

# Reproductive Disorders among Veterinary Clinic Presentations in Sokoto Metropolis, Nigeria (2015-2025): A Multi-Clinic Retrospective study

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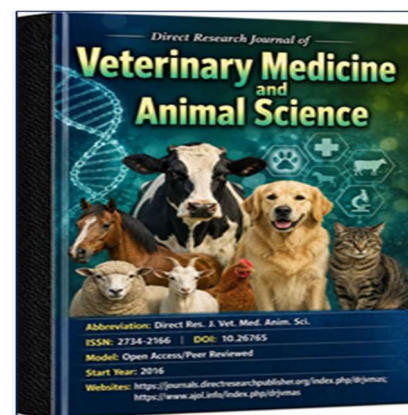
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### ABSTRACT

Reproductive disorders are important causes of reduced fertility, production losses, treatment expenditure and compromised animal welfare. Although veterinary clinical records provide an accessible source of information on the reproductive caseload presented for professional care, clinic-based evidence from northern Nigeria remains limited, particularly across multiple facilities and animal species. This study described the distribution and pattern of reproductive presentations recorded at veterinary facilities in Sokoto metropolis over an 11-year period. A retrospective analysis was conducted on 1,000 de-identified clinical presentations recorded between 2015 and 2025 at Aliyu Jodi Clinic, Fakon Idi Clinic, Runjin Sambo Clinic, the Usmanu Danfodiyo University Veterinary Teaching Hospital and participating private practices. Variables extracted from the clinical records included clinic, visit date, species, sex, age, reproductive status, diagnosis, management system, treatment, hospitalization and outcome. Reproductive case status was defined from the recorded Case Type field and cross-checked against the diagnosis coding rule. Descriptive statistics, Pearson chi-square tests and multivariable logistic regression were used to examine the distribution of reproductive presentations and factors associated with reproductive case classification. Of the 1,000 presentations, 265 (26.5%; 95% CI 23.9-29.4%) were classified as reproductive. The most frequent reproductive diagnoses were dystocia (34/265; 12.8%), abortion (32/265; 12.1%), mastitis classified as reproductive/peripartum (32/265; 12.1%), other reproductive infections or conditions (29/265; 10.9%), metritis (28/265; 10.6%) and ovarian cysts (25/265; 9.4%). Female presentations had a higher reproductive-case proportion than male presentations (30.9% versus 21.1%;  $\chi^2=11.70$ ,  $P<0.001$ ), and the adjusted odds of reproductive-case classification were lower for males than females (OR=0.60, 95% CI 0.45–0.80;  $P<0.001$ ). Species, clinic, season, management system and year were not statistically associated with reproductive case status. Among reproductive presentations, 195/265 (73.6%) were recorded as recovered or improved, whereas 31/265 (11.7%) died or were euthanized and 39/265 (14.7%) were referred or lost to follow-up. The findings describe the reproductive component of the recorded veterinary clinical caseload rather than population-level disease prevalence. The study provides a contemporary multi-clinic description of reproductive presentations in Sokoto and extends earlier single-facility observations from the metropolis, while also highlighting the limitations of routine clinical records for estimating population burden.

**Keywords:** Reproductive disorders; Veterinary epidemiology; Dystocia; Abortion; Mastitis; Retrospective study; Sokoto; Nigeria



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## INTRODUCTION

Efficient reproduction is central to the biological and economic performance of livestock and companion-animal populations. Failure to conceive, pregnancy loss, abnormal parturition and postpartum disease can reduce the number of offspring produced, prolong calving or kidding intervals, increase replacement and treatment costs, and compromise animal welfare. Reproductive disorders therefore have consequences that extend beyond the individual clinical case to herd productivity, household income and the efficiency of animal production systems. In dairy cattle, for example, postpartum uterine disease is associated with delayed uterine recovery and impaired establishment of pregnancy, while reproductive disease more generally can reduce productive performance through its effects on fertility and survival (Sheldon *et al.*, 2006; Mee, 2008; Gilbert, 2012). Dystocia is particularly important because difficult parturition may increase maternal and neonatal morbidity and may adversely affect subsequent reproductive performance (Mee, 2008). Abortion is similarly important because it represents a direct loss of reproductive output and may also be a clinical signal of infectious, nutritional, managerial or other underlying problems (Peter AT, 2000).

The reproductive health of animals in northern Nigeria is influenced by a heterogeneous mixture of production systems and environmental conditions. Sokoto metropolis is served by government veterinary clinics, a university veterinary teaching hospital and private veterinary practices. The animals presented to these facilities represent a mixture of pastoral, agro-pastoral, peri-urban, commercial and companion-animal populations. The clinical caseload may therefore include cattle, sheep, goats, camels, equids, poultry, dogs, cats and other animals. Such heterogeneity is useful for describing the range of reproductive problems encountered by veterinary services. It also complicates interpretation because the probability of presentation depends on species, production purpose, proximity to veterinary services, owner awareness, referral behavior, economic capacity and the diagnostic and recording practices of individual facilities. Routine veterinary records are particularly valuable for retrospective epidemiological description because they can capture many years of clinical activity without requiring prospective recruitment. However, they are not equivalent to population-based surveillance. The denominator in a clinic record study is normally the population of recorded clinical encounters rather than all animals at risk in the community. Consequently, the resulting proportion is best understood as a clinical caseload proportion unless the study has an appropriate population denominator (Dohoo *et al.*, 2003). The distinction is important because animals with disease may be more likely to be presented than healthy animals, and animals in remote production

systems may be underrepresented. Referral and access patterns can also differ among clinics and across time. STROBE and the veterinary-specific STROBE-Vet guidance emphasise that observational studies should describe the study setting, unit of observation, data sources, selection process and limitations in sufficient detail to permit assessment of internal and external validity (von Elm *et al.*, 2007; O'Connor *et al.*, 2016). Previous Nigerian studies illustrate both the value and the limitations of clinic-based reproductive records. An earlier retrospective study at the Usmanu Danfodiyo University Veterinary Teaching Hospital in Sokoto reviewed reproductive cases in sheep, goats and cattle from 1991 to 2005. Among 88 recorded reproductive cases, sheep accounted for the largest proportion, and dystocia was the most frequently recorded condition, followed by pregnancy toxemia, retained placenta and mastitis (Umaru *et al.*, 2009). The study also reported a predominance of female cases. These observations provide a useful historical reference for reproductive case patterns in Sokoto, but this study was limited to one teaching hospital and three ruminant species.

Evidence from other Nigerian locations also suggests that the pattern of reproductive disorders varies with species and production context. Wosu and Anene reported reproductive disorders among goats and sheep presented to the University of Nigeria Veterinary Teaching Hospital over a 10-year period, with dystocia and abortion among the principal disorders in goats. Abortion, pregnancy toxemia and milk fever among important conditions in sheep (Wosu and Anene, 1990). A more recent study of small ruminants presented to a veterinary office in Bauchi identified dystocia, mastitis, uterine prolapse, agalactia and vaginal prolapse among the reproductive conditions encountered and reported differences according to species and breed (Yerima *et al.*, 2021). Similarly, a 2024 retrospective study from Nsukka documented a substantial caseload of reproductive disorders and reproduction-related procedures, with dystocia, castration and transmissible venereal tumour among the more frequent recorded conditions (Njoga *et al.*, 2024). These studies show the value of clinical records while also showing that the composition of the reproductive caseload depends strongly on the animals and services represented in the underlying records.

Studies from northeastern Nigeria also illustrate the potential contribution of infectious and management-related factors to reproductive losses. For example, a study of smallholder cattle and goat farms in Maiduguri investigated *Leptospira hardjo* antibodies in relation to reproductive histories and found serological evidence in a subset of animals and herds with reported reproductive disorders (Stephen *et al.*, 2022). Historical survey work in northern Nigeria has likewise documented abortion and

variation in reproductive performance among cattle herds, while noting substantial under-reporting of abortions to veterinary authorities (Nuru and Dennis, 1976). These findings reinforce an important point for interpretation of clinic records: recorded reproductive cases represent only the portion of disease that reaches and is documented by veterinary services.

Despite the earlier Sokoto study, there remains a need for a broader description of the reproductive clinical caseload across multiple veterinary facilities and over a more recent period. A multi-clinic dataset can provide information on whether the reproductive component of the clinical workload has been concentrated in particular species or facilities, whether the recorded proportion has changed materially over time. They also provide information about the diagnoses that account for the largest share of reproductive presentations, and the outcomes documented after veterinary intervention. Such information can assist service planning and identify areas in which prospective surveillance or targeted reproductive-health interventions may be warranted. The present study therefore analyzed 1,000 clinical presentations recorded at veterinary facilities in Sokoto metropolis from 2015 through 2025. The objectives were to: (i) estimate the proportion of recorded clinical presentations classified as reproductive; (ii) describe the distribution of reproductive presentations by species, clinic, sex, year, season and management system; (iii) characterize the diagnostic spectrum of reproductive cases; (iv) describe recorded clinical outcomes; and (v) examine factors associated with reproductive case classification using multivariable logistic regression. Because the denominator consists of clinic presentations rather than the total animal population of Sokoto, the study is explicitly interpreted as a description of the veterinary clinical caseload rather than an estimate of population prevalence.

## MATERIALS AND METHODS

### Study design, setting and data source

This was a retrospective observational analysis of routinely recorded veterinary clinical presentations. The analysis covered the period from 2015 through 2025 and covered five clinical service categories in Sokoto metropolis: Aliyu Jodi Clinic, Fakon Idi Clinic, Runjin Sambo Clinic, the Usmanu Danfodiyo University Veterinary Teaching Hospital (UDUVTH), and participating private veterinary practices. The available records were converted into a dataset containing 1,000 de-identified clinical presentations. The facilities represented a mixed clinical environment in which livestock and companion animals may be presented for preventive, medical, surgical and reproductive care. Because observational veterinary studies may contain several organizational levels, including individual animals, owners, farms and clinics, the unit of analysis should be distinguished from the source of the records (O'Connor et al., 2016; Sargeant

et al., 2016). In the present dataset, one row represented one recorded clinical presentation and the Record ID field was unique across the 1,000 records. Thus, the analytical unit was the clinical presentation.

### Sampling procedure and Inclusion criteria/ Exclusion criteria

All available records in the participating clinics were considered as case presentations but only records with complete set of the following variables were included in the study dataset; clinic, visit date, species, sex, age, reproductive status, diagnosis, management system, treatment, hospitalization and outcome.

### Variables and operational definitions

The variables available for analysis were clinic, date of visit, species, sex, age, reproductive status, diagnosis, management system, treatment, hospitalization and outcome. Calendar year and month were derived or cross-checked from the recorded visit date. Species categories were Camel, Cat, Cattle, Dog, Donkey, Goat, Horse, Other, Poultry and Sheep. Sex was coded as male or female. Management system was categorized as extensive, semi-intensive or intensive, and season was represented by the dry and rainy categories recorded in the dataset.

### Data cleaning and quality control

The records were processed programmatically. Dates were parsed as calendar dates and the recorded year and month were compared with the parsed visit date. Numeric codes were interpreted using the study codebook. Duplicate Record ID values were searched for, and the relationship between Case Type and Diagnosis Code was checked. The final dataset contained no duplicate Record ID values, and year and month agreed with the parsed visit date for all records. Case Type was also concordant with the diagnosis-code rule for all records. These checks were done to ensure internal consistency of the files, although they do not establish the accuracy of the original clinical diagnoses. Retrospective clinical records may contain differences in diagnostic certainty, terminology and recording completeness among clinicians and facilities. They also cannot necessarily distinguish an initial diagnosis from a diagnosis made after additional investigations unless those details were explicitly recorded. Accordingly, the study evaluates the recorded clinical classification rather than independently verified disease diagnoses.

### Statistical analysis

Descriptive statistics were used to summarize the clinical caseload. Counts and percentages were calculated for categorical variables, while median age was reported for

the overall dataset and by reproductive case status. The overall proportion of reproductive presentations was calculated as the number of reproductive presentations divided by the total number of clinical presentations. The 95% confidence interval for this proportion was calculated using the Wilson score method, which is an established approach for binomial proportions (Wilson, 1927). Pearson chi-square tests were used to examine univariable associations between reproductive case status and species, clinic, sex, year, season and management system. The annual distribution of reproductive presentations was also plotted to display variation across the 11-year period. For interpretation, a categorical year analysis addresses whether proportions differ among individual years, whereas a regression term treating year as a continuous variable addresses the presence of an overall linear temporal trend.

A multivariable logistic regression model was specified with reproductive case status as the binary dependent variable. Explanatory variables were species, sex, clinic, centered year, season and management system. Year was centred at 2015 to improve interpretability of the intercept and reduce unnecessary numerical scaling. Categorical predictors were entered using indicator variables, with the first alphabetical category selected in the model as the reference category. Adjusted odds ratios, 95% confidence intervals and P-values were reported. Model diagnostics included convergence assessment, Akaike information criterion (AIC), McFadden pseudo- $R^2$ , variance inflation factors (VIFs) and a decile-based Hosmer–Lemeshow calibration test. McFadden's pseudo- $R^2$  is a likelihood-based measure that is not directly equivalent to the  $R^2$  of ordinary linear regression and is most appropriately interpreted in relation to competing logistic models rather than as a simple percentage of variance explained (Hosmer et al., 2013). The maximum observed VIF was used to assess potentially problematic collinearity among predictors. A p-value < 0.05 was considered statistically significant. All analyses were performed in SPSS and Python (using pandas, SciPy, stats models and matplotlib).

## Ethical considerations

The analysis used de-identified clinical records and did not involve direct animal experimentation or collection of new biological samples. However, formal approval and consent were sought from the management of participating facilities. UDUS IACUC has approved the work with a reference number IACUC/UDUS/FVM/208/2024

## RESULTS

The study included 1,000 recorded clinical presentations. No duplicate records were used. Of the 1,000 presentations, 265 were classified as reproductive and 735 as non-reproductive. The resulting reproductive-case proportion was 26.5%, with a Wilson 95% confidence

**Table 1:** Overall clinical caseload presented to veterinary facilities in Sokoto metropolis from 2015 to 2025

| Variables                                    | Values    |
|----------------------------------------------|-----------|
| Total number of cases (n)                    | 1000      |
| Reproductive cases (n)                       | 265       |
| Non reproductive cases (n)                   | 735       |
| Proportion of reproductive cases (%)         | 26.5      |
| Wilson 95% confidence interval (%)           | 23.9-29.4 |
| median age for all presentations (yrs)       | 3.3       |
| Median age among reproductive cases (yrs)    | 3.0       |
| Median age among nonreproductive cases (yrs) | 3.4       |

interval of 23.9–29.4%. The median age was 3.3 years for all presentations, 3.0 years among reproductive presentations and 3.4 years among non-reproductive presentations (Table 1). The dataset included a broad range of species. Goats constituted the largest number of presentations (255), followed by cattle (186), dogs (155), sheep (110), poultry (81), camels (60), cats (52), horses (45), donkeys (33) and other species (23). The proportion of presentations classified as reproductive varied from 17.4% among the other species category to 31.7% among cattle. Sheep had a reproductive-case proportion of 29.1%, while camel and horse presentations each had a proportion of 26.7%. The reproductive proportions among goats, cats, dogs and poultry were 25.1%, 25.0%, 24.5% and 24.7%, respectively (Table 2).

**Table 2:** Species distribution of cases presented to veterinary facilities in Sokoto metropolis from 2015 to 2025

| Species | All presentations | Reproductive cases | Reproductive (%) |
|---------|-------------------|--------------------|------------------|
| Camel   | 60                | 16                 | 26.7             |
| Cat     | 52                | 13                 | 25.0             |
| Cattle  | 186               | 59                 | 31.7             |
| Dog     | 155               | 38                 | 24.5             |
| Donkey  | 33                | 7                  | 21.2             |
| Goat    | 255               | 64                 | 25.1             |
| Horse   | 45                | 12                 | 26.7             |
| Other   | 23                | 4                  | 17.4             |
| Poultry | 81                | 20                 | 24.7             |
| Sheep   | 110               | 32                 | 29.1             |

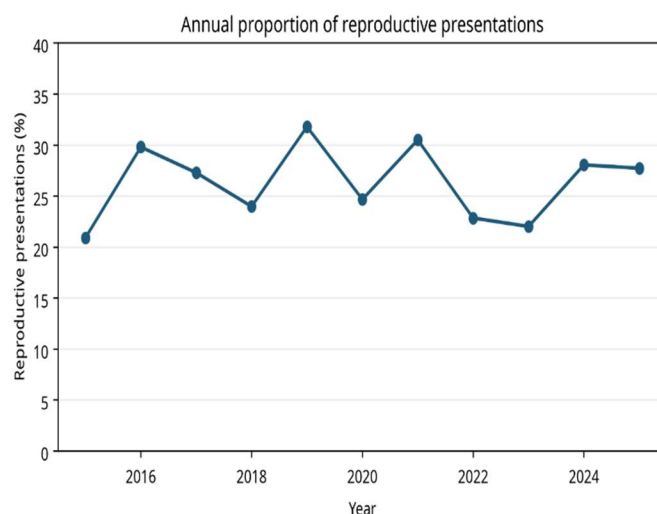
Species was not significantly associated with reproductive case status in the Pearson chi-square analysis ( $\chi^2=5.20$ ,  $df=9$ ,  $P=0.816$ ). The absence of statistical evidence for a difference should not be interpreted as proof that reproductive problems occur at identical rates in all species. Rather, within this clinic-based dataset, the observed differences among species were not sufficiently large relative to the available sample sizes to demonstrate an association. The smaller numbers in some species categories also resulted in wider uncertainty around their species-specific proportions. Reproductive presentations accounted for 24.6% to 29.9% of the presentations

**Table 3:** Clinic distribution of reproductive cases presented to veterinary facilities in Sokoto metropolis from 2015 to 2025

| Clinic              | All presentations | Reproductive cases | Reproductive (%) |
|---------------------|-------------------|--------------------|------------------|
| Aliyu Jodi Clinic   | 354               | 89                 | 25.1             |
| Fakon Idi Clinic    | 126               | 31                 | 24.6             |
| Private practices   | 90                | 23                 | 25.6             |
| Runjin Sambo Clinic | 211               | 63                 | 29.9             |
| UDUVTH              | 219               | 59                 | 26.9             |

**Table 4:** Cases distribution of reproductive cases presented to veterinary facilities in Sokoto metropolis from 2015 to 2025

| Year | All presentations | Reproductive cases | Reproductive (%) |
|------|-------------------|--------------------|------------------|
| 2015 | 67                | 14                 | 20.9             |
| 2016 | 94                | 28                 | 29.8             |
| 2017 | 99                | 27                 | 27.3             |
| 2018 | 96                | 23                 | 24.0             |
| 2019 | 107               | 34                 | 31.8             |
| 2020 | 73                | 18                 | 24.7             |
| 2021 | 82                | 25                 | 30.5             |
| 2022 | 92                | 21                 | 22.8             |
| 2023 | 100               | 22                 | 22.0             |
| 2024 | 107               | 30                 | 28.0             |
| 2025 | 83                | 23                 | 27.7             |

**Figure 1:** Trend of annual reproductive cases among veterinary clinics in Sokoto metropolis

recorded at the five clinic categories (Table 3). Runjin Sambo Clinic had the highest recorded proportion (29.9%), whereas Fakon Idi Clinic had the lowest (24.6%). The clinic-level differences were not statistically significant ( $\chi^2=1.85$ ,  $df=4$ ,  $P=0.763$ ). These findings suggest that the reproductive component of the recorded caseload was broadly similar across the participating facilities during the study period, although clinic-specific referral patterns and service characteristics may still influence the types of cases presented. Female presentations were more frequently classified as reproductive than male presentations. Among 550 female presentations, 170 (30.9%) were reproductive, compared with 95 of 450 male presentations (21.1%). This difference was statistically

significant ( $\chi^2=11.70$ ,  $df=1$ ,  $P<0.001$ ). The observed difference is consistent with the composition of the reproductive diagnoses, several of which are inherently female-specific or strongly associated with pregnancy, parturition or the postpartum period. Season was not associated with reproductive case status ( $\chi^2=0.01$ ,  $df=1$ ,  $P=0.909$ ), and management system was also not associated with case status ( $\chi^2=0.04$ ,  $df=2$ ,  $P=0.980$ ). Annual reproductive-case proportions ranged from 20.9% in 2015 to 31.8% in 2019, with intermediate fluctuations in the other years (Table 4). The year-based chi-square test did not indicate a significant difference across the 11 years ( $\chi^2=6.15$ ,  $df=10$ ,  $P=0.803$ ). The annual pattern of reproductive presentations is shown in (Figure 1).

**Table 5:** Diagnostic spectrum of reproductive cases presented to veterinary facilities in Sokoto metropolis from 2015 to 2025

| Diagnosis                              | Cases | Proportion of reproductive cases (%) |
|----------------------------------------|-------|--------------------------------------|
| Dystocia                               | 34    | 12.8                                 |
| Abortion                               | 32    | 12.1                                 |
| Mastitis (repro/peripartum)            | 32    | 12.1                                 |
| Other reproductive infection/condition | 29    | 10.9                                 |
| Metritis                               | 28    | 10.6                                 |
| Ovarian cyst                           | 25    | 9.4                                  |
| Vaginal prolapse                       | 18    | 6.8                                  |
| Retained fetal membranes (RFM)         | 14    | 5.3                                  |
| Uterine prolapse                       | 12    | 4.5                                  |
| Transmissible venereal tumour (TVT)    | 12    | 4.5                                  |
| Endometritis                           | 11    | 4.2                                  |
| Pyometra                               | 10    | 3.8                                  |
| Repeat breeding                        | 8     | 3.0                                  |

**Table 6:** Outcome of reproductive cases presented to veterinary facilities in Sokoto metropolis from 2015 to 2025

| Outcome           | Cases | Of reproductive cases (%) |
|-------------------|-------|---------------------------|
| Recovered         | 150   | 56.6                      |
| Improved          | 45    | 17.0                      |
| Died              | 23    | 8.7                       |
| Referred          | 21    | 7.9                       |
| Lost to follow-up | 18    | 6.8                       |
| Euthanized        | 8     | 3.0                       |

Among the 265 reproductive presentations, dystocia was the most frequently recorded diagnostic group, with 34 cases (12.8%). Abortion and mastitis classified as reproductive/peripartum each accounted for 32 cases (12.1%). Other reproductive infections or conditions accounted for 29 cases (10.9%), followed by metritis (28; 10.6%) and ovarian cysts (25; 9.4%). Vaginal prolapse accounted for 18 cases (6.8%), retained fetal membranes for 14 (5.3%), uterine prolapse and transmissible venereal tumour for 12 each (4.5%), endometritis for 11 (4.2%), pyometra for 10 (3.8%) and repeat breeding for 8 (3.0%). The diagnostic categories together accounted for all 265 reproductive presentations (Table 5). Clinical outcomes were recorded for all 265 reproductive presentations. Recovery was documented in 150 cases (56.6%), improvement in 45 (17.0%), death in 23 (8.7%), referral in 21 (7.9%), loss to follow-up in 18 (6.8%) and euthanasia in 8 (3.0%). Overall, 195/265 (73.6%) were recorded as recovered or improved. Death or euthanasia occurred in 31/265 (11.7%), while the remaining 39 cases (14.7%) were referred or lost to follow-up. Because referral and loss to follow-up do not provide definitive final outcomes, the 73.6% figure should be interpreted as the proportion with a recorded outcome of recovery or improvement rather than a definitive treatment-success rate (Table 6). The multivariable logistic regression model converged using all 1,000 presentations. The reference categories were Camel for species, Female for sex, Aliyu Jodi Clinic for clinic, Dry season for season and Extensive

management for management system; year was centred at 2015. Male animals had significantly lower odds of reproductive case classification than females (adjusted OR=0.60, 95% CI 0.45–0.80,  $P<0.001$ ). The corresponding interpretation is that female presentations had higher odds of being classified as reproductive cases than male presentations after adjustment for the variables included in the model (Table 7). The model AIC was 1174.9 and McFadden pseudo- $R^2$  was 0.017. The maximum VIF was 3.94, indicating no severe multicollinearity by the diagnostic used. The Hosmer-Lemeshow statistic was 5.08 with 8 degrees of freedom ( $P=0.749$ ), providing no evidence of poor calibration according to that test. No species contrast, clinic contrast, season, management category or linear year trend were statistically significant.

## DISCUSSION

This multi-clinic retrospective study identified 265 reproductive presentations among 1,000 veterinary clinical presentations recorded in Sokoto metropolis between 2015 and 2025. The principal finding is therefore that reproductive presentations constituted 26.5% of the recorded clinical caseload in the study dataset. This figure should be interpreted as a caseload proportion rather than a population prevalence because the denominator was composed of veterinary presentations rather than all animals residing in or using the resources of Sokoto

**Table 7:** Multivariable logistic regression modelling of reproductive cases presented to veterinary facilities in Sokoto metropolis from 2015 to 2025

| Predictor comparison            | Adjusted OR | 95% CI    | P-value |
|---------------------------------|-------------|-----------|---------|
| Cat vs Camel                    | 0.92        | 0.39-2.18 | 0.855   |
| Cattle vs Camel                 | 1.34        | 0.69-2.58 | 0.384   |
| Dog vs Camel                    | 0.98        | 0.49-1.96 | 0.965   |
| Donkey vs Camel                 | 0.77        | 0.28-2.14 | 0.617   |
| Goat vs Camel                   | 0.96        | 0.51-1.84 | 0.910   |
| Horse vs Camel                  | 1.09        | 0.45-2.64 | 0.842   |
| Other species vs Camel          | 0.57        | 0.17-1.96 | 0.376   |
| Poultry vs Camel                | 0.93        | 0.43-2.02 | 0.862   |
| Sheep vs Camel                  | 1.17        | 0.58-2.39 | 0.661   |
| Male vs Female                  | 0.60        | 0.45-0.80 | <0.001  |
| Fakon Idi vs Aliyu Jodi         | 0.96        | 0.59-1.55 | 0.861   |
| Private practices vs Aliyu Jodi | 1.04        | 0.61-1.78 | 0.891   |
| Runjin Sambo vs Aliyu Jodi      | 1.28        | 0.87-1.89 | 0.204   |
| UDUVTH vs Aliyu Jodi            | 1.10        | 0.75-1.62 | 0.631   |
| Rainy vs Dry                    | 0.97        | 0.73-1.29 | 0.821   |
| Intensive vs Extensive          | 0.96        | 0.64-1.46 | 0.859   |
| Semi-intensive vs Extensive     | 0.98        | 0.66-1.46 | 0.938   |
| Per one-year increase           | 1.00        | 0.96-1.05 | 0.916   |

metropolis. The distinction is particularly important in veterinary clinical epidemiology, where access to veterinary care, owner help-seeking, referral behavior and the availability of diagnostic services can strongly influence which animals enter the clinical record (Dohoo et al., 2003; O'Connor et al., 2016). The magnitude of the reproductive caseload nevertheless provides useful information for veterinary service planning. Approximately one in four recorded presentations in the present study was classified as reproductive. Even if this proportion cannot be extrapolated to the community, it indicates that reproductive health constitutes a substantial component of the workload encountered by participating veterinary services. The finding is also relevant when considered alongside earlier Sokoto evidence. Umaru and colleagues reviewed 88 reproductive cases recorded at UDUVTH over 1991-2005 and identified sheep, goats and cattle as the principal species represented, with dystocia as the most frequent diagnosis (Umaru et al., 2009). The present study extends the historical evidence by covering 2015–2025, multiple clinic categories and a broader range of species. The two studies are not directly comparable as prevalence studies because the earlier investigation was restricted to reproductive cases and did not use the same 1,000-case all-presentation denominator. Nevertheless, both indicate that reproductive problems form a persistent component of veterinary clinical activity in the study area. Dystocia was the most frequent individual diagnosis in the present study, accounting for 12.8% of reproductive presentations. This is consistent with the repeated prominence of dystocia in Nigerian clinical studies. The earlier Sokoto study identified dystocia as the leading reproductive condition among sheep, goats and cattle (Umaru et al., 2009). Wosu and Anene likewise found dystocia to be the major reproductive diagnosis among

goats presented to the University of Nigeria Veterinary Teaching Hospital during 1978-1988 (Wosu and Anene, 1990). A more recent Nigerian retrospective study from Nsukka also identified dystocia as the most frequent reproductive disorder or reproduction-related presentation (Njoga et al., 2024). The recurring importance of dystocia across these studies is biologically plausible because difficult parturition can arise from fetal maldisposition, fetopelvic disproportion, maternal factors, inadequate supervision or other management and biological factors, and can produce serious consequences for both dam and offspring (Mee, 2008; Omotoso et al., 2024).

Abortion represented 12.1% of the reproductive presentations. Abortion is an especially important clinical endpoint because it can reflect a broad range of infectious, nutritional, environmental, genetic and management influences, and because the cause is frequently not established in routine clinical records. Historical survey data from northern Nigeria demonstrated that abortion occurred in a substantial proportion of surveyed cattle herds and also highlighted under-reporting to veterinary authorities (Nuru and Dennis, 1976). The present study cannot determine the causes of abortion because the available records were not designed as an etiological investigation. Consequently, the observed number of abortion presentations should be used primarily to describe the clinical caseload rather than to infer the frequency of specific infectious or non-infectious causes. Mastitis classified as reproductive/peripartum accounted for another 12.1% of reproductive presentations. Mastitis is a major production disease and is closely connected to the periparturient period in many production systems as many Nigerian evidence has also documented mastitis among reproductive case records. Umaru et al. reported mastitis among the leading conditions in their earlier

Sokoto study, while Yerima et al. included mastitis among reproductive disorders recorded in small ruminants presented to a veterinary office in Bauchi (Umaru et al., 2009; Yerima et al., 2021). Metritis, endometritis, retained fetal membranes, uterine prolapse and vaginal prolapse collectively formed an important component of the caseload. These conditions are clinically interconnected with pregnancy, parturition and postpartum uterine recovery. In cattle, postpartum uterine disease has been associated with delayed uterine recovery and reduced reproductive performance, while the broader literature demonstrates relationships between disease and subsequent fertility (Sheldon et al., 2006; Gilbert, 2012; Fourichon et al., 2001). The presence of these diagnoses in the Sokoto caseload therefore brings out the need for reproductive case management that extends beyond emergency treatment of parturition problems to postpartum monitoring and prevention.

The ovarian cyst category accounted for 9.4% of reproductive presentations. Ovarian dysfunction can have important consequences for fertility, but the clinical meaning of a recorded ovarian cyst depends on the diagnostic criteria used and the species involved. The present multi-species dataset does not permit detailed assessment of whether ovarian cysts were confirmed by ultrasonography, rectal examination, hormonal testing or another diagnostic approach. This is an example of why routine clinical records are useful for caseload surveillance but less suitable for estimating the true biological prevalence of specific disorders without standardized diagnostic protocols.

The finding that female presentations were more likely than male presentations to be classified as reproductive cases was statistically robust in both the univariable and multivariable analyses. However, the interpretation requires care. Several of the most frequent diagnoses in the dataset, dystocia, abortion, ovarian cysts, metritis, endometritis, pyometra and uterine or vaginal prolapse, are female-specific or predominantly female conditions. It is therefore expected that females will contribute a large share of reproductive presentations. The adjusted OR of 0.60 for males should consequently be interpreted as an association with case classification rather than evidence that sex independently causes reproductive disease. The result primarily reflects the biological composition of the reproductive diagnoses and the sex distribution of the clinical population.

No statistically significant association was found between species and reproductive case status. This differs in emphasis from some earlier Nigerian studies, in which species differences were evident among reproductive cases or small-ruminant populations (Wosu and Anene, 1990; Yerima et al., 2021). The difference may reflect the broader species composition of the present dataset and the use of all clinical presentations as the denominator. For example, a species can have a large number of reproductive cases simply because it is heavily represented among all veterinary presentations, without

necessarily having a higher reproductive-case proportion. Conversely, a small species group may have a high percentage based on relatively few observations. The current analysis therefore appropriately avoids ranking species by raw reproductive case counts alone. Clinic was also not significantly associated with reproductive case status. This result suggests that the proportion of reproductive presentations was broadly comparable across the participating facilities, but it should not be interpreted as evidence that the facilities have identical clinical functions. Differences in referral pathways, diagnostic equipment, clinician expertise and client populations may still influence the spectrum of individual reproductive diagnoses. The relatively similar overall reproductive proportions could simply indicate that reproductive cases constitute a persistent component of veterinary workload across different service points.

No evidence of a seasonal association was observed. This finding is notable because earlier Nigerian work has reported seasonal variation in some reproductive conditions, particularly among small ruminants (Wosu and Anene, 1990). The absence of an overall seasonal association in the present study does not exclude seasonality for individual diagnoses. Different reproductive conditions may have different seasonal determinants, and aggregation of all reproductive cases into a single binary outcome can mask opposing patterns. A larger dataset with standardized month-to-season definitions and diagnosis-specific analyses could therefore be more informative for evaluating seasonal reproductive risks. Similarly, there was no evidence of a difference in reproductive case status across the three management categories. This finding should be interpreted cautiously because management system is a broad classification and may not capture the specific nutritional, breeding, housing, disease prevention and veterinary-service practices that influence reproduction. The absence of an overall association does not imply that management is unimportant; rather, the available categorical variable may have been too coarse to detect more specific management-related effects.

The annual proportions fluctuated between 20.9% and 31.8%, but neither the categorical year comparison nor the linear year term indicated a statistically significant temporal pattern. The observed variation is therefore more appropriately described as year-to-year fluctuation than as an increasing or decreasing trend. Changes in the number and composition of presentations, clinic activity, referral patterns, animal populations and recording practices could all contribute to annual variation. The study was not designed to distinguish these explanations.

The outcome data provide a useful clinical perspective. Almost three quarters of reproductive presentations were recorded as recovered or improved, whereas 11.7% died or were euthanized. However, outcome interpretation is constrained by the 14.7% that were referred or lost to follow-up. Referral may represent appropriate escalation of care rather than treatment failure, while loss to follow-

up provides no information about the eventual outcome. The outcome findings should therefore be viewed as documentation of recorded clinical disposition rather than a prospective estimate of case-fatality or treatment success. The regression model showed good convergence and no evidence of severe multicollinearity according to the reported diagnostics. The Hosmer–Lemeshow test did not indicate poor calibration. However, the McFadden pseudo- $R^2$  was 0.017, indicating that the selected predictors provided only a modest improvement in model fit relative to the intercept-only model. This is not necessarily surprising in a heterogeneous retrospective clinical dataset, where important determinants such as owner behavior, referral status, nutritional status, parity, breed, pregnancy stage, diagnostic resources and clinician-specific factors were not available or were not incorporated into the model. The model should therefore be regarded as an exploratory analysis of observed associations rather than a predictive model for individual animals.

An additional methodological consideration is the potential clustering of observations within clinics. Animals presenting at the same facility may share geographical catchment, owner characteristics, access patterns and clinical recording practices. Standard logistic regression assumes independence of observations, so unmodelled clustering could affect the precision of standard errors. Veterinary observational reporting guidance specifically encourages investigators to consider the organizational structure of animal-health data (O'Connor et al., 2016; Sargeant et al., 2016).

The major strength of this study is the breadth of the clinical dataset relative to earlier Sokoto reports. It covers an 11-year period, multiple veterinary service points and a wider range of animal species, and it combines descriptive caseload analysis with an adjusted association model. The programmatic data checks also provide evidence of internal consistency: no duplicate Record ID values were identified, date components were consistent, and the reproductive classification agreed with the diagnosis-code rule.

The principal limitations arise from the retrospective clinical nature of the data. First, the denominator is a clinical denominator and therefore does not permit estimation of population prevalence or incidence. Second, the available record structure does not establish with certainty whether all presentations correspond to unique animals; repeated visits by the same animal could influence the observed caseload. Third, referral, access, owner help-seeking and facility-specific case ascertainment may produce selection bias. Fourth, retrospective records may contain incomplete or non-standardized diagnoses, and the present dataset does not permit independent verification of all diagnoses. Fifth, the study does not establish causal relationships between the variables analyzed and reproductive disease. Finally, the available analysis did not explicitly model clustering within clinics.

These limitations do not eliminate the value of the study, but they define the appropriate level of inference. The findings are most defensible as a description of reproductive presentations recorded by participating veterinary services in Sokoto metropolis during 2015–2025. The results can inform service planning, training priorities and hypotheses for prospective surveillance, but they should not be used as direct estimates of the community burden of reproductive disease.

## Conclusion

Reproductive presentations accounted for 265 of 1,000 veterinary clinical presentations (26.5%) recorded across participating facilities in Sokoto metropolis from 2015 to 2025. Dystocia, abortion, reproductive/peripartum mastitis, other reproductive infections or conditions, metritis and ovarian cysts were the leading recorded diagnostic groups. Female presentations had higher odds of reproductive-case classification than male presentations, while species, clinic, season, management system and year were not statistically associated with reproductive case status in the specified analyses. Among reproductive presentations, recovery or improvement was documented in 73.6%, while 11.7% died or were euthanized. Taken together, the findings demonstrate that reproductive cases constitute an important component of the veterinary clinical workload in Sokoto. Because the denominator represents recorded presentations rather than the underlying animal population, the 26.5% estimate should be interpreted as a clinic-caseload proportion rather than population prevalence. Future work should strengthen routine record systems by documenting unique animal identifiers, standardized diagnostic definitions, pregnancy and parity information, management and nutritional variables, referral status and follow-up outcomes. Such improvements would support more rigorous prospective estimates of the incidence and determinants of reproductive disease in northern Nigeria.

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## Declaration of competing interest

The authors declare no competing interests.

## Data availability

The study records were obtained from participating

veterinary clinics and are not publicly available because they contain potentially sensitive clinical and owner-related information. De-identified analytical files and analysis code may be made available by the corresponding author on reasonable request, subject to institutional and clinic permissions.

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