Prevalence of brucellosis in cattle and adopted control measures in South Africa from 2014 to 2019

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Abstract

Bovine brucellosis is a neglected zoonotic disease in developing countries, endemic, and a growing challenge to public health. The development of cost-effective control measures for the disease can only be affirmed by knowledge of the disease epidemiology and the ability to define its risk profiles. This study aimed to document the trend of bovine brucellosis and the control measures adopted following reported cases from 2014 to 2019 in South Africa. The data on confirmed cases of bovine brucellosis was retrieved from the website of the World Organization for Animal Health (WOAH). Descriptive analysis and the analysis of variance (ANOVA) were utilized for significance (p < 0.05). The data retrieved revealed an overall average bovine brucellosis prevalence rate of 8.48%. There were significant differences in bovine brucellosis prevalence across the provinces in 2014, 2015, 2017, 2018, and 2019 (p < 0.05). Provinces with generally lower annual temperatures, namely KwaZulu Natal, Western Cape, and Free State, had higher prevalences of bovine brucellosis, while disease trends for Gauteng, Northern Cape, and Eastern Cape provinces were not easy to establish due to missing data for some of the years falling within the study period. The study identified gaps in the reporting of bovine brucellosis and documentation of disease control measures in the country. The present study not only identified these gaps but also proposed the need for future studies that detect the prevalence of cattle brucellosis at the animal/herd level. This recommendation, if implemented, can provide further insights into the disease situation in South Africa and pave the way for more effective control measures.

Keywords: Brucellosis, Prevalence, Zoonotic, Vaccination, South Africa, WOAH


Introduction

Livestock production is the mainstay of South African agriculture. Frean et al. (2018) estimated that 60% of the South African population relies on agriculture, with cattle production playing a key role. Animal products play an important role in the food industry and contribute to safe and affordable high-quality protein for a growing population (Mpofu, 2018; Schelling et al., 2021). Demand for red meat and milk in South Africa has risen in the last 10–20 years. Cattle and small ruminants are assumed to be the main source of human infections. Several control options exist, with vaccination and/or test-and-slaughter of positive animals being the cornerstone of most control programs. Bovine brucellosis is a chronic disease that negatively impacts cattle reproduction and production by causing abortions, stillbirths, weak calves, retained placentas, decreased milk yield, and reduced fertility in breeding stock (Fürst et al., 2017; Kolo et al., 2019; Modisane, 2019). In addition, brucellosis poses a barrier to the importation and exportation of cattle, thereby constraining livestock trade (Mahomed et al., 2015). According to Moreno (2021), the global occurrence of brucellosis is often high due to factors such as unrestricted movement of cattle and lack of vaccination of susceptible animals. Prevalences of bovine brucellosis were documented in previous studies in South Africa. Bishop (1984) reported a prevalence of 1.50 % for cattle sampled at the Cato Ridge abattoir in KwaZulu-Natal province in 1984. Hesterberg et al.
Falenski, 2023). Important factors affecting bovine brucellosis include surveillance, vaccination, movement control, biosecurity practices, testing, isolation, and slaughter policy (Durrani et al., 2020). The study was conducted to document the trend of bovine brucellosis and the control measures adopted following reported cases from 2014 to 2019 in South Africa.

Materials and methods

Study design and analysis

The study used secondary data from the World Organization for Animal Health (WOAH) on reported cases of brucellosis in cattle in South Africa from 2014 to 2019. The study obtained an exemption from ethical review due to the availability in the public domain of the data used in this study. The data was accessed from the WOAH. WOAH is an intergovernmental organization that supports, coordinates, and promotes animal disease control. It is responsible for providing all available information about exceptional disease events that occur in the member countries, as well as follow-up reports and six-monthly reports on WOAH-listed disease situations in each country. The information portal allows the data to be viewed, analyzed, and extracted in different formats. The data was analyzed using the IBM Statistical Package for Social Sciences software version 29.0. The Shapiro-Wilk test was used to assess the normality of the data before the analysis. Descriptive statistics (frequencies and percentages) were used to evaluate the control measures that were adopted along with identifying the provinces that are most affected by bovine brucellosis in South Africa from 2014 to 2019. The prevalence of bovine brucellosis was obtained by using the equation:

\[
\text{prevalence} = \frac{\text{cases}}{\text{susceptible}} \times 100.
\]

One-way analysis of variance (ANOVA) was used to evaluate the statistically significant differences in the prevalence of bovine brucellosis between the years and between the provinces. The level of significance was observed at \( p < 0.05 \).

Results and discussion

Mean annual bovine brucellosis prevalence rates in the provinces of South Africa from 2014 to 2019

The results of the mean annual bovine brucellosis
prevalence rates in the provinces of South Africa from 2014 to 2019 are presented in Table 1. The results showed that the highest prevalence of bovine brucellosis was observed in 2015 (55.52%) in Northwest Province. Table 2 compares the prevalence of bovine brucellosis across the provinces of South Africa from 2014 to 2019. There were statistically significant differences (p<0.05) in bovine brucellosis prevalence across the provinces except for the year 2016 (p>0.05), with the Eastern Cape province having the highest prevalence. The overall prevalence of bovine brucellosis was 8.48% in comparison with 7.7% reported by Mfune et al. (2022) from a study conducted in Malawi, 9.3% reported by Sagamiko et al. (2018) from a study conducted in Tanzania, 9.3% and 10.1% reported by Ogugua et al. (2018) from a study conducted in Nigeria. Ayoola et al. (2017) reported a bovine brucellosis prevalence of 7.81% from a study conducted in Nigeria, while Mfune et al. (2021) reported a prevalence of 7.53% from a study conducted in Zambia. According to Agada et al. (2017) and Boukary et al. (2013), several risk factors influence the occurrence of bovine brucellosis, such as production systems as well as seasonal changes in temperature and rainfall that would cause animals to travel long distances before getting a pasture or water source that is shared by many other herds. High cattle populations coupled with uncontrolled movement of cattle herds, thereby promoting inter-herd interactions, have been reported to pose a high risk for cattle brucellosis transmission. Sichewo et al. (2020) and Govindasamy et al. (2021) reported that free movement of cattle in communal farming, sharing of pastures, and watering points in the same area were significant risk factors for bovine brucellosis in cattle herds. For example, in regions of Rwanda where cattle are raised under small-scale zero-grazing systems, lower prevalences of between 1.7 to 2% were reported. However, in the eastern region of the country with the highest cattle populations under an extensive production system, average prevalence rates of 18.9% were reported (Segwagwe, 2018). Lita et al. (2016) stated that brucellosis cases tend to be concentrated in areas where cattle populations are high. Furthermore, Getachew et al. (2016) indicated that results on bovine brucellosis prevalence can be affected by other factors, such as the type of diagnostic test utilized. Indirect enzyme-linked immunosorbent assay (ELISA) was reported to provide the best sensitivity and specificity as compared to the Rose Bengal Plate test (RBPT) and complement fixation test (CFT). Djangwani et al. (2021) reported that diagnostic tests such as the Rose Bengal test (RBT) and c-ELISA tend to be more sensitive compared to CFT and i-Elisa. There were significant differences in the prevalence of bovine brucellosis across the provinces of South Africa during the years 2014, 2015, 2017, 2018, and 2019 (p<0.05). Furthermore, there was a general decrease in the disease prevalence rates in the provinces of Mpumalanga, Free State, and Western Cape during the study period. KwaZulu Natal and Limpopo Province witnessed an increasing trend. However, full disease trends for Gauteng, Northern Cape, and Eastern Cape Province could not be established due to missing data for some of the years falling within the study period. The missing data could be attributable to the under-reporting of the disease by cattle farmers (Caine et al., 2017) and the predominant voluntary nature of the brucellosis testing scheme in South Africa. Yawa et al. (2020) reported that under-reporting of cattle diseases is common, especially among communal cattle farmers, due to a lack of knowledge of cattle diseases. Provinces with generally lower average annual temperatures and high precipitation, namely KwaZulu Natal, Western Cape, and Free State tended to have higher prevalences of bovine brucellosis during the study period. Botopela (2022) reported that Brucella organisms can survive longer (2-3 months) in wet soils following abortion cases than in dry soils (1-2 months).

**Bovine brucellosis control measures**

Results in Table 3 show control and prevention measures that were implemented against bovine brucellosis during the study period. The findings revealed that the highest number of animals killed and disposed of was observed in 2015 (n=828), while the highest number of vaccinated animals was observed in 2014 (59,498). Cattle brucellosis is a reportable disease in the Republic of South Africa. Therefore, control measures have been instituted through the Animal Diseases Act 35 of 1984 and the bovine brucellosis scheme (R.2483 of 9 Dec 1988), which is regulated by the Director of Animal Health, Department of Agriculture, Land Reform and Rural Development (DALRRD). The purpose is to prevent the spread
Table 1: Mean annual bovine brucellosis prevalence rates in the provinces of South Africa from 2014 to 2019.

<table>
<thead>
<tr>
<th>Year</th>
<th>L</th>
<th>NW</th>
<th>GP</th>
<th>MP</th>
<th>NC</th>
<th>FS</th>
<th>KZN</th>
<th>WC</th>
<th>EC</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>-</td>
<td>7.94</td>
<td>-</td>
<td>22.96</td>
<td>17.15</td>
<td>19.84</td>
<td>-</td>
<td>9.86</td>
<td>0.13</td>
</tr>
<tr>
<td>2015</td>
<td>0.83</td>
<td>55.52</td>
<td>33.85</td>
<td>-</td>
<td>12.86</td>
<td>22.88</td>
<td>2.89</td>
<td>26.35</td>
<td>8.06</td>
</tr>
<tr>
<td>2016</td>
<td>7.05</td>
<td>5.57</td>
<td>-</td>
<td>7.11</td>
<td>-</td>
<td>11.86</td>
<td>11.28</td>
<td>4.00</td>
<td>4.83</td>
</tr>
<tr>
<td>2017</td>
<td>8.01</td>
<td>14.16</td>
<td>-</td>
<td>5.76</td>
<td>11.11</td>
<td>4.85</td>
<td>-</td>
<td>-</td>
<td>6.16</td>
</tr>
<tr>
<td>2018</td>
<td>-</td>
<td>13.35</td>
<td>-</td>
<td>4.80</td>
<td>-</td>
<td>8.20</td>
<td>13.86</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2019</td>
<td>21.58</td>
<td>15.56</td>
<td>-</td>
<td>3.04</td>
<td>-</td>
<td>6.31</td>
<td>19.94</td>
<td>8.45</td>
<td>-</td>
</tr>
</tbody>
</table>


Table 2: Prevalence of bovine brucellosis across the provinces of South Africa from 2014 to 2019.

<table>
<thead>
<tr>
<th>Year</th>
<th>L</th>
<th>NW</th>
<th>GP</th>
<th>MP</th>
<th>NC</th>
<th>FS</th>
<th>KZN</th>
<th>WC</th>
<th>EC</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>10.84±0.00</td>
<td>20.51±19.68</td>
<td>2.89±0.00</td>
<td>9.92±0.00</td>
<td>22.88±0.00</td>
<td>20.96±12.89</td>
<td>5.69±0.00</td>
<td>27.82±14.95</td>
<td>9.83±0.00</td>
<td>0.01</td>
</tr>
<tr>
<td>2015</td>
<td>0.43±0.00</td>
<td>10.56±0.66</td>
<td>-</td>
<td>7.11±0.06</td>
<td>-</td>
<td>11.85±7.52</td>
<td>11.28±0.00</td>
<td>4.00±0.00</td>
<td>42.82±35.01</td>
<td>0.17</td>
</tr>
<tr>
<td>2016</td>
<td>8.01±6.34</td>
<td>14.16±0.97</td>
<td>-</td>
<td>5.76±0.84</td>
<td>11.11±0</td>
<td>4.84±0.41</td>
<td>3.05±0.00</td>
<td>-</td>
<td>6.16±0.00</td>
<td>0.04</td>
</tr>
<tr>
<td>2017</td>
<td>-</td>
<td>13.34±2.92</td>
<td>-</td>
<td>4.80±2.09</td>
<td>-</td>
<td>8.19±1.81</td>
<td>13.86±0.00</td>
<td>-</td>
<td>-</td>
<td>0.03</td>
</tr>
<tr>
<td>2018</td>
<td>21.57±19.69</td>
<td>15.56±4.20</td>
<td>-</td>
<td>3.04±1.26</td>
<td>-</td>
<td>6.31±1.34</td>
<td>19.94±15.96</td>
<td>8.45±0.00</td>
<td>-</td>
<td>0.05</td>
</tr>
</tbody>
</table>


Table 3: Bovine brucellosis control measures in South Africa from 2014 to 2019, based on data obtained from the WOAH on brucellosis control measures and actions taken.

<table>
<thead>
<tr>
<th>Year</th>
<th>Killing and disposal N (average)</th>
<th>Vaccination N (average)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>199 (7)</td>
<td>59.498 (7.437)</td>
</tr>
<tr>
<td>2015</td>
<td>828 (52)</td>
<td>41.420 (2.589)</td>
</tr>
<tr>
<td>2016</td>
<td>638 (46)</td>
<td>7.396 (528)</td>
</tr>
<tr>
<td>2017</td>
<td>118 (8)</td>
<td>6.309 (451)</td>
</tr>
<tr>
<td>2018</td>
<td>286 (29)</td>
<td>7.913 (791)</td>
</tr>
<tr>
<td>2019</td>
<td>295 (21)</td>
<td>5.155 (368)</td>
</tr>
</tbody>
</table>
of brucellosis through the disease testing scheme (established under section 10 of the Animal Disease Act 35). Testing is compulsory for only high-risk herds that have been confirmed or suspected of infection using RBT and CFT. However, for the herds that are perceived as low-risk, farmers are not obliged to join the brucellosis testing scheme. Vaccination is practiced in South Africa according to the stipulated standards with mainly B. abortus S19 and, to a lesser extent, B. abortus RB 51 in cattle, while B. melitensis Rev 1 is used in sheep and goats. These control measures, amongst others, are instituted to prevent a spillover of the disease to other domestic animals and wildlife in areas close to the wildlife parks (Simpson et al., 2018). Alton et al. (2016) recommended the use of abattoir facilities to monitor disease control policies, detect newly introduced disease agents, assess intervention programs, such as brucellosis vaccination, and facilitate early intervention to mitigate the epidemic loss of animals. Food and Agriculture Organization (FAO) recommends long-term mass vaccination of up to 10 years as a starting point to control the disease. Zamri-Saad and Kamarudin (2016) reported that the control of livestock movement, screening of replacement livestock before their introduction to the farms, and hygienic disposal of abortive materials are basic farm management practices as additional elements to the success of any brucellosis control strategy.

Conclusions

The current study revealed an 8.48% overall prevalence of bovine brucellosis in South Africa within the period 2014 to 2019. This study offered baseline data that will help to enhance informed disease control policies in the country. Although certain critical epidemiological information was lacking, the findings of our study can be used to drive, monitor, adjust, or establish policies to reduce the challenges posed by brucellosis in the country’s cattle sector. Therefore, in designing its approach to control brucellosis, the responsible authorities could take advantage of such studies to determine the epidemiological units of intervention and design-appropriate brucellosis control strategies in line with other key considerations. We recommend the development and implementation of multisectoral One Health surveillance and control strategies to minimize disease burden in animals and humans.

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