease in humans with subclinal, acute and chronic forms. Outbreaks of Q fever have been reported from different countries (Arricau-Bouvery and Rodolakis, 2005). In Nigeria, a prevalence of 11% in cattle at slaughter has been reported (Addo and Schnurenberger, 1977). The major occupation of the people of Kaduna state is agriculture, with an estimated population of 1,144,000 cattle (KDSG ,2008). Cattle being a major source of human infection indicates the people are at risk of infection. Coxiellosis is a disease of both economic and public health significance. (Arricau- Bouvery and Rodolakis, 2005). There is the need to study this disease in farm animals as it relates to the farmers.

II. Materials And Methods

This study was carried out in the four LGAs that constitute Kaduna metropolis which are Kaduna north, Kaduna south and some parts of Chikun and Igabi Local Government areas. Localities sampled were Sabon Gayan, Rigachikun, Kabala, Tollgate, Babban saura, Kinkinau, Kaduna express, Gonin Gora, Barakallahu and Galari. The study was carried out in the second quarter of the year to determine the prevalence of coxiellosis in farm animals. The target population were cattle from farms. Sampling frame was drawn from a list of cattle farms around Kaduna metropolis compiled from data from animal health workers and private veterinary practitioners. Only farms whose owners consented were included, only farms that had 20 or more cattle were included. Forty two farms which had over 20 cattle were selected for this study. Those that did not meet the criteria were excluded. Information on age, sex, and breed were recorded in forms for the animals. Questionnaire to obtain information on management system, observed clinical signs, whether milk was boiled before consumption or not and risk factors associated with *C.burnetti* were administered. Twenty percent of cattle were sampled from each of 42 different farms and a sample size of 539 was obtained. Systematic random

sampling technique was employed. Blood for sera were collected from the jugular vein of cattle in the 42 farms. Samples were analyzed using a commercially available enzyme linked immunosorbent assay (ELISA) kit obtained from ID Vet Innovative Diagnostics, Montpellier - France. This test uses *Coxiella burnetti* phase 1 and phase 11 strains isolated in France from an aborted bovine placenta. The test kit has a sensitivity and a specificity of 100% (Manufacturer's data). Analysis was done according to the manufacturer's instructions. A sample to positive ratio (SP%) greater than 50% was considered positive. Odds ratio were used to analyzse the data at 95% confidence interval. Small sized data were subjected to Fisher's exact test.

III. Results

Of the 539 samples tested, 78 samples were positive giving a prevalence of 14.5%. Twenty four herds tested positive giving a herd prevalence of 57.1%.

There was no significant difference in infection between female cattle and male cattle (OR = 1.03, 1, 95% CI 0.54 - 1.97) (Table 1). The prevalence of *Coxiella burnetti* infection was significantly higher ($P<0.05$) in the local breed of cattle than the cross breeds while none of the exotic breeds sampled tested positive. *Coxiella burnetti* antibodies was more prevalent in cattle older than 3 years than in cattle aged 3 years and below (OR=1.13, 95% CI 0.69-1.86). Age was however not significantly associated with infection. The rate of detection of *Coxiella burnetti* antibodies was higher in the intensive management system (66.7%) compared to that in the semi intensive system (55.6%) (Table 2). However there was no statistically significant relationship between the management system and *Coxiella burnetti* infection. (OR = 0.63, 95% CI, 0.10 – 3.86).

A higher rate of infection was observed from herds supplemented with commercial feed (62.5%) than herds fed on locally compounded feed (53.8%). There was no significant relationship between mode of supplementary feeding and prevalence of infection. (Table 2).

There was no association between herd infection and type of housing (OR = 1.00) (Table 2). Prevalence of infection was higher in herds with no ectoparasite control (100%) compared to herds with ectoparasite control (56.1%) (Table 3).

Deworming routinely was associated with a lower prevalence but the association was not significant ($P>0.05$). (Table 3). Cleaning and disinfection of equipment after use was found to have a significantly protective effect (OR = 0.15, 95% CI, 0.03-0.79) (Table 4). Quarantine of newly purchased animals and rodent control were associated with lower prevalence (OR = 0.63, 95%CI, 0.18-2.20) and (OR= 0.46, 95%CI, 0.07-3.06) respectively. (Table 4).However, the associations were not statistically significant.

The prevalence of infection was higher in herds with no history of abortions or stillbirths (70%) compared to herds with abortion history (45.5%). (Table 5) This was however not statistically significant (OR = 0.36, 95% CI, 0.10-1.28).

Farms that burn after birth materials had a higher rate of infection, (100%) (Table 5) than farms that bury after birth materials (55%).

The presence of other animals on the farm was associated with infection (Table 5) but the association was not statistically significant (OR = 1.35, 95% CI 0.08 – 23.20).

Table 1 Prevalence of *Coxiella burnetti* infection in relation to sex, age and breed of cattle from farms in Kaduna Metropolis

Risk factor	Positive (%)	Negative (%)	Total (%)	OR	95% CI on OR	FE
Sex						
Male	13(14.1)	79(85.9)	92(100)	1		
Female	65(14.5)	382(85.5)	447(100)	1.03	0.54-1.97	
Total	78(14.5)	461(85.5)	539(100)			
Age (years)						
≤3	29(13.6)	184(86.4)	213(100)	1		
>3	49(15.1)	275(84.9)	324(100)	1.13	0.69-1.86	
Total	78(14.5)	459(85.5)	537(100)			
Breed						
Local	77(17.1)	373(82.9)	450(100)			P=0.00
Exotic	0(0)	10(100)	10(100)			
Cross	1(1.3)	78(98.7)	79(100)			
Total	78(14.5)	461(85.5)	539(100)			

Table 2 Prevalence of *Coxiella burnetti* infection in relation to management of cattle from farms in Kaduna Metropolis.

Risk factor	Positive (%)	Negative (%)	Total (%)	OR	95% CI on OR
Management system					
Intensive	4(66.7)	2(33.3)	6(100)	1	
Semi-intensive	20(55.6)	16(44.4)	36(100)	0.63	0.10-3.86
Total	24(57.1)	18(42.9)	42(100)		
Supplementary feeding					
Commercial feed	10(62.5)	6(37.5)	16(100)	1	
Locally compounded	14(53.8)	12(46.2)	26(100)	0.70	0.20-2.50
Total	24)57.1)	18(42.9)	42(100)		
Type of housing					
Complete housing	4(57.1)	3(42.9)	7(100)	1.00	
Fenced area	20(57.1)	15(42.9)	35(100)	1.00	0.19-5.15
Total	24(57.1)	18(42.9)	42(100)		

Table 3 Prevalence of *Coxiella burnetti* infection in relation to parasite and rodent control in cattle farms in Kaduna Metropolis.

Risk factor	Positive (%)	Negative (%)	Total (%)	OR	95% CI on OR	FE
Ectoparasite control						
Yes	23(56.1)	18(43.9)	41(100)			P=1.00
No	1(100)	0(0)	1(100)			
Total	24(57.1)	18(42.9)	42(100)			
Routine deworming						
Yes	21(53.8)	18(46.2)	39(100)			P=0.25
No	3(100)	0(0)	3(100)			
Total	24(57.1)	18(42.9)	42(100)			
Rodent control						
Yes	2(40)	3(60)	5(100)	0.46	0.07 – 3.06	
No	22(59.5)	15(40.5)	37(100)	1		
Total	24(57.1)	18(42.9)	42(100)			

Table 4 Prevalence of *Coxiella burnetti* infection in relation to biosecurity measures in cattle farms in Kaduna Metropolis.

Biosecurity Measures	Positive (%)	Negative (%)	Total (%)	OR	95% CI on OR	FE
Foot bath						
Yes	0(0)	2(100)	2(100)			P=0.18
No	24(60)	16(40)	40(100)			
Total	24(57.1)	18(42.9)	42(100)			
Cleaning and disinfection of equipment after use						
Yes	13(44.8)	16(55.2)	29(100)	0.15	0.03 – 0.79	
No	11(84.6)	2(15.4)	13(100)	1		
Total	24(57.1)	18(42.9)	42(100)			
Quarantine of newly purchased animals						
Yes	8(500)	8(50)	16(100)	0.63	0.18 – 2.20	
No	16(61.5)	10(38.5)	26(100)	1		
Total	**24(57.1)**	**18(42.9)**	**42(100)**			

Table 5 Prevalence of *Coxiella burnetti* infection in relation to reproductive problems and presence of other animals in cattle farms in Kaduna Metropolis.

Risk factor	Positive (%)	Negative (%)	Total (%)	OR	95% CI on OR	FE
Abortion or stillbirth history						
Yes	10(45.5)	12(54.5)	22(100)	0.36	0.10-1.28	
No	14(70)	6(30)	20(100)	1		
Total	24(57.1)	18(42.9)	42(100)			
Disposal of afterbirth materials						
Burn	2(100)	0(0)	2(100)			P=0.50
Bury	22(55)	18(45)	40(100)			
Total	24(57.1)	18(42.9)	42(100)			
Presence of other animals						
Yes	23(57.5)	17(42.5)	40(100)	1.35	0.08- 23.20	
No	1(50)	1(50)	2(100)	1		
Total	24(57.1)	18(42.9)	42(100)			

IV. Discussion

A prevalence of 14.5% to *Coxiella burnetti* antibodies was obtained in this study. This indicates that cattle in Kaduna metropolis have been exposed to *Coxiella burnetti* infection and this may be responsible for some of the reproductive disorders among infected cattle. The high prevalence recorded may be due to local management practices, environmental and climatic conditions and method of screening of samples. Geographical variations in the prevalence of infections have been reported in a number of studies. In Nigeria, Addo and Schnurenberger (1977) reported a prevalence of 11% in cattle. In USA, Italy, Southern Sudan, Zimbabwe, Chad, Central African Republic and Algeria, prevalences reported were 3.4% (McQuiston and Childs, 2002), 11.6% (Parisi *et al*., 2006) 40.4% (Reinthaler *et al*., 1988), 39% (Kelly *et al*., 1993), 4% (Schelling *et al*., 2003), 14.3% (Nakoune *et al*., 2004) and 7.9% (Cekani *et al*., 2008) respectively. The herd prevalence of 57.1% could be due to the management system that allows different herds with different infection status to mix together while grazing or drinking water. This favors the spread of infection from one herd to the other.

Rate of infection was slightly higher among females than males and this is probably because, the organism has a high affinity for the placenta, fetal membranes and mammary glands (Babudieri, 1959) and is found in large numbers in these tissues. This agrees with the study by Cetinkaya *et al*., (2000) where no significant association between seroprevalence of coxiellosis and sex of cattle was found in the east of Turkey.

Local breed of cattle had a significantly higher rate of infection than the cross breeds while none of the exotic breeds sampled had infection. . Exotic and cross breeds of cattle are priced animals and they tend to be better managed in terms of disease and tick control. This probably accounts for the lack of seropositivity seen. However, in the study by Cetinkaya *et al*.,(2000), no significant association was seen between seropositivity and breed of cattle.

Cattle over 3 years had a higher prevalence of infection than cattle 3 years and below. However age was not significantly associated with infection. Cattle older than 3 years are more likely to be breeding and shedding the organism, especially during parturition. Also, it may be due to a higher probability of contact with the organism with increasing age. Ruiz-Fons *et al*.,(2010) reported an age associated prevalence with infection rates higher in adult cattle than heifers.

Cattle reared under the intensive management system had a higher rate of infection compared to those under semi-intensive management. Contact between animals is greater in the intensive management system thereby increasing the likelihood of exposure to infection. Capuano *et al.*, 2001 reported that different management systems showed different degree of exposure to infection.

Herds with ectoparasite control had a lower rate of infection compared to herds with no ectoparasite control. The significance of ticks in transmitting the disease in ruminants has been documented (Lang, 1990), and therefore tick control can reduce the incidence of *Coxiella burnetti* infection in livestock (Angelakis and Raoult, 2010). In a study, Cantas *et al.,* (2011) reported the presence of ticks on animals as a significant risk factor associated with *Coxiella burnetti* abortions. .

Routine deworming was found to be associated with a lower prevalence. This is probably because deworming routinely makes animals less susceptible to infections

Biosecurity measures such as the use of foot bath and quarantine of newly purchased animals were associated with a lower rate of infection, which was not significant. Biosecurity measures help in reducing infectious

agents, and also reduce the risk of their transmission. Farms with rodent control had a lower frequency of infection compared to farms with no rodent control. Rodents are a source of infection as previous studies have reported the occurrence *of Coxiella burnetti* in rodents (Lang, 1990; Marrie *et al*, 1986).

Cleaning and disinfection of equipment after use was found to have a significantly protective effect. Good hygienic procedures can reduce the incidence of *Coxiella burnetti* infection in livestock (Angelakis and Raoult, 2010).

Abortion history was not significantly associated with infection and frequency of infection was higher in herds with no history of abortions or stillbirths compared to herds with abortion history. In some reports, infection with *Coxiella burnetti* did not result in abortion suggesting that infection sometimes can pass unnoticed (Paiba *et al*., 1999). Ruiz-Fons *et al.*, (2010) found that *Coxiella burnetti* antibody prevalence did not differ statistically in relation to herd abortion history. On the other hand, significant associations between seroprevalence and abortion have been reported for cattle in several studies (Cabassi *et al*., 2006; Cetinkaya *et al*., 2000). S

The presence of other animals like sheep, goats, cats and dogs was associated with infection, but the association was not significant. Domestic pets such as dogs and cats are known to be an additional source of infection (Lang 1990; Woldehiwet, 2004).

V. Conclusion

This study reports for the first time to the best of our knowledge the prevalence and risk factors associated with coxiellosis in Kaduna metropolis. The high prevalence necessitates that people at risk should be informed and preventive measures taken. Improved sanitation on farms through good hygienic practices, parasite and rodent control can reduce the rate of infection

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