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# SEROPREVALENCE OF SMALL RUMINANT BRUCELLOSIS AND ITS EFFECT ON REPRODUCTION IN DISTRICT DADU, PAKISTAN

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## ABSTRACT

Brucellosis is a contagious zoonotic disease caused by *Brucella* species, affecting domestic animals and humans. In small ruminants, mainly caused by *Brucella melitensis* and *Brucella ovis*, the disease leads to abortions, infertility, reduced milk yield, and significant economic losses. This study aimed to determine the seroprevalence and associated risk factors of brucellosis in sheep and goats in District Dadu, Sindh, Pakistan. A total of 400 blood samples (200 goats and 200 sheep) were randomly collected from animals with a history of abortion across four tehsils (Dadu, Johi, Khairpur Nathan Shah, and Mehar). Samples were screened using the Rose Bengal Plate Test (RBPT) and confirmed by ELISA. A structured questionnaire was used to assess potential risk factors. Overall seroprevalence was 6.5% (26/400), with slightly higher prevalence in goats (7.0%) than sheep (6.0%). Johi and Mehar tehsils showed the highest prevalence. Significant risk factors included poor biosecurity practices ($p<0.0207$), repeated abortions ($p<0.0254$), and introduction of new animals without quarantine ($p<0.0213$). Animals with reproductive disorders showed higher seropositivity, while no significant breed-wise differences were observed. The findings indicate a moderate prevalence of brucellosis in the study area, highlighting the need for improved biosecurity, awareness, and routine screening to reduce economic losses and zoonotic risk.

## 1. INTRODUCTION

Small ruminants were the first animals that humans domesticated (Jesse *et al.*, 2020). Small ruminants are accounted more than half of all domesticated ruminants worldwide, and they play a significant role in the farming systems of most of the developing nations (Gebremedhin *et al.*, 2015). According to recent research conducted in various parts of the world, there are now 1.94 billion small ruminants worldwide, up from 1.35 billion in 2011 (Tedeschi *et al.*, 2011).

There are an estimated 82.5 million goats and 31.9 million sheep in Pakistan's small ruminant population (Economic Survey of Pakistan, 2022). Small ruminants have several advantages over large ruminants in a number of ways, such as lower feed costs, faster turnover, suitable size at slaughter and ease of management (Zahra *et al.*, 2014). Additionally, because they experience far lower rates of mortality during dry spells than large ruminants, they exhibit a greater tolerance to unfavorable conditions. Furthermore, because there is an excessive risk of losing large ruminants, breeders prefer sheep and goats (Zahra *et al.*, 2014).

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The Production of sheep and goats in developing countries is still low, primarily because of underfeeding, inadequate management practices, and diseases, despite the significance of small ruminants for producers' livelihoods (Gizaw, 2010). The subsector's productivity and output are significantly below the target level for a number of reasons, with poor nutrition and illness being the most frequently recorded. A single abortion in a small ruminant may be caused by toxic feed or genetics. As soon as an abortion outbreak occurs in a lock, the cause should be determined in order to decide whether to implement control measures (Godifa & Desta., 2010). Diseases are one of the main factors limiting the financial gains from the production of goats and sheep. Brucellosis is one such disease that reduces small ruminant productivity and hinders global trade (Ademosun, 1994).

It is a common and economically significant zoonosis worldwide. Various animal species are impacted by this disease, which has global significance. As obligatory parasites, *Brucella* species depend on their animal host to survive. Humans, ruminants, pigs, rodents, dogs, and marine mammals are among the host species. Ingestion or inhalation of organisms can result in infection. Milk, semen, vaginal discharge, urine, and the birth fluids of animals that are infected all contain high concentrations of the organism. Brucella can live with long-term exposure to the environment without a host if the right conditions are met. According to Glenn and Karen (2005), they remains viable in soil for up to 125 days to six months at $0^c$ in carcasses and tissues, and up to a year in feces. Brucellosis is a zoonotic infection that spreads globally, impacting humans as well as animals (Rahimoon *et al.,* 2024). Many domestic animals, including humans and goats, sheep, cows, and camels, can contract brucellosis. *Brucella* species are slow-growing, gram-negative bacteria with a coccobacillus shape. They can live and reproduce inside cells including placental trophoblasts, macrophages, epithelial cells and dendritic cells. Extreme temperature, humidity, and pH conditions can all be tolerated by *Brucella* species, which can also survive longer in frozen and aborted materials (Corbel and Beeching, 2004).

In few couple of years reproductive disorders in small ruminants were observed in the vicinity of district Dadu of Pakistan, causing huge economic losses for small farmers. No study has been conducted in recent years, that's why this study was conducted to know the involvement of brucellosis in reproductive disorders in the study area.

## 2. MATERIALS AND METHODS

**3.1** ***An overview of the research area***

The research was carried out in Dadu district, situated in Sindh, Pakistan. Dadu city is is administratively subdivided into four talukas Dadu, Johi, Khairpur Nathan shah and Mehar. Dadu city is located at Longitude: 67.7854429, Latitude: 26.7853063, Elevation: 41m / 135feet. There are 283729 sheep and 800064 goats found in the area according to report of (Sindh Province Report Livestock Census, 2006).

**3.2** ***Study animal and sample size and type***

The study animals were sheep and goat which are found in district Dadu. Blood samples were taken with simple random selection method from sheep and goats. 400 animals were randomly selected from small ruminants with history of abortion using a simple random sampling method. Total 400 samples were collected from four tehsils of district Dadu, 100 samples from each tehsil. 200 hundred sample from caprine and 200 hundred from ovine.

**3.3** ***Study design***

This study employed a cross-sectional design, in which blood samples were randomly collected from sheep and goats for analysis using the Rose Bengal Agglutination Test and Enzyme-Linked Immunosorbent Assay (ELISA). A questionnaire survey was developed and was interviewed to sheep and goat owners.

**3.5** ***Sample procedure***

Based on the history of abortion, blood samples were taken from the sheep and goat that were chosen at random. From the jugular vein, about 6 ml of blood samples were extracted using sterile plain vacutainer tubes. Then the samples were transported to Central veterinary diagnostic laboratory sub center Dadu using icebox immediately after collection. After appropriately labeling the samples and letting them clot for 24 hours at room temperature, the serum was separated in order to test for *brucella melitensis* antibodies. Samples were tested for *Brucella melitensis* antibodies using the Rose Bengal Plate Test (RBPT), with positive samples were confirmed by Enzyme linked immune sorbent assay (ELISA) at Central veterinary diagnostic laboratory Tandojam.

**3.6** ***Questionnaire survey***

A questionnaire survey was formed to gather information related to the causes and incidence of abortion. Additionally, the interview included potential risk factors such as the type of housing system, biosecurity practices, age at the time of abortion, recurrence of abortion, and the level of awareness among farmers or small ruminant owners regarding abortion-related issues. A questionnaire survey was also used to record association of brucellosis to various reproductive disorders such as abortions, retained placenta, stillbirths and infertility were recorded.

**3.7** ***Statistical analysis***

After carefully entering all of the collected data into Microsoft Excel sheets, it was prepared for statistical analysis. ANOVA method was performed using statistics 8.1 software was used to analyze the results.

## 3. RESULTS AND DISCUSSION

In this study 400 blood samples were examined for detection of brucellosis (*Brucella melitensis*) in small ruminants (caprine and ovine). Initially samples were screened through Rose Bengal plate test and positive samples were confirmed by using (ELISA); Out of these screened samples, 30 samples were detected positive for brucellosis (*Brucella melitensis)* in both caprine and ovine. The rate of prevelance was calculated as 7.5% of the disease in both caprine and ovine. The brucellosis (*Brcuella melitensis*) was diagnosed positive 18 (09%) in caprine and 14 (07%) in ovine as mentioned in (Table NO. 4.1).

**4.1 General prevalence of brucellosis in the study area in small ruminants**

Total of 400 serum samples were collected from two small ruminant species, including 200 samples from caprine (goats) and 200 from ovine (sheep). The samples were initially screened using the Rose Bengal Plate Test (RBPT), followed by confirmation through Enzyme-Linked Immunosorbent Assay (ELISA). Out of the 200 caprine samples, 18 (9.0%) were RBPT-positive, and 14 (7.0%) were confirmed positive by ELISA. Similarly, in the ovine group, 14 samples (7.0%) were RBPT-positive, with 12 (6.0%) confirmed through ELISA. The overall seroprevalence of brucellosis in the examined small ruminants was 6.5%. Statistical analysis indicates no significant difference in seroprevalence between caprine and ovine species (P = 0.5528). These findings indicate a comparable level of brucella exposure among goats and sheep in the studied population, with slightly higher positivity observed in caprines.

**4.2 Prevalence of brucellosis across different areas**

Four areas of district Dadu were included in the study, There was not major difference in prevalence in different areas of study (p = 0491). Prevalence rate in taluka Dadu in both species was recorded 4.00%, in Johi 10.00% in goats and 8.00% in sheep. In KN Shah 6.00% in both species and in Mehar it was recorded 8.00% in caprine and 7.00 in ovine.

**4.2.1 Prevalence of brucellosis across different areas in caprine**

To determine the geographical distribution of brucellosis in caprine, a total of 200 serum samples were collected from four different areas: Dadu, Johi, KN Shah, and Mehar, with 50 samples from each area. The samples were screened using the Rose Bengal Plate Test (RBPT) and confirmed through Enzyme-Linked Immunosorbent Assay (ELISA).

In Dadu, 3 out of 50 samples (6.0%) were RBPT-positive, with 2 samples (4.0%) confirmed by ELISA. In Johi, 6 samples (12.0%) tested positive by RBPT, and 5 (10.0%) were confirmed by ELISA. From KN Shah, 4 samples (8.0%) were RBPT-positive, and 3 (6.0%) were ELISA-positive. Mehar had 5 RBPT-positive samples (10.0%), with 4 (8.0%) confirmed through ELISA. The overall seroprevalence across all four areas was calculated at 7.0%.

Statistical analysis showed a significant difference in the prevalence of brucellosis among the four locations (P = 0.0491), suggesting that the disease distribution is not uniform and may be influenced by local risk factors, management practices, or animal movement patterns

**4.2.1 Prevalence of brucellosis across different areas in ovine**

To assess the distribution of brucellosis in ovine populations, a total of 200 serum samples were collected from four different areas: Dadu, Johi, KN Shah, and Mehar, with 50 samples obtained from each location. All samples were screened using the Rose Bengal Plate Test (RBPT) and subsequently confirmed through Enzyme-Linked Immunosorbent Assay (ELISA).

In Dadu, 2 samples (4.0%) tested positive by both RBPT and ELISA. Johi exhibited a slightly higher seropositivity with 5 samples (10.0%) testing RBPT-positive and 4 (8.0%) confirmed by ELISA. In KN Shah, 3 samples (6.0%) tested positive through both RBPT and ELISA, while in Mehar, 4 samples (8.0%) were RBPT-positive and 3 (6.0%) were confirmed by ELISA. The overall seroprevalence of brucellosis in ovine, based on ELISA, was 6.0%.

Although some variation was observed in the prevalence across different regions, statistical analysis revealed no significant difference among the areas (P = 0.1835). This indicates a relatively uniform distribution of brucellosis in sheep across the surveyed districts.

**4.3 Breed wise prevalence of brucellosis in caprine and ovine**

According to breed wise prevalence rate in different breeds 9.68%, 7.41%, 6.15% and 6.00% in kamori, pateri, barri, and tapri was respectively recorded. And in sheep 6.31%, 4.61%, 7.50% in dumbi, kachhi and kooka respectively prevalence rate was recorded. In the study area there was not a significant difference in prevalence in both species (in caprine and ovine prevalence difference was (p=0.1654), (p=0.2679) respectively).

**4.4 Reproductive problems in female with the prevalence of brucellosis**

In This study also investigated the relationship between common reproductive disorders and the seroprevalence of brucellosis in female goats and sheep. A total of 200 samples each were collected from goats and sheep. Reproductive conditions considered included retained placenta, stillbirths, and infertility. Brucellosis positivity was determined using ELISA.
Among goats with a history of retained placenta, 8 out of 45 animals (17.80%) tested positive, compared to only 6 out of 155 (3.87%) animals without this condition. The difference was statistically significant (P = 0.0080), indicating a strong association between retained placenta and brucellosis.

Similarly, goats with stillbirths showed a significantly higher prevalence (15.62%) compared to those without (5.35%), with a P-value of 0.0184. Infertility also showed a trend toward higher seropositivity (10.77% in infertile goats vs. 5.18% in fertile ones), though the association was borderline significant (P = 0.0584).

In sheep, animals with a history of retained placenta had a higher prevalence of brucellosis (12.00%) compared to those without (5.14%), and the association was statistically significant (P = 0.0400). A marked increase in brucellosis seroprevalence was also observed among sheep with stillbirths (18.18%) versus those without (4.49%), with the difference being statistically significant (P = 0.0105).

Moreover, infertile sheep showed a significantly higher prevalence (16.12%) than fertile sheep (4.14%) (P = 0.0137), indicating a potential link between brucellosis infection and infertility.

These findings indicate a significant association between brucellosis and certain reproductive disorders particularly retained placenta, stillbirths, and infertility in both goats and sheep.

**4.5 Prevalence of brucellosis (*brucella melitensis*) in small ruminants (caprine and ovine) according to the different investigated risk factors**

Prevalence of *Brucella melitensis* among small ruminants (goats and sheep) based on various investigated risk factors. A total of 400 samples were examined, and the data were analyzed by categorizing animals according to housing conditions, biosecurity practices, age during abortion, abortion frequency, flock size, and the introduction of new animals into the herd. A higher prevalence was observed in animals under mixed housing (6.83%) compared to separate housing (4.08%), although the difference was not statistically significant (p = 0.1913). Biosecurity measures had a notable impact on brucellosis prevalence. No positive cases were recorded among animals from farms where biosecurity protocols were implemented (0.00%), while a prevalence of 6.84% was recorded among animals from farms lacking biosecurity (p = 0.0207). The age during abortion also appeared to influence disease prevalence. Animals older than two years at the time of abortion had a higher prevalence (7.41%) compared to those younger than two years (3.33%), though the difference was not statistically significant (p = 0.1021). Regarding the frequency of abortion, animals that had aborted for the second time showed a significantly higher prevalence of brucellosis (14.28%) compared to those with only a first-time abortion (5.58%), with a p-value of 0.0254. In terms of flock size, herds with fewer than 10 animals had a higher prevalence (7.16%) compared to larger flocks with more than 10 animals (1.96%). Although this difference approached significance (p = 0.0667). Finally, the addition of new animals into the herd without proper quarantine was significantly associated with increased prevalence. Herds that introduced new animals had a prevalence of 6.75%, while those without new additions reported no cases (0.00%), with a statistically significant p-value of 0.0213.

The aim of this study was to determine the seroprevalence of *Brucella melitensis* infection in small ruminants (caprine and ovine) in District Dadu, Sindh, Pakistan, and identify associated risk factors. The overall seroprevalence of brucellosis in small ruminants was found to be 7.5% using Rose Bengal Plate Test (RBPT) and 6.5% after confirmation through ELISA, indicating that brucellosis remains an important health problem in sheep and goats in this region.

When comparing species, the prevalence in goats (7.0%) was slightly higher than in sheep (6.0%). However, the difference was not statistically significant ($p>0.5528$), suggesting that both species are nearly equally susceptible to *Brucella melitensis* infection under local management conditions. Our findings on the occurrence of Brucella infections are consistent with recent reports by Kolachi *et al.* (2024), Shafee *et al.* (2016), Hussain *et al.* (2014), and Iqbal *et al.* (2013), who documented prevalence rates of 2.17%, 2.3%, 7%, and 10% in Dadu, Balochistan, Punjab, and Kohat, respectively. In contrast, Gul *et al.* (2015) reported lower prevalence rates of 1.91% in sheep and 2% in goats within Pakistan. Similarly, Shahzad (2017) observed a prevalence of 0.23% in goats and 0% in sheep in Punjab. Beyond Pakistan, seroprevalence rates reported in Bangladesh were 9.53% and 2.6% by Shafy *et al.* (2016) and Rahman *et al.* (2011), respectively. In India, Saikia *et al.* (2019) documented an overall seroprevalence of 1.72% in goats, while in Nepal, Pandeya *et al.* (2016) found a 2.6% prevalence of *Brucella melitensis* in caprine populations. These findings are consistent with reports from other regions of Pakistan and neighboring countries where small ruminants are known reservoirs for brucellosis.

Area-wise, although prevalence rates varied between tehsils, ranging from 4% in Dadu to 10% in Johi for goats, and similar trends in sheep, no significant differences were observed (p-values >0.05). This suggests that brucellosis is widely distributed across the district without being confined to a specific geographic area. Factors such as shared grazing grounds, communal watering points, and lack of biosecurity may contribute to uniform distribution across the region.

Breed-wise analysis revealed some variation, with Kamori goats (9.68%) and Kooka sheep (7.50%) showing the highest seroprevalence in their respective species. However, the There were no statistically significant differences between breeds. No meaningful correlation was seen in the breed-specific seroprevalence (0.1654) in goats and (0.2679) in sheep between the breed of sheep and goats sampled and seropositivity. Despite the fact that Brucella infections are not breed specific (Bala, 2013 Comparing the Red Sokoto breed to the Sahel, West African Dwarf, Kano brown, and Cross breeds, the highest seroprevalence was found. This report indicates breed specific prevalence Junaidu *et al.* (2010), Tijjani *et al.* (2009) and Dogo *et al.*, 2016 who stated that the Red Sokoto breed has the highest brucellosis prevalence. These findings imply that while certain breeds may appear more affected, management practices likely play a greater role in disease transmission than genetic susceptibility.

Reproductive disorders, particularly retained placenta, stillbirths, and infertility, were significantly associated with Brucella infection (p-values <0.05). Animals with a history of these reproductive problems showed notably higher brucellosis prevalence compared to healthy animals. This highlights the pathogenic role of *Brucella melitensis* in causing severe reproductive failures, which not only affects animal welfare but also results in substantial economic losses to livestock owners.

Several risk factors were evaluated in this study. Herds without biosecurity measures exhibited a significantly higher prevalence (6.84%) compared to herds with biosecurity practices where no cases were detected ($p<0.0207$). Similarly, mixed housing (6.83%) showed higher infection rates than separate housing (4.08%), although the difference was not statistically significant.

Age at abortion also influenced seroprevalence; animals older than 2 years were more commonly affected than younger animals, which could be attributed to prolonged exposure risk. Similar findings have been documented in Ethiopia and in various other parts of the world (Asmare *et al.*, 2013). Moreover, during the dry season, adult animals often migrate in search of pasture and water, which heightens the likelihood of interaction with other herds and consequently increases the risk of disease transmission.

A statistically significant correlation was found between larger flock sizes and Brucella seropositivity in goats. This relationship may be attributed to the fact that as flock size grows, stocking density typically rises as well, creating conditions that facilitate disease transmission, one of the determinants for exposure to Brucella infection especially following abortion or parturition. The link between flock size and the prevalence of anti-Brucella antibodies has also been documented in these studies (Asmare *et al.*, 2013).

The frequency of abortion was another important factor. Animals that aborted for the second consecutive time had a higher prevalence (14.28%) compared to those with first-time abortions (5.58%), suggesting that repeated reproductive failure could be an indicator of chronic infection with *Brucella melitensis*. Brucellosis, particularly caused by *B. melitensis*, is a known cause of late-term abortions, retained placenta, and infertility in small ruminants, especially goats and sheep (Corbel, 2006).

Reproductive failure often manifests as one of the earliest clinical signs of infection, and its recurrence may suggest a persistent or inadequately managed infection in the animal or the herd. Recurrent abortions in animals could result from a chronic carrier state, where the organism persists intracellularly despite the absence of overt clinical signs (Seleem *et al.*, 2010). Several studies have highlighted a higher seroprevalence of brucellosis in animals with multiple abortions. Kaltungo *et al.* (2014) in Nigeria found that goats with multiple abortion events had higher seroprevalence rates of brucellosis, suggesting chronic or recurring infection.

Furthermore, the addition of new animals to the herd without proper quarantine significantly increased brucellosis prevalence (6.75% vs. 0%, p = 0.0213). This finding emphasizes the importance of introducing strict biosecurity and quarantine measures to prevent disease introduction and spread. Several studies have demonstrated the risk associated with introducing new animals into herds without quarantine. For instance, a study by Matope *et al.* (2010) in Zimbabwe identified animal movement and introduction without testing as key risk factors for herd-level brucellosis seropositivity. Similarly, Cadmus *et al.* (2006) reported a significant association between brucellosis seroprevalence and the absence of quarantine practices in Nigerian cattle herds. These findings echo the results of the present study, reinforcing the critical need for regulated animal introductions. Quarantine is a well-established disease prevention strategy involving the physical separation and clinical observation of newly acquired or returning animals over a specific period (usually 30 days), during which diagnostic testing is conducted (Gul & Khan, 2007).

Lastly, farmer awareness played a crucial role. Owners with knowledge about causes of abortion had lower prevalence rates (1.96%) compared to those without awareness (7.16%), highlighting the need for farmer education as a key tool in brucellosis control programs. Several epidemiological studies support the findings of this research. For example, Muma *et al.* (2007) in Zambia reported that knowledge about brucellosis and its reproductive consequences among farmers was inversely correlated with herd seroprevalence. Similarly, Tadesse (2016) in Ethiopia found that farmers who had been trained or informed about the disease were more likely to adopt preventive practices, including isolation of aborted animals, safe disposal of fetal materials, and boiling of milk before consumption. These practices directly reduce the risk of disease transmission among animals and from animals to humans. Education initiatives targeting livestock keepers have proven effective in controlling other zoonotic diseases as well.

## 4. CONCLUSION

The purpose of this study was to ascertain the prevalence of brucellosis (*Brucella melitensis*) and associated risk factors in small ruminants in district Dadu, Sindh, Pakistan. A cross-sectional study involving 400 blood samples, collected randomly from animals with a history of abortion across four tehsils, revealed an overall seroprevalence of 6.5% through RBPT and ELISA confirmation. The prevalence was slightly higher in goats (7.0%) compared to sheep (6.0%), though the difference was statistically non-significant. Area-wise, breed-wise, and species-wise comparisons indicated no major significant variation in the prevalence rates.

Reproductive disorders, particularly retained placenta, stillbirths, and infertility, showed a substantial correlation with seropositivity for brucellosis. Key risk factors included poor biosecurity practices, mixed housing systems, lack of awareness among farmers, older animal age, consecutive abortions, and addition of new animals into the herd without quarantine. Farms without biosecurity measures and larger flock sizes showed relatively higher prevalence rates.

Overall, the findings highlight that brucellosis remains an important reproductive health problem in small ruminants of Dadu District, with considerable implications for livestock productivity and public health. Strengthening biosecurity measures, improving farmer awareness, and routine screening of animals are crucial steps advised to prevent brucellosis from spreading in this area.

*Brucella melitensis* remains a significant zoonotic pathogen affecting small ruminants, leading to substantial economic losses in livestock production and posing serious public health risks. The disease causes reproductive failures such as abortions, stillbirths, and reduced milk yield, severely impacting farmers' livelihoods. Despite control efforts, challenges such as limited surveillance, inadequate vaccination coverage, and poor biosecurity measures persist. Addressing *B. melitensis* requires a coordinated One Health approach involving veterinary services, public health authorities, and livestock owners to mitigate transmission and reduce its burden.

## 5. CONFLICT OF INTEREST

All authors have declared that there is no conflict of interest regarding the publication of this article.

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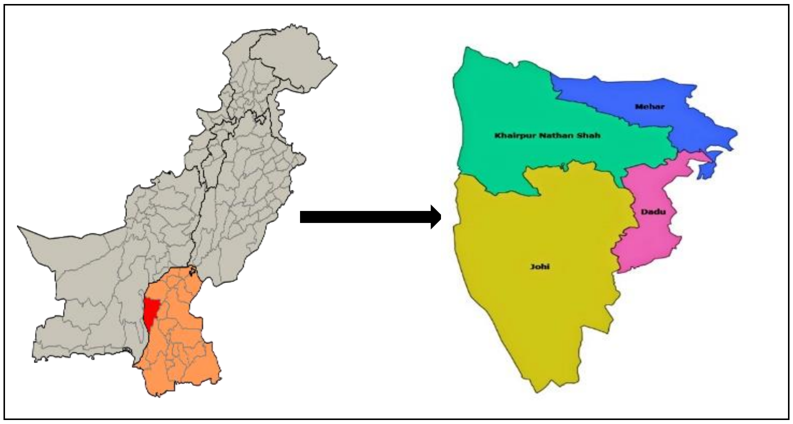


Figure 1. Study area

Table 4.1 General prevalence of brucellosis in the study area in the study area

| Animal species | Samples Examined | RBPT positive samples | ELISA Positive samples | Prevalence (%) | P-value |
|---|---|---|---|---|---|
| Caprine | 200 | 18 | 14 | 07% | 0.5528 |
| Ovine | 200 | 14 | 12 | 06% | |
| Total | 400 | 32 | 26 | 6.5% | |

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Table 4.2 area wise prevalence of brucellosis in caprine.

| Sampling area | Sample Examined | RBPT POSITIVE | ELISA POSITIVE | Prevalence (%) | P-value |
|---|---|---|---|---|---|
| Dadu | 50 | 3 | 2 | 4.00 | 0.0491 |
| Johi | 50 | 6 | 5 | 10.00 | |
| KN shah | 50 | 4 | 3 | 6.00 | |
| Mehar | 50 | 5 | 4 | 8.00 | |
| Total | 200 | 18 | 14 | 7.00 | |

Table 4.3 Area wise prevalence of Brucellosis in Ovine

| Sampling area | No of maple tested | RBPT positive | ELISA positive | Prevalence (%) | P-value |
|---|---|---|---|---|---|
| Dadu | 50 | 2 | 2 | 4.00 | 0.1835 |
| Johi | 50 | 5 | 4 | 8.00 | |
| KN shah | 50 | 3 | 3 | 6.00 | |
| Mehar | 50 | 4 | 3 | 6.00 | |
| Total | 200 | 14 | 12 | 6.00 | |

Table 4.4 Prevalence of brucellosis in different breeds of goats and sheep

| Animal | Breeds | Total samples | Positive samples | Prevalence (%) | P-value |
|---|---|---|---|---|---|
| Goats | Kamori | 31 | 3 | 9.68 | 0.1654 |
| | Pateri | 54 | 4 | 7.41 | |
| | Barri | 65 | 4 | 6.15 | |
| | Tapri | 50 | 3 | 6.00 | |
| Sheep | Dumbi | 95 | 6 | 6.31 | 0.2679 |
| | Kachhi | 65 | 3 | 4.61 | |
| | Kooka | 40 | 3 | 7.50 | |

Table 4.5 Reproductive problems in female with the prevalence of brucellosis

| Species | Effects on reproduction | Condition | No. Samples | Positive samples | Prevalence (%) | P-value |
|---|---|---|---|---|---|---|
| Goats | Retained placenta | Present | 45 | 8 | 17.80 | 0.0080 |
| | | Absent | 155 | 6 | 3.87 | |
| | Still births | Present | 32 | 5 | 15.62 | |
| | | Absent | 168 | 9 | 5.35 | 0.0184 |
| | Infertility | Present | 65 | 7 | 10.77 | |
| | | Absent | 135 | 7 | 5.18 | 0.0584 |
| Sheep | Retained placenta | Present | 25 | 3 | 12.00 | 0.0400 |
| | | Absent | 175 | 9 | 5.14 | |
| | Still births | Present | 22 | 4 | 18.18 | |
| | | Absent | 178 | 8 | 4.49 | 0.0105 |
| | Infertility | Present | 31 | 5 | 16.12 | |
| | | Absent | 169 | 7 | 4.14 | 0.0137 |

Table 4.6 Prevalence of Brucellosis (*Brucella melitensis*) in small ruminants (Caprine and Ovine) according to the different investigated risk factors

| Variable | Category | No. of Samples Examined | Positive samples | Prevalence (%) | P-value |
|---|---|---|---|---|---|
| Housing system | Mixed | 351 | 24 | 6.83% | |
| | Separate | 49 | 02 | 4.08% | 0.1913 |
| Biosecurity measures | Yes | 20 | 0 | 0.00% | |
| | No | 380 | 26 | 6.84% | 0.0207 |
| Age during abortion | > 2 years | 310 | 23 | 7.41% | |
| | < 2 years | 90 | 3 | 3.33% | 0.1021 |
| Frequency of abortion | 1st time | 358 | 20 | 5.58% | |
| | 2nd time | 42 | 6 | 14.28% | 0.0254 |
| Flock Size | >10 animals | 51 | 1 | 1.96% | |
| | <10 animals | 349 | 25 | 7.16% | 0.0667 |
| Addition of new animals | Yes | 385 | 26 | 6.75% | |
| | No | 15 | 0 | 0.00% | 0.0213 |