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# Serological survey of *Brucella* infection in horses in Kano Metropolis, Kano State, Nigeria

AY Baba[1]*, SNA Shehu[2], AKB Sackey[2], EC Okolocha[3], BY Kaltungo[4], M Babashani[4], HU Buhari[5], YM Sanusi[3], AO Ahmed[6] & N Elelu[7]

1. *Department of Veterinary Medicine, University of Ilorin, Ilorin, Nigeria*
2. *Department of Veterinary Medicine, Ahmadu Bello University, Zaria, Nigeria*
3. *Department of Veterinary Public Health and Preventive Medicine, Ahmadu Bello University, Zaria, Nigeria*
4. *Veterinary Teaching Hospital, Ahmadu Bello University, Zaria, Nigeria*
5. *Samaru College of Agriculture, Ahmadu Bello University, Zaria, Nigeria*
6. *Department of Veterinary Microbiology, University of Ilorin, Nigeria*
7. *Department of Veterinary Public Health and Preventive Medicine, University of Ilorin, Nigeria*

*Correspondence: Tel.: +2348069419530; E-mail: baba.ya@unilorin.edu.ng



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Brucellosis is a zoonotic bacterial disease with worldwide distribution. A cross-sectional study was conducted to determine the serological prevalence of brucellosis in horses within Kano Metropolis. A total of 328 serum samples were collected for the study. Modified Rose Bengal Plate Test (mRBPT) was conducted on all the samples while the Serum Agglutination Test with EDTA (SAT-EDTA) was conducted on the mRBPT-positive samples. The prevalence of brucellosis in horses within the Kano metropolis was found to be 24.09 % (79/328) and 11.89 % (39/328) with mRBPT and SAT-EDTA respectively. There was no statistically significant difference in the seropositivity by the tests used. From the study, 37 (23.27%) out of the 159 mares were seropositive for *Brucella* antibodies using mRBPT while 16 (43.24 %) were positive using SAT-EDTA. Similarly, of the 169 stallions, 38 (22.4 %) were positive using mRBPT and of these 22(57.89 %) were further positive by using SAT-EDTA. Unlike the age and use of the horses; location, sex, and breed were not significantly associated with the seroprevalence rate obtained in the study using mRBPT $P<0.05$. This study showed that Brucella antibodies were circulating in the horses in the study area. Further study is recommended to determine the *Brucella* species circulating in these horses, particularly that brucellosis is zoonotic with serious public health significance. There is also the need to examine the horse owners and grooms for possible *Brucella* antibodies because equine brucellosis has serious public health significance.

*Keywords*: *Brucella* infection, Epidemiology, Horses, mRBPT, SAT-EDTA, Serology

## Introduction

Brucellosis is an infectious bacterial disease with worldwide distribution and has been reported in many domestic and wild animals and man (Kubuafor *et al.*, 2000; OIE, 2000; Aparicio, 2013). It is also one of the most important zoonoses today (OIE, 2000). The disease has economic importance as it affects livestock production and productivity. It also affects human productivity (OIE, 2000). There are eleven

*Brucella* species with *Brucella abortus, B melitensis, B suis* being the most common species encountered in livestock worldwide (Aparicio, 2013). Domestic animals commonly affected include bovine, ovine, caprine, and equine Spp, though canine and feline Spp have also been reported to equally be susceptible (Aparicio, 2013).

In Nigeria, reports of the disease in domestic animals include those of Esuruoso (1974), Bale & Kumi-Diaka (1981), Bale & Kwanashie (1984), Ior *et al*. (2013), Ocholi *et al.* (1996) and Ocholi (2004) and more recently those of Cadmus *et al*. (2006), Bertu *et al.* (2010), Kaltungo *et al*. (2013), Kaltungo *et al*. (2018), Buhari *et al*. (2020) and Baba *et al*. (2021). Most of these studies reported the disease in cattle, sheep, goats, horses and camels. There were also reports of the disease in chickens by Adesiyun & Abdu (1984), Gugon *et al*. (2012) and Ior *et al*. (2013). The disease has similarly been reported in rodents in Nigeria (Avong, 2000).

Previous research on brucellosis in Nigeria has indicated that livestock owners had a fair idea of the disease, only in cattle and too little extent in small ruminants and horses (Bertu *et al.*, 2010; Kaltungo *et al*., 2013; Yakubu, 2016; Buhari *et al*., 2020; Baba *et al*., 2021). These authors also reported that livestock owners and the general public seemed to have poor attitudes towards the disease as it was common for people to drink unpasteurized milk as well as eat poorly cooked meat from cattle and small ruminants (Kaltungo *et al*., 2013; Buhari *et al*., 2015; Kaltungo *et al*., 2018). They also reported that pastoralists commonly disposed of aborted foetuses by hanging them on trees or dumping them away from their herds without regard to possible transmission and spread of diseases like brucellosis. In a study, Kaltungo *et al*. (2018) reported that pastoralists had co-habitation with their livestock like sheep, goats, chickens and even donkeys and horses. Thus, it is possible for the transmission and spread of brucellosis among domestic animals and even humans should any of the animal species be infected with *Brucella* species.

It is for this reason that this study was undertaken to determine the seroprevalence of brucellosis in horses in Kano Metropolis, Kano State, Nigeria which was the subject of this study.

**Materials and Methods**

*Study area and sample frame*

The study was conducted in four Local Government Areas (LGAs) which were purposefully selected (based on the availability of horses) out of the seven LGAs of the Kano Metropolis. The selected LGAs include Kano Municipal Council, Gwale, Nasarawa, and Tarauni (Figure 1). The study area is part of Kano State, one of the 36 States that make up Nigeria (Barau *et al.*, 2015). Kano State is situated between latitudes $13^0$N and $11^0$N and between longitudes $8^0$W and $10^0$E. The State has a human population of 9,383,682 (NPC, 2006). There are an estimated 2,500 horses in Kano State out of the 1.4 million horses reported to be in Nigeria (FAO, 2019). The horses in Kano State were made up of polo, racing and ceremonial horses with most of the horses being found in Kano metropolis (Musa, 2013). Thus, for the study, the horses in the Kano metropolis were considered most appropriate in determining the status of horses in Kano State with regard to brucellosis.

*Ethical approval*:

The study was conducted according to the specification of the Ahmadu Bello University Committees on Animal Use and Care (ABUCAUC/2018/029).

*Sample size determination*

The sample size for the study was calculated based on the formula by Michael (2005) thus:

$$n = \frac{z^2 pq}{d^2}$$

Where:

N= Minimum sample size

*P*= Prevalence (20.05% as reported by Baba *et al*., 2022).

Sample size (horses) = $\frac{1.96^2 \text{ x } (0.2005 \text{ x } 1 - 0.2005)}{(0.05)^2}$

n = 246.

However, a total of 328 blood samples for serum were collected with the intention of increasing the sample size to accommodate attrition.

*Sample collection and preservation*

The blood samples were collected through the jugular vein of each sampled horse using 18G needle and 10ml syringes after the horses were effectively restrained using a temporary halter by an assistant (Baba *et al*., 2019). The collected blood samples were then decanted into a sterile blood sample bottle without ethylenediaminetetraacetic acid (EDTA). The bottles were then labelled with the number of the horse and its location. They were then kept in a slanting position in a Coleman box in which ice packs

were placed. Other information on the sampled horses included the location of sampling, sex, age and breed and were recorded in a log book for further use during data analysis. The bottles were then transported to the Bacterial Zoonoses Laboratory of the Department of Veterinary Public Health and Preventive Medicine, Ahmadu Bello University, Zaria. At the laboratory, each blood sample was centrifuged at 1000g for 5 minutes to separate the serum from the clot as previously described (Baba *et al*., 2022). The sera were then transferred into separate serum tubes and labelled according to the previous number of collections. The sera were then kept at -20$^0$C till used.

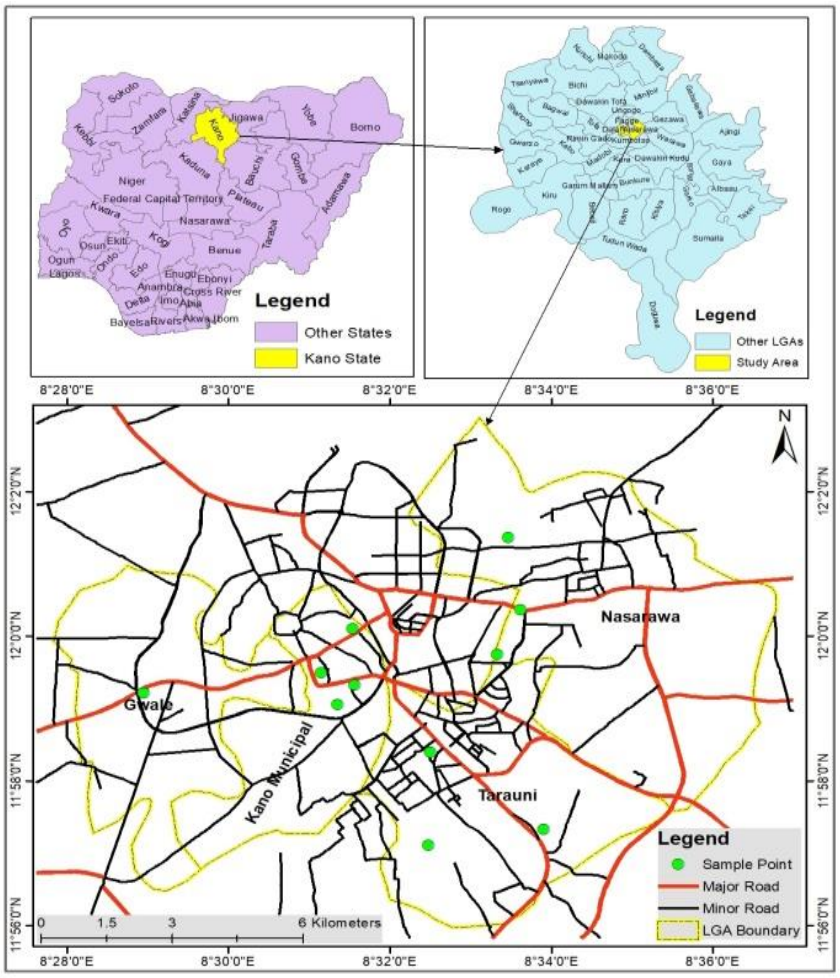


**Figure 1**: Map of Nigeria highlighting Kano State and the Local Government Areas Sampled in the metropolis

*Serological analysis*

Two serological tests were performed and they included a modified Rose Bengal Plate Test (mRBPT) and Serum Agglutination Test with EDTA (SAT-EDTA). The SAT-EDTA was used on the samples that were positive by mRBPT as the mRBPT was used as a screening test. For the mRBPT, the method of Bale (1980) as modified by Bertu (2014) was used. Briefly, the stored serum samples were removed from the freezer and placed on the working bench and allowed to thaw. Then a clean, grease-free white ceramic tile was placed adjacent to the serum tubes. For each serum sample, 75 ul of the serum was placed on the ceramic white tile and 25 ul of the RBPT antigen was similarly placed beside the serum sample. An applicator stick was then used to mix the serum and *Brucella abortus* RBPT antigen. The tile was then rocked gently for 4 minutes to further mix the contents. The results were then read as positive if agglutination was observed and negative if no agglutination appeared. The results were also recorded in the logbook. The RBPT antigen was sourced from the Oondersteport Biological Laboratory Products, South Africa. As for the SAT-EDTA, it was performed according to the method of Brown *et al*. (1981).

*Data collation and statistical analysis*

Data generated were presented in tables. The data were also analyzed using SPSS version 17.0 (2009). Fisher's exact test was used to test for agreement between M-RBPT and SAT-EDTA, $P<0.05$ was considered significant.

**Results**

From the study, a total of 92 samples were collected from the Kano Municipal Council (KMC) while 37, 129 and 70 samples were collected from Gwale, Nasarawa, and Tarauni LGAs respectively (Table 1). Horses at KMC were made up of 91 Arewa breeds and 1 Talon breed. Similarly, horses at Gwale were made up of 5 Argentine, 29 Sudan and 3 Talon breeds. As for those at Nasarawa, 2 were Arewa, 4 Argentine, 98 Sudan and 25 Talon while the horses at Tarauni were made up of 5 Arewa, 2 Argentine, 62 Sudan and 1 Talon breeds.

Of the 328 horses that were sampled, 79 (24.09 %) were seropositive for *Brucella* antibodies using mRBPT. Furthermore, of the 79 serum samples that were positive for mRBPT, 39 (11.89 %) were further positive by SAT-EDTA (Table 2). There was no statistically significant difference in the seropositivity by the tests used.

From the study, 37 (23.27%) out of the 159 female horses were seropositive for *Brucella* antibodies using mRBPT while 16 (43.24) were positive using SAT-EDTA. Similarly, of the 169 male horses, 38 (22.4%) were positive using mRBPT and of these, 22 (57.89%) were further positive by using SAT-EDTA (Table 3). By location, all the 92 horses sampled from the KMC were males and 24 (26.09%) of them were seropositive for *Brucella* antibodies using mRBPT while of these 24, 16 (66.67%) were further positive using SAT-EDTA. Similarly, of the 25 female horses from Gwale LGA, 8 (32.00%) were positive for *Brucella* antibodies using mRBPT and out of these 8, 4 (50.00%) were also positive for using SAT-EDTA. None of the 12 horses from Gwale LGA was positive for *Brucella* antibodies using both mRBPT and SAT-EDTA (Table 3). In Nasarawa LGA, a total of 129 horses comprising of 90 female and 39 male horses respectively were sampled. Of the 90 female horses, 21 (23.33%) were seropositive using mRBPT and out of these, 8 (38.10%) were further positive using SAT-EDTA. Furthermore, of the 39 male horses in Nasarawa LGA, 7 (17.95%) were positive using mRBPT

**Table 1**: Distribution of horses sampled for B*rucella* infection in sampled LGAs of Kano metropolis, Kano State, Nigeria

| | | Breed of horses sampled | | | |
|---|---|---|---|---|---|
| LGA | No Sampled (%) | Arewa | Argentine | Sudan | Talon |
| Kano Municipal | 92 (28.05) | 91 (98.91) | 0 (0) | 0 (0) | 1 (1.09) |
| Gwale | 37 (11.28) | 0 (0) | 5 (13.51) | 29 (78.38) | 3 (8.11) |
| Nasarawa | 129 (39.33) | 2 (1.55) | 4 (3.10) | 98 (75.97) | 25 (19.38) |
| Tarauni | 70 (21.34) | 5 (7.14) | 2 (2.86) | 62 (88.57) | 1 (1.43) |
| Total | 328 (100) | 98 (29.88) | 11 (3.35) | 189 (57.62) | 30 (9.15) |

RBPT: Pearson Chi-Square= 2.821[a]; p= 0.420

SAT-EDTA: Pearson Chi-Square= 5.763[a]; p= 0.124

**Table 2**: Seroprevalence of *Brucella* infection using mRBPT and SAT-EDTA of horses sampled in four LGAs of Kano Metropolis, Kano State, Nigeria

| LGA | Number (%) Positive by test type | | |
|---|---|---|---|
| | Number of Samples tested | mRBPT (%) | SAT-EDTA (%) |
| Kano Municipal | 92 | 28 (30.43) | 17 (60.71) |
| Gwale | 37 | 8 (21.62) | 4 (50.00) |
| Nasarawa | 129 | 28 (21.71) | 13 (46.43) |
| Tarauni | 70 | 15 (21.43) | 5 (33.33) |
| Total | 328 | 79 (24.09) | 39 (49.37) |

RBPT: Pearson Chi-Square= 2.821[a], P= 0.420

SAT-EDTA: Pearson Chi-Square= 5.763[a]; P= 0.124

**Table 3**: Seroprevalence of *Brucella* infection by sex of horses sampled in four LGAs of Kano Metropolis, Kano State, Nigeria

| LGA/Sex | Female - No Positive (%) | | Male - No Positive (%) | |
|---|---|---|---|---|
| | mRBPT | SAT-EDTA | mRBPT | SAT-EDTA |
| Kano Municipal | 0 (0.00) | 0 (0.00) | 24 (26.09) | 16 (66.67) |
| Gwale | 8 (32.00) | 4 (50.00) | 0 (0.00) | 0 (0.00) |
| Nasarawa | 21 (23.33) | 8 (38.10) | 7 (17.95) | 5 (71.43) |
| Tarauni | 8 (18.18) | 4 (50.00) | 7 (26.92) | 1 (1.27) |
| Total | 37 (23.27) | 16 (43.24) | 38 (22.49) | 22 (57.89) |

mRBPT: Fisher's Exact Test= .029[a]; p= 0.896

SAT-EDTA: Fisher's Exact Test= .698[a]; p= 0.491

while 5 (71.43%) of these positive ones were further positive using SAT-EDTA. In Tarauni LGA 44 female horses were sampled out of which 8 (18.18%) were positive by using mRBPT and 4 (50.00%) of these 8 were further positive by using SAT-EDTA. Furthermore, of the 26 male horses, 7 (26.92%) were positive by using mRBPT while 1(1.27%) of the 7 positive horses was further positive by using SAT-EDTA (Table 3). There was no statistically significant association between the seroprevalence of *Brucella* infection and sex in these horses ($P > 0.05$).

The seroprevalence by age of horses is presented in Table 4. Of the 91 horses in the 1 to 5 years old bracket, 20 (21.98%) were positive by mRBPT while of these positive 9 (45.00%) were positive by SAT-EDTA. Similarly, of the 216 horses in the 6 to 10 years old, 51 (23.61%) were positive for *Brucella* antibodies by mRBPT while out of those that were positive 25 (49.02%) were further positive by using STA-EDTA. Furthermore, of the 18 horses that were 11 to 15 years old, 5 (27.78%) were seropositive for *Brucella* antibodies using mRBPT while 4 (80.00%) out of the 5 that were positive were also positive by using SAT-EDTA. All (100%) the horses that were 15 years or older were positive by using mRBPT and only one (33.33%) of them was positive by using SAT-EDTA. (Table 4). There was a significant association between mRBPT seropositivity and age of animals sampled ($P < 0.05$).

With regard to seropositivity by the breed of horses, of the 98 Arewa breeds of horses 30 (30.61%) were positive by using mRBPT while of these 30 horses that were positive by mRBPT 18 (60.00%) were positive further positive by using SAT-EDTA. Also, of the 11 Argentine horses, 4 (36.36%) were positive for *Brucella* antibodies and none of them was positive for SAT-EDTA. Similarly, of the 89 Sudan horses that were tested, 36 (19.05%) were positive by using mRBPT while 15 (41.67%) of them were also positive by using SAT-EDTA. With regard to the Talon breed of horses, 9 (30.00%) out of the 30 Talon horses were positive by mRBPT and of these positive Talon horses, 6 (66.67%) were also positive by SAT-EDTA (Table 5).

Considering seroprevalence by purpose, 92 horses were ceremonial while 215 and 21 were polo and racing respectively. Of the 92 ceremonial horses, 28 (30.43%) were seropositive by using mRBPT and of these 28, 17 (60.71%) were further positive by using SAT-EDTA. Similarly, of the 215 polo horses, 50 (23.26%) were positive for *Brucella* antibodies by using mRBPT and of these 50 that were positive, 22 (44.00%) were further positive by using SAT-EDTA. Of the 21 racing horses, only 1 (4.76%) was seropositive for *Brucella* antibodies and was not positive for *Brucella* antibodies by using SAT-EDTA (Table 6).

**Table 4**: Seroprevalence of *Brucella* antibodies in horses in selected Local Government Areas of Kano State by age

| Age group | No. sampled | No. positive (%) using mRBPT | No. positive (%) using SAT-EDTA |
|---|---|---|---|
| 1– 5 years old | 91 | 20 (21.98) | 9 (45.00) |
| 6 – 10 years old | 216 | 51 (23.61) | 25 (49.00) |
| 11 – 15 years old | 18 | 5 (27.78) | 4 (80.00) |
| >15 years old | 3 | 3 (100.00) | 1 (33.33) |
| Total | 328 | 79 (24.09) | 39 (49.37) |

mRBPT: Pearson Chi-Square; P= 0.020 df= 3

SAT-EDTA: Pearson Chi-Square; P =0.318

**Table 5**: Seroprevalence using mRBPT and SAT-EDTA by breed of horses sampled in four LGAs of Kano Metropolis, Kano State, Nigeria

| LGA/ Horse Breeds | Arewa | | Argentine | | Sudan | | Talon | |
|---|---|---|---|---|---|---|---|---|
| | mRBPT | SAT-EDTA | mRBPT | SAT-EDTA | mRBPT | SAT-EDTA | mRBPT | SAT-EDTA |
| Kano Municipal | 28 (30.78) | 17 (60.71) | 0 (0.00) | 0 (0.00) | 0 (0.00) | 0 (0.00) | 0 (0.00) | 0 (0.00) |
| Gwale | 0 (0.00) | 0 (0.00) | 1 (20.00) | 0 (0.00) | 7 (24.14) | 4 (57.14) | 0 (0.00) | 0 (0.00) |
| Nasarawa | 0 (0.00) | 0 (0.00) | 1 (25.00) | 0 (0.00) | 18 (18.37) | 7 (38.89) | 9 (36.00) | 6 (66.67) |
| Tarauni | 2 (40.00) | 1 (50.00) | 2 (100.000) | 0 (0.00) | 11 (17.74) | 4 (36.36) | 0 (0.00) | 0 (0.00) |
| Total | 30 (30.61) | 18 (60.00) | 4 (36.36) | 0 (0.00) | 36 (19.05) | 15 (41.67) | 9 (30.00) | 6 (66.67) |

mRBPT: Fisher's Exact Test=6.732; p= 0.073

SAT-EDTA: Fisher's Exact Test= 9.464; p = 0.018

**Table 6**: *Brucella* Seroprevalence using mRBPT and SAT-EDTA by use in horses sampled in four LGAs of Kano Metropolis, Kano State, Nigeria

| LGA/USES | Ceremonial | | Polo | | Racing | |
|---|---|---|---|---|---|---|
| | mRBPT | SAT-EDTA | mRBPT | SAT-EDTA | mRBPT | SAT-EDTA |
| Kano Municipal | 28 (30.43) | 17 (60.71) | 0 (0.00) | 0 (0.00) | 0 (0.00) | 0 (0.00) |
| Gwale | 0 (0.00) | 0 (0.00) | 8 (21.62) | 4 (50.00) | 0 (0.00) | 0 (0.00) |
| Nasarawa | 0 (0.00) | 0 (0.00) | 27 (25.00) | 13 (48.15) | 1 (4.76) | 0 (0.00) |
| Tarauni | 0 (0.00) | 0 (0.00) | 15 (21.43) | 5 (33.33) | 0 (0.00) | 0 (0.00) |
| Total | 28 (30.43) | 17 (60.71) | 50 (23.26) | 22 (44.00) | 1 (4.76) | 0 (0.00) |

mRBPT: Fisher's Exact Test= 6.732; P= 0.030
SAT-EDTA: Fisher's Exact Test= 6.857; P= 0.026

**Discussion**

From the study, it was shown that horse breeds encountered included Arewa, Argentine, Sudan and Talon breeds of horses. This shows that exotic horses that include Argentine and Sudan horses are found in Nigeria. This is possible due to the participation of Nigerians in sporting games like polo and racing. Thus, it is possible that exotic equine diseases could be found in Nigeria if a purposeful search is undertaken. An overall seroprevalence of 24.0% by using mRBPT for *Brucella* antibodies in horses was obtained from the study area. Earlier on, Okoh *et al*. (1978) also reported demonstrating *Brucella* antibodies in dogs in Kano State. Thus, the organism might have been circulating among domestic animals in the State. This has shown that Brucella species are circulating among horses in the study area. A reason that could be advanced for the seropositivity of these horses is the fact that, especially for the ceremonial horses, they are allowed to graze in the open along with other animals like small ruminants whose movements are not controlled due to the cultural habits of most communities in Nigeria. *Brucella* species antibodies have similarly been reported in many domestic animals in Nigeria. For example, Esuruoso & Hill (1971), Falade *et al*. (1975), Falade & Shonekan (1981), Bertu *et al*. (2010), Kaltungo *et al*. (2013), Buhari *et al*. (2015), Kaltungo *et al*. (2018) and a couple of others have variously reported *Brucella* infections in cattle, sheep and goats and camels. Not only that, Falade (1974) reported demonstrating *Brucella* antibodies in humans in southern Nigeria. Reports of seroprevalences of *Brucella* in horses in Nigeria include those of Ehizibolo *et al*. (2011), Ardo & Abubakar (2016) and Baba *et al*. (2022) with seroprevalences ranging from 6.7 to 22.7 %. A report of the seroprevalence of *Brucella* in donkeys has similarly been made by Tijjani *et al*. (2017) in Northeastern Nigeria. The higher seroprevalence reported in this study could be due to greater contact of these horses with other animals in the study area. It could also be due to greater participation of the polo and racing horses in the study in tournaments as the grooms handling the horses reported recent participation in tournaments in Lagos, which also serves as a commercial, polo and racing centre in Nigeria. Another reason for the high seroprevalence of *Brucella* in these horses could be the observation of Baba *et al*. (2022) that grooms were in the habit of borrowing grooming tools from among themselves and that these horses could be harbouring the organisms. There is the need to have a close look at the clinical cases of the disease in horses as Kaltungo *et al*. (2018) and Buhari *et al*. (2020) variously reported acute and chronic cases of brucellosis in small ruminants in Nigeria.

The higher seroprevalence by using SAT-EDTA compared to the use of mRBPT has similarly been reported by Kaltungo *et al*. (2013) in small ruminants. Baba *et al*. (2022) also demonstrated having higher seroprevalence by using SAT-EDTA than by using mRBPT during their study on *Brucella* infection in horses in Kaduna State, Nigeria. This is because SAT-EDTA is more specific and sensitive and therefore more capable of detecting infected animals than RBPT (Kaltungo *et al*., 2018).

In addition to demonstrating *Brucella* antibodies in domestic animals, Bertu (2014) reported demonstrating *B. abortus* in cattle in Plateau State of Nigeria using PCR. Furthermore, Buhari *et al*. (2020) reported demonstrating *B abortus* and *B. suis* in sheep and goats from two institutional farms and a slaughter slab in Zaria, Northern Nigeria. The demonstration of both antibodies and antigens to *Brucella* species in Nigeria indicates that the organism is circulating among animals and possibly even in humans in Nigeria and it is endemic. The fact that *Brucella* organisms thrive in Nigeria means that there is a lot of public health implications. This could be due to the poor animal health care delivery system along

with ineffective private Veterinary practice since there are over 8,500 Veterinarians in the country (VCN 2018). It could also mean the public Veterinary Services is weak as to organize routine disease surveillance against animal diseases. Furthermore, the poor laboratory and disease reporting systems in Nigeria could indicate that the prevalence of the disease, brucellosis and even other important diseases could be greater than envisaged.

The seroprevalence by LGA indicated that the horses in Kano Municipal Council (LGA) had the highest seroprevalence. This could be because these horses were ceremonial horses and the owners did not take particular attention to the health management of the horses compared to those for polo and racing horses. It could also mean that the ceremonial horses had greater contact with other domestic animals in the area since the disease has been variously reported in domestic animals in Nigeria (Baba *et al*., 2022).

From the study, there was no significant association between the seroprevalence and sex of the horses using both mRBPT and SAT-EDTA. This is contrary to the earlier report of Baba *et al*. (2022) where they found higher seroprevalence in male (8.65%) than in female (0.84%) horses during their study in Kaduna State. Similarly, Ardo & Abubakar (2016) reported higher seroprevalence in males than in female horses. Furthermore, Tijjani *et al*. (2017) reported higher seroprevalences of *Brucella* antibodies in male donkeys than in females. However, Kaltungo *et al*. (2013), Buhari *et al*. (2015) and Yakubu (2016) all reported higher seroprevalences in female cattle and small ruminants than in their male counterparts.

With regard to seroprevalence by age, the seroprevalence increased by age and this is statistically significant ($P<0.05$) by using mRBPT. This finding corroborates those of Ardo & Abubakar (2016) while it differs from that of Baba *et al*. (2022) who reported decreasing seroprevalence by age. With regard to seroprevalence in other domestic animals, Kaltungo *et al*. (2013) reported that adult small ruminants had higher seroprevalence than young ones. Similarly, Buhari *et al*. (2015) reported that the seroprevalence was higher in adult cattle than in young ones.

From the study, there was no statistically significant difference in the seroprevalence of *Brucella* antibodies among the horse breeds under the study ($P>0.05$). This could be due to the fact that the horses had a fair share of exposure if one looks at their participation in polo and racing while the ceremonial horses are engaged almost weekly during weekly ceremonial events like weekend marriage horse riding and leisure riding by youths at weekends in the study area and in many towns in northern Nigeria. However, Baba *et al*. (2022), in a study on the seroprevalence of *Brucella* in horses in Kaduna State, Nigeria demonstrated significant differences among horse breeds with the Arewa breed of horses having the highest seroprevalence of 11.90% followed by the Argentine breed of horses with 1.69% and Sudan and Talon breed of horses with 0.00% each. In their study on the seroprevalence of *Brucella* in goats in southern Nigeria, Ogugua *et al*. (2014) reported that there was no significant difference by breed in infection with *Brucella* species. Similarly, Kaltungo *et al*. (2018) reported no significant difference between sheep and goat breeds infected with *Brucella* species. The absence of any difference in infection rate could be due to the fact that these animals are raised under an extensive management system whereby different herds and flocks mix during grazing in communal grazing land or in the countryside as reported by Saidu *et al*. (1991).

With regard to the purpose of the horses, seroprevalence was seen to be highest in the ceremonial horses (30.43%) and least in the racing horses (4.7%). This could be because the ceremonial horses had greater chances of mixing with other domestic animals like sheep and goats as previously reported (Kaltungo *et al*., 2018). It could also be because the polo and racing horses had greater attention since they are more expensive and the owners are possibly more money conscious as replacing a polo or racing horse could be more expensive than ceremonial ones. In a similar study, Baba *et al*. (2022) also reported seroprevalence to be highest in ceremonial horses followed by racing and least in polo horses. This study corroborates the previous studies on the seroprevalence of brucellosis in Kano metropolis (Saidu *et al*. 1991; Kaltungo *et al*., 2018; Baba *et al*., 2022) even though, the study did not cover the entire state.

In conclusion, this study clearly provided evidence there were *Brucella* antibodies among horses found in Kano state. There is a need to determine the *Brucella* species circulating in these horses, particularly since brucellosis is zoonotic with serious public health significance. There is also the need to examine the horse owners and grooms for possible *Brucella* antibodies as doing this can significantly reduce the possible spread of the infection from horses to humans closely related to the horses and even beyond.

This study does not cover a large study area and hence, it may be difficult to extrapolate the results to

the entire State or the country. In addition, the study does not take into consideration, the factors associated with equine brucellosis.

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**Conflict of Interest**
The authors declare that there is no conflict of interest.

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