

Research Article

Knowledge, Attitude, and Practices Regarding Brucellosis Among Veterinarians and Pet Owners in Lahore, Pakistan

Zain Ali ^{*1}, Muhammad Anas Habib ², Muhammad Ali ³

¹ School of Infection and Immunity,
University of Glasgow, United Kingdom

² Diagnostic Lab Manager, Sahary
Veterinary Centre, Al-Shahaniya Qatar.

³ Department of Biotechnology,
University of Azad Jammu and Kashmir
Muzaffarabad, AJ&K

*Corresponding author:

Mr. Zain Ali
(e-mail: Zainalisraa6@gmail.com)

Date of Receiving: 02/03/2025

Date of Acceptance 20/04/2025

Date of Publishing 10/06/2025

ABSTRACT Brucellosis is a zoonotic disease that affects both humans and animals and remains endemic in many developing countries. It is transmitted through direct animal contact or consumption of raw animal products. Farmers and veterinarians are at higher risk due to occupational exposure. Knowledge, attitudes, and practices (KAP) play a key role in preventing disease transmission. This study aimed to assess KAP regarding brucellosis among veterinarians and animal owners in Punjab, Pakistan. A cross-sectional survey was conducted in selected districts. Participants included veterinarians and pet animal owners. A structured questionnaire was used, consisting of both closed and open-ended questions. A total of 300 individuals were approached, and 277 completed the survey. Data were analyzed using descriptive and comparative statistics. Knowledge, attitude, and practice scores were generated, and group differences were tested at $p < 0.05$. Results showed that most respondents recognized brucellosis as a zoonotic disease and identified abortion as the main clinical sign. Vaccination was reported as the most effective preventive measure. However, only 39% of participants demonstrated high knowledge, while 61% had low knowledge. Females, younger respondents, and veterinarians showed higher knowledge levels. Attitudes toward disease prevention were generally positive, with 86% expressing favourable views. Vaccination, reporting, and safe handling practices were widely supported. Animal owners and older participants reported more negative attitudes compared to veterinarians and younger respondents. Practices were poor despite awareness. Only 12.6% demonstrated good practices, while 87.4% showed poor preventive behaviour. Use of protective clothing and quarantine measures was inconsistent. Natural breeding and raw milk consumption were common. Males reported better practices than females, while profession had little effect. The comparison of KAP revealed a strong association between knowledge and attitudes, but a weak link between knowledge and practices. In conclusion, veterinarians and animal owners showed knowledge gaps, positive attitudes, but poor preventive practices. Awareness did not consistently translate into safe behavior. Targeted training and practical interventions are needed to improve brucellosis control and reduce transmission risks.

KEYWORDS Brucellosis, Knowledge, Attitudes, and Practices (KAP), Veterinarians, Animal Owners, Zoonotic Diseases

Introduction

Brucellosis is a widespread zoonotic disease that affects both humans and animals. The disease is caused by *Brucella* species, which are small, Gram-negative bacteria (Shayan *et al*, 2025). It primarily affects livestock such as cattle, sheep, and goats, but wildlife can also act as reservoirs. Transmission to humans occurs through direct contact with infected animals or consumption of contaminated animal products (Kgasi and Michel, 2025). Raw milk and

unpasteurized dairy products are major sources of infection. Occupational exposure is also a major risk, especially for farmers, veterinarians, and abattoir workers (Wubaye *et al*, 2024). Poor hygiene practices and lack of protective measures increase the chances of infection. Infected animals may show abortions, infertility, and reduced productivity. Humans may experience fever, fatigue, joint pain, and complications affecting multiple organs (Hlaing *et al*, 2024; Wubaye *et al*, 2024). The disease remains endemic in many developing countries with weak animal health services. Brucellosis

To cite this article: Ali, Z., M. A. Habib, and M. Ali. (2025). *Knowledge, Attitude, and Practices regarding Brucellosis among Veterinarians and Pet Owners in Lahore, Pakistan*. Journal of Epidemiology and Infection Biology 2(1):24-32.

continues to cause both public health and economic burdens worldwide.

Knowledge, attitudes, and practices (KAP) play a crucial role in disease prevention and control (Sadiq *et al*, 2021). Awareness about zoonotic diseases improves health-seeking behavior and adoption of preventive measures (Monje *et al*, 2020). Correct knowledge helps individuals identify sources of infection and risky behaviors. Attitudes shape the willingness of communities to adopt protective strategies. Positive attitudes are linked with reporting, vaccination, and biosecurity practices. Practices reflect the actual behaviors that determine disease outcomes (Singh *et al*, 2019). Unsafe practices, such as drinking raw milk, increase the risk of brucellosis transmission (da Silva *et al*, 2020). Farmers' habits of ignoring quarantine and using natural breeding can worsen disease spread. Veterinarians' protective clothing and hygiene practices reduce exposure risk. KAP surveys provide insight into gaps between awareness and actual behavior (Singh *et al*, 2019; Abunna *et al*, 2024; Kgasi and Michel, 2025). Such surveys are vital for guiding health education and policy interventions. They help design targeted strategies to reduce zoonotic disease transmission.

This study focuses on the knowledge, attitudes, and practices of veterinarians and animal owners regarding brucellosis. The main objective is to assess awareness levels and compare responses between the two groups. A specific aim is to identify knowledge gaps that influence disease transmission. Another objective is to evaluate preventive practices such as vaccination, protective clothing, and quarantine measures. The study also seeks to understand attitudes toward reporting and controlling brucellosis. The research question is whether there are differences in KAP between veterinarians and animal owners. The null hypothesis states that no significant differences exist between the two groups. The alternative hypothesis states that significant differences do exist in their responses. Understanding these differences will highlight areas requiring focused training. The findings will support the development of effective awareness campaigns. This study will ultimately provide evidence to improve control strategies for brucellosis.

Materials and Methods

Study design and Study population

A cross-sectional survey was conducted to assess the knowledge, attitudes, and practices (KAP) regarding brucellosis among veterinarians and animal owners. The study was carried out in selected districts of Punjab Province, Pakistan, where brucellosis is considered endemic. Participants were recruited from both rural and urban areas to ensure a representative sample. The study population included veterinarians working in the public and private sectors as well as animal owners involved in raising pets. Participants were selected using purposive sampling to capture individuals with direct exposure to animals at risk of brucellosis. Eligibility criteria included being actively engaged in veterinary services or animal care at the time of the survey.

Questionnaire development

Data were collected using a structured questionnaire specifically designed for this study. The questionnaire was adapted from previously validated KAP survey tools with modifications to fit the context of brucellosis. It consisted of sections covering socio-demographic information, knowledge of brucellosis transmission and prevention, attitudes toward control measures, and practices related to animal handling, milk consumption, and biosecurity. The questionnaire included both closed-ended and multiple-choice questions. Pretesting was performed on a small group to ensure clarity and reliability before full-scale data collection.

Data collection

Face-to-face interviews were conducted by trained enumerators. For veterinarians, data were collected at veterinary hospitals, field offices, and during routine visits. For animal owners, interviews were conducted at farms, markets, and households. Participation was voluntary, and informed consent was obtained from all respondents. Confidentiality and anonymity of responses were maintained throughout the study.

Data Analysis

Data were entered into Microsoft Excel and later imported into R statistical language (version 4.2.1) for cleaning and analysis. Descriptive statistics were used to summarize socio-demographic characteristics and response distributions. Frequencies and percentages were calculated for categorical variables. Comparative analysis between veterinarians and animal owners was performed using chi-square or Fisher's exact test, as appropriate. Knowledge, attitude, and practice scores were generated by assigning points to correct responses, and mean scores were compared between groups using t-tests or non-parametric alternatives. Results were presented in tables and graphs with significance set at $p < 0.05$.

Results

A structured questionnaire was used for data collection. Initially, 300 participants were approached, but 277 provided complete responses. The questionnaire consisted of both open-ended and closed-ended questions. The majority were closed-ended questions designed to capture categorical responses, while a few open-ended questions allowed participants to elaborate on their views. Most of the items were categorical in nature, covering knowledge, attitudes, and practices related to brucellosis. The combination of question types ensured both measurable data and qualitative insights.

Knowledge section

Most respondents recognized brucellosis as a zoonotic disease (Fig. 1). A large proportion were also aware that vaccination is an effective way of controlling the disease. Abortion in animals was the most frequently identified sign of brucellosis. Fever was also recognized by more than half of the participants. Joint swelling and lameness were mentioned by nearly half of the respondents. Coughing was rarely selected as a sign of brucellosis. Direct contact with

infected animals or their secretions was the most common source of infection identified. Unpasteurized milk was also frequently reported as a source of transmission. Inhalation of aerosols in contaminated environments was less frequently recognized. Avoidance of unpasteurized milk consumption was acknowledged as an important preventive measure. The use of protective gloves was also commonly reported. Vaccination was considered the most effective preventive strategy by the majority of respondents.

The analysis of knowledge revealed that 107 respondents (39%) demonstrated high knowledge, while 170 respondents (61%) showed low knowledge (Table 1). Gender differences were significant, as females were more likely to have high knowledge compared to males. Profession also played a role, with veterinarians showing higher knowledge levels than animal owners. Age groups

showed variation, as younger respondents (<30 years) were more knowledgeable than middle-aged (30–50 years) or older (>50 years) participants. Location also influenced knowledge distribution, with Bahawalpur reporting a higher proportion of high knowledge compared to low knowledge. Lahore contributed the largest share of responses, with more individuals in the low knowledge group. Multan and Sargodha had relatively higher proportions of low knowledge respondents compared to other districts. In Rawalpindi, most respondents were in the high knowledge group, while in KPK, knowledge levels were also favorable. Smaller regions such as AJK, Sindh, and Gilgit had very few participants, but most showed low knowledge. Overall, gender, profession, age, and location were significant factors influencing knowledge, with females, veterinarians, and younger respondents showing comparatively higher levels of knowledge.

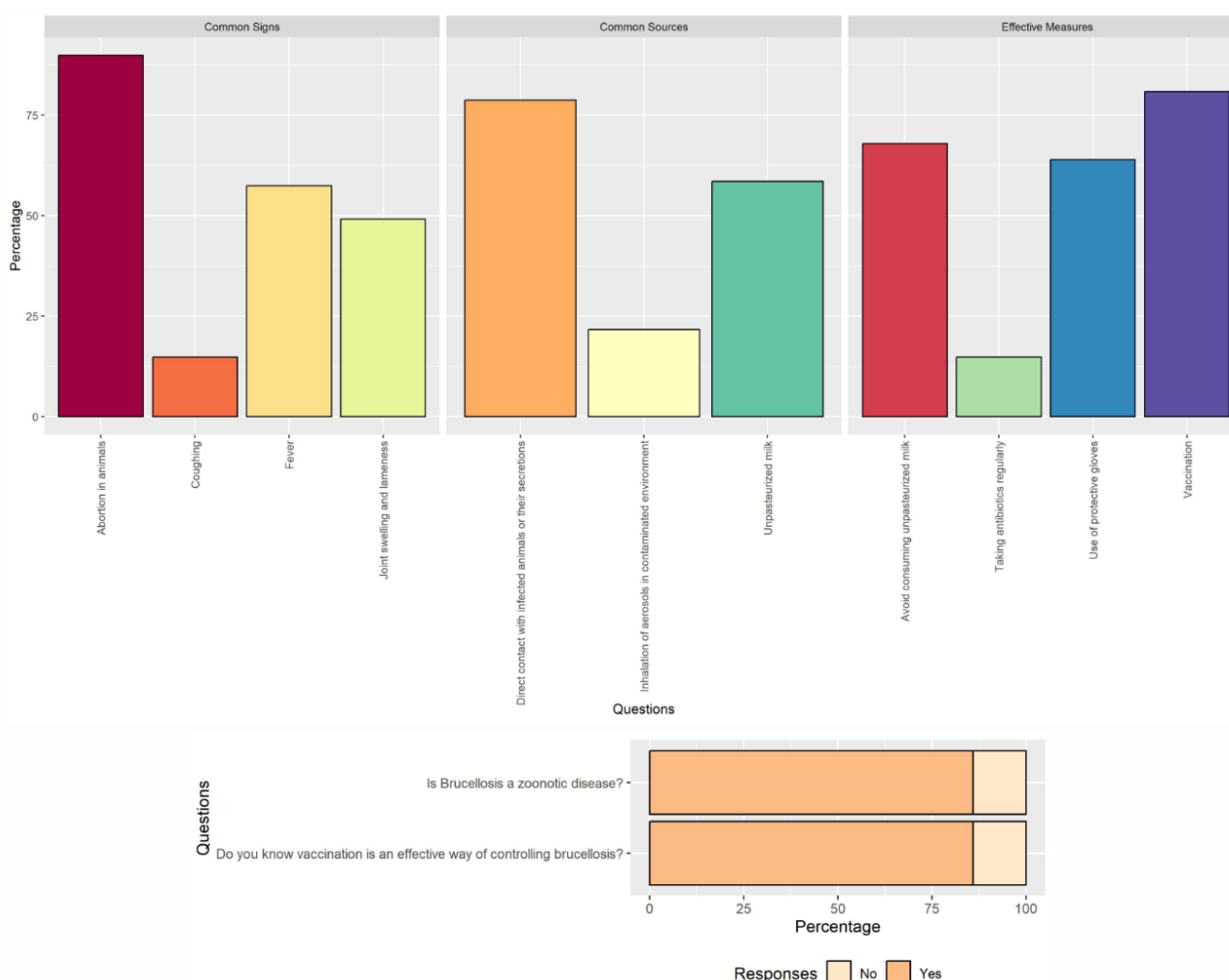


Fig. 1: Summary of the responses related to knowledge section.

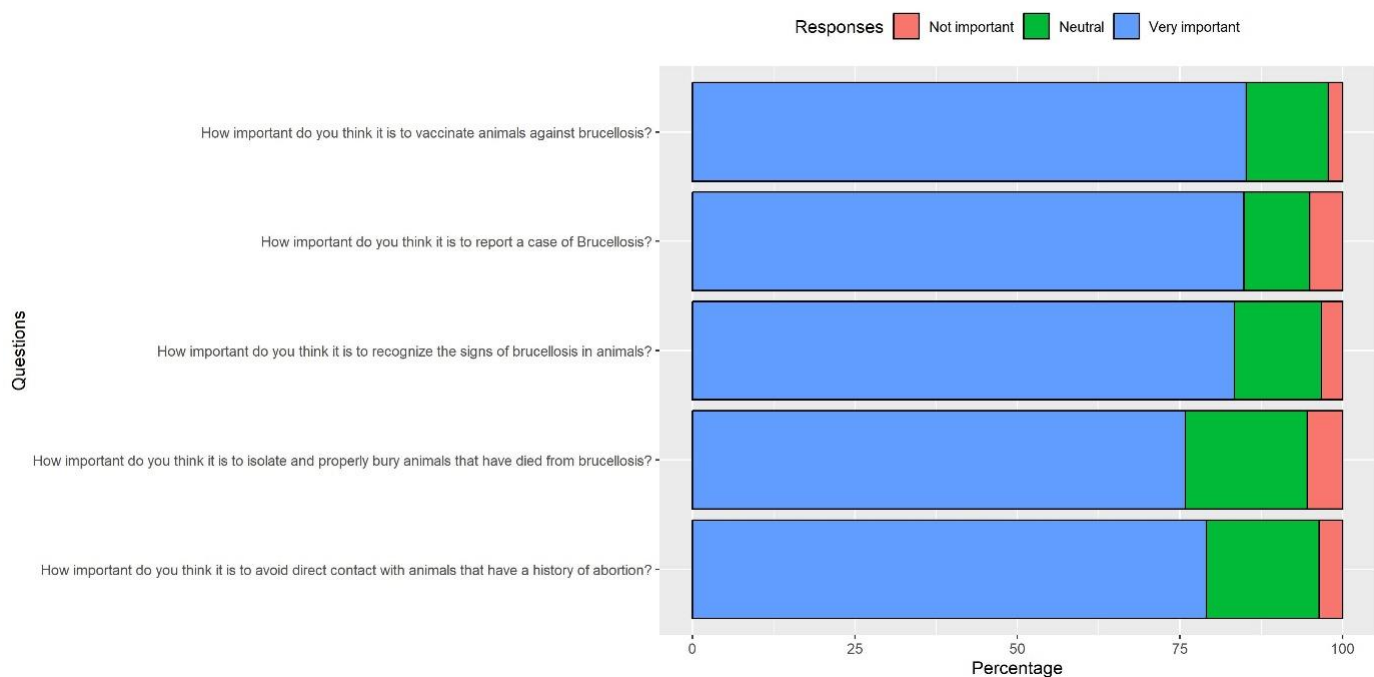
Attitude Section

The majority of respondents regarded vaccination of animals against brucellosis as very important (Fig. 2). Only a small proportion expressed neutrality toward this preventive measure. Very few respondents considered vaccination as not important. Reporting of brucellosis cases was also perceived as very important by most participants. Neutral attitudes toward reporting were limited, while only a minor fraction found it unimportant. Recognition of the signs of brucellosis in animals was strongly emphasized as

very important by most respondents. A small number of participants gave neutral responses, and very few considered it unimportant. Isolating and properly burying dead animals was also recognized as a very important action. Neutral and negative responses were minimal for this preventive practice. Avoiding direct contact with animals that have a history of abortion was seen as very important by the majority. A smaller group remained neutral, while only a few respondents considered it unimportant. Overall, the results indicate that attitudes toward prevention and control of brucellosis were highly positive among participants.

Table 1: Association of knowledge level with demographic factors of respondents.

Characteristic	Levels	High Knowledge (N = 107)	Low Knowledge (N = 170)	p-value
Gender	Female	33 (31%)	27 (16%)	0.004
	Male	74 (69%)	143 (84%)	
Profession	Animal owner	37 (35%)	85 (50%)	0.013
	Veterinarian	70 (65%)	85 (50%)	
Age Groups	<30Y	83 (78%)	109 (64%)	0.050
	>50Y	6 (5.6%)	13 (7.6%)	
	30-50Y	18 (17%)	48 (28%)	
Location	Bahawalpur	16 (15%)	11 (6.5%)	0.041
	Dera Ghazi Khan	7 (6.5%)	12 (7.1%)	
	Faisalabad	11 (10%)	14 (8.2%)	
	Gujranwala	4 (3.7%)	4 (2.4%)	
	Gujrat	2 (1.9%)	4 (2.4%)	
	Lahore	34 (32%)	66 (39%)	
	Multan	9 (8.4%)	23 (14%)	
	Rawalpindi	5 (4.7%)	1 (0.6%)	
	Sahiwal	7 (6.5%)	13 (7.6%)	
	Sargodha	3 (2.8%)	15 (8.8%)	
	KPK	7 (6.5%)	4 (2.4%)	
	AJK	1 (0.9%)	2 (1.2%)	
	Sindh	1 (0.9%)	0 (0%)	
	Gilgit	0 (0%)	1 (0.6%)	

**Fig. 2: Summary of the responses related to attitude section.**

The analysis of attitudes revealed that most respondents showed a positive attitude (239; 86%), while a smaller proportion had a negative attitude (38; 14%) (Table 2). Gender differences were not statistically significant, though males reported more negative attitudes compared to females. Profession had a strong association with attitude, as animal owners reported a higher frequency of negative attitudes (82%) compared to veterinarians (18%). Age showed a significant influence, with younger participants (<30 years) demonstrating more positive attitudes, while middle-aged (30–50 years) and older (>50 years) participants expressed higher levels of negative attitudes. Location-wise, Lahore had the highest number of both

positive and negative attitudes, reflecting its larger sample size. Respondents from Sargodha also showed a relatively higher proportion of negative attitudes compared to other districts. In contrast, some regions, including Dera Ghazi Khan, KPK, AJK, Sindh, and Gilgit, reported only positive attitudes. Faisalabad, Multan, Bahawalpur, and Sahiwal had mixed patterns, but the majority of respondents in these districts maintained positive attitudes. Overall, profession and age were significant determinants of attitudes, while gender and location showed weaker associations. The findings indicate that veterinarians and younger respondents were more likely to hold favorable attitudes compared to other groups.

Table 2: Association of attitude level with demographic factors of respondents.

Characteristic	Levels	Positive attitude (N = 239)	Negative attitude (N = 38)	p-value
Gender	Female	55 (23%)	5 (13%)	0.2
	Male	184 (77%)	33 (87%)	
Profession	Animal owner	91 (38%)	31 (82%)	<0.001
	Veterinarian	148 (62%)	7 (18%)	
Age Groups	<30Y	178 (74%)	14 (37%)	<0.001
	>50Y	12 (5.0%)	7 (18%)	
	30-50Y	49 (21%)	17 (45%)	
Location	Bahawalpur	23 (9.6%)	4 (11%)	0.4
	Dera Ghazi Khan	19 (7.9%)	0 (0%)	
	Faisalabad	23 (9.6%)	2 (5.3%)	
	Gujranwala	7 (2.9%)	1 (2.6%)	
	Gujrat	5 (2.1%)	1 (2.6%)	
	Lahore	83 (35%)	17 (45%)	
	Multan	28 (12%)	4 (11%)	
	Rawalpindi	6 (2.5%)	0 (0%)	
	Sahiwal	17 (7.1%)	3 (7.9%)	
	Sargodha	12 (5.0%)	6 (16%)	
	KPK	11 (4.6%)	0 (0%)	
	AJK	3 (1.3%)	0 (0%)	
	Sindh	1 (0.4%)	0 (0%)	
	Gilgit	1 (0.4%)	0 (0%)	

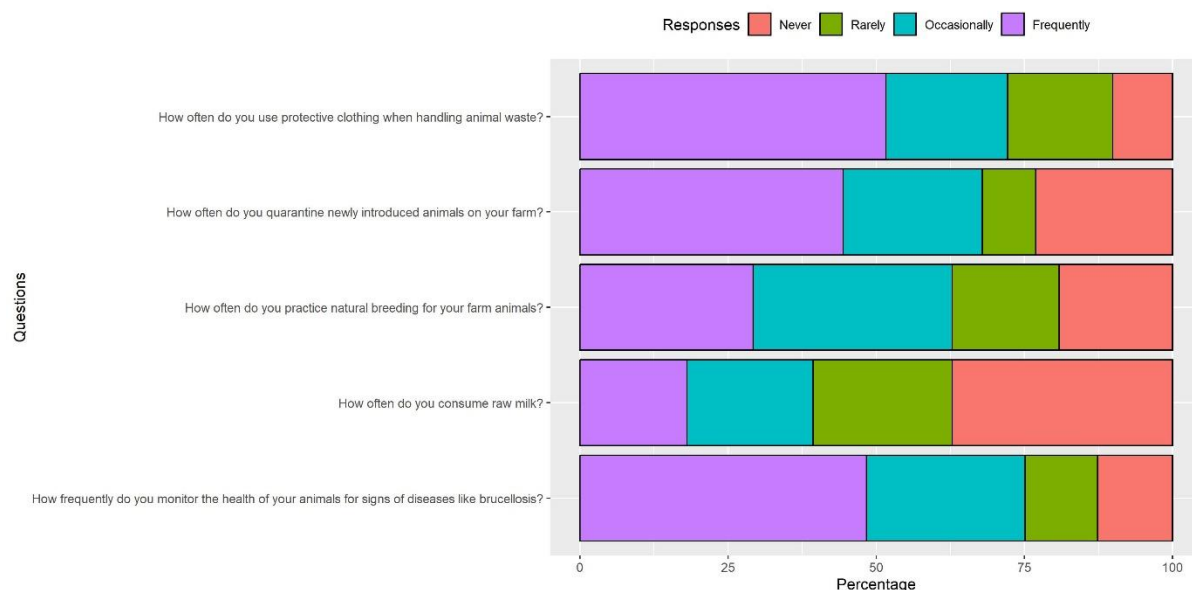


Fig. 3: Summary of the responses related to practices section.

Practices section

Most respondents reported using protective clothing when handling animal waste, though the frequency varied (Fig. 3). A considerable proportion used protective clothing frequently, while others did so only occasionally. A smaller group used it rarely, and some never practiced it. Quarantining of newly introduced animals was less consistently observed. Many respondents never quarantined new animals, while others practiced it only occasionally. A smaller fraction quarantined animal frequently, and few did so rarely. Natural breeding of farm animals was a common practice among respondents. A significant proportion reported practicing it frequently, while others did it

occasionally. Some respondents rarely practiced natural breeding, and a notable proportion never used it. Consumption of raw milk showed concerning trends, with many respondents consuming it frequently or occasionally. Only a smaller proportion rarely consumed it, and some reported never consuming raw milk. Monitoring animal health for signs of brucellosis was reported frequently by most respondents. Others did so occasionally, while fewer monitored rarely or not at all. Overall, the practices varied widely, with protective clothing, raw milk consumption, and animal health monitoring standing out as key areas.

The analysis of practices revealed significant variation across demographic groups. Out of 277 participants, only 35

(12.6%) reported good practices, while the majority, 242 (87.4%), showed poor practices (Table 3). Gender differences were significant, as males had a higher proportion of good practices (91%) compared to females (8.6%). Professionally, both animal owners (51%) and veterinarians (49%) demonstrated good practices, with no significant difference between groups. Age distribution showed that participants aged <30 years reported more poor practices, while those between 30–50 years exhibited relatively better practices. Very few respondents over 50 years practiced good preventive measures. Location-wise, good practices were scattered across districts, with Lahore contributing the highest proportion of respondents, though most still demonstrated poor practices. Participants from Sahiwal and Sargodha also showed relatively better practices compared to other regions. In contrast, regions like AJK and Sindh had no representation among good practice groups. Interestingly, Gilgit had one respondent who practiced good preventive measures despite a very small sample size. Overall, the findings indicate poor adherence to preventive practices, with gender and age showing stronger associations than profession or location.

Comparison of KAP sections

The comparison of knowledge, attitude, and practices revealed distinct patterns (Fig. 4). Younger participants (<30 years) showed higher knowledge scores compared to older groups. A moderate association was also noted between attitude and practices, while knowledge and practices showed weaker correlation. Attitude was more positive among veterinarians, while practices showed no strong difference between groups. Correlation analysis indicated that knowledge strongly influenced attitude but less so practices. Only a small proportion had high knowledge with good practices. A notable number of participants with low knowledge still showed good practices. The association between knowledge and practices was weaker than that between knowledge and attitude.

Discussion

This study assessed knowledge, attitudes, and practices (KAP) regarding brucellosis among veterinarians and animal owners in Punjab, Pakistan. The main objective was to evaluate awareness levels and identify factors associated with differences in responses. Results showed considerable gaps between knowledge, attitudes, and actual practices. While most respondents recognized brucellosis as a zoonotic disease, only a minority demonstrated high knowledge. Attitudes toward prevention were generally positive, but practices such as protective clothing, quarantine, and avoidance of raw milk were inconsistent. These findings suggest that awareness does not always translate into behavior, a trend reported in previous zoonotic disease KAP studies (Reynes *et al*, 2012; Njenga *et al*, 2020). Previous research in Pakistan and other endemic regions has also highlighted similar gaps between knowledge and practices, despite positive perceptions of disease control (Singh *et al*, 2019; Ahmed *et al*, 2024). The

results therefore reinforce the importance of targeted awareness programs that not only inform but also encourage behavior change. This gap between what respondents know and how they act poses challenges for disease prevention. Addressing these mismatches is critical to reduce brucellosis transmission at the community level. Knowledge assessment revealed that only 39% of respondents demonstrated high knowledge, while the majority fell into the low knowledge group. Females and veterinarians showed better knowledge compared to males and animal owners, respectively. Younger participants were also more knowledgeable than older groups, indicating the role of education and exposure in shaping awareness. These findings are consistent with previous studies in Pakistan and other endemic countries where veterinarians typically report higher awareness due to formal training (Moutos *et al*, 2022; Ahmed *et al*, 2024; Gajdacs and Jamshed, 2024; Shayan *et al*, 2025). However, animal owners often lack structured education on zoonotic diseases, which contributes to lower knowledge levels (Abunna *et al*, 2024). Regional differences were also observed, with higher knowledge reported in Bahawalpur compared to Lahore or Multan. Such variations may reflect local training initiatives or access to veterinary services. Similar geographic differences have been reported in KAP studies from Africa and South Asia, where urban or better-resourced areas often show improved awareness (Cloete *et al*, 2019; Zhang *et al*, 2019). Despite reasonable recognition of signs such as abortion and fever, misconceptions persisted, with some respondents failing to identify other important symptoms or sources of transmission. This highlights persistent gaps in community education, echoing earlier findings that knowledge of zoonoses is often fragmented.

Attitudes toward brucellosis prevention and control were largely positive, with 86% of respondents demonstrating favorable views. Vaccination, case reporting, and avoidance of risky contact were perceived as very important by most participants. Gender differences were not statistically significant, but profession and age showed strong associations with attitudes. Veterinarians and younger individuals expressed more positive views, while animal owners and older respondents displayed more negative attitudes. These findings agree with reports from Turkey and Iran, where younger populations and professionals demonstrated stronger support for vaccination and reporting (Ansari-Lari and Oroji, 2023). However, the persistence of negative attitudes among animal owners is concerning, as these groups play a central role in controlling disease transmission. Location-wise, Lahore had the largest share of both positive and negative responses, possibly reflecting its larger and more diverse sample. Similar variations have been noted in studies from East Africa, where urban centers showed mixed perceptions compared to rural areas (Sabuncuoglu and Çoban, 2008).

Despite reasonable knowledge and positive attitudes, practices remained weak. Only 12.6% of respondents demonstrated good practices, while the majority (87.4%) had poor preventive behaviors. Use of protective clothing was inconsistent, and quarantine of new animals was rarely observed. Natural breeding was widely practiced, increasing risks of disease spread. Consumption of raw

Table 3: Association of practices level with demographic factors of respondents.

Characteristic	Levels	Good practices (N = 35)	Bad practices (N = 242)	p-value
Gender	Female	3 (8.6%)	57 (24%)	0.048
	Male	32 (91%)	185 (76%)	
Profession	Animal owner	18 (51%)	104 (43%)	0.4
	Veterinarian	17 (49%)	138 (57%)	
Age Groups	<30Y	20 (57%)	172 (71%)	0.063
	>50Y	1 (2.9%)	18 (7.4%)	
	30-50Y	14 (40%)	52 (21%)	
Location	Bahawalpur	5 (14%)	22 (9.1%)	0.2
	Dera Ghazi Khan	2 (5.7%)	17 (7.0%)	
	Faisalabad	3 (8.6%)	22 (9.1%)	
	Gujranwala	2 (5.7%)	6 (2.5%)	
	Gujrat	1 (2.9%)	5 (2.1%)	
	Lahore	9 (26%)	91 (38%)	
	Multan	1 (2.9%)	31 (13%)	
	Rawalpindi	1 (2.9%)	5 (2.1%)	
	Sahiwal	4 (11%)	16 (6.6%)	
	Sargodha	4 (11%)	14 (5.8%)	
	KPK	2 (5.7%)	9 (3.7%)	
	AJK	0 (0%)	3 (1.2%)	
	Sindh	0 (0%)	1 (0.4%)	
	Gilgit	1 (2.9%)	0 (0%)	

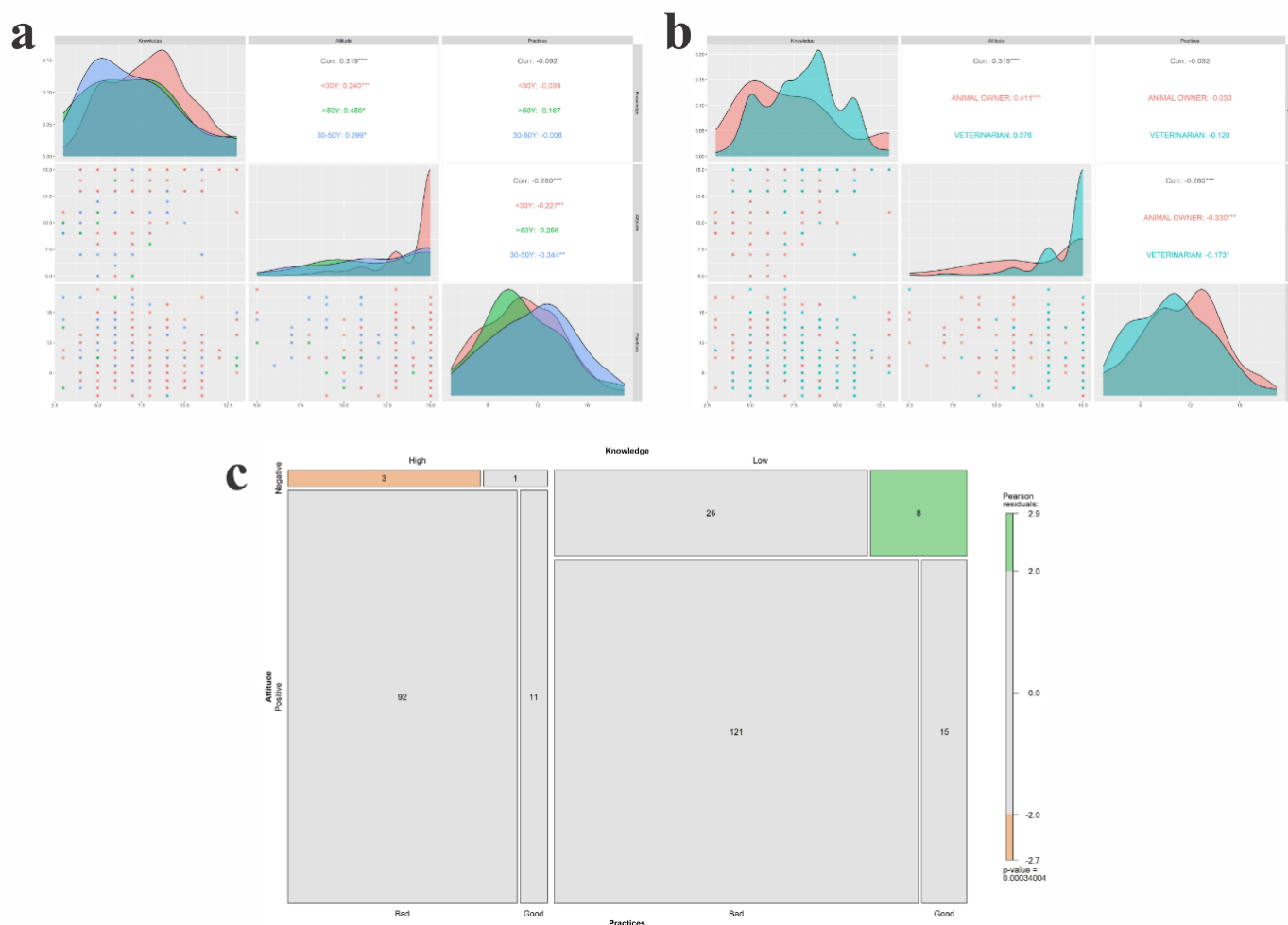


Fig. 4: Comparison of scores obtained by respondents across KAP sections (a) A significant positive correlation was observed between knowledge and attitude. **(b)** Veterinarians had significantly higher knowledge scores compared to animal owners. **(c)** Most respondents demonstrated low knowledge with poor attitude and bad practices.

milk was frequent, despite awareness of its risks, revealed findings from other South Asian studies where cultural habits often override health concerns (Silveira *et al*, 2023). Gender differences were notable, with males showing better practices compared to females, while profession did not significantly influence practice levels. This contrasts with studies from Africa, where veterinarians typically displayed stronger preventive behaviors (Nyokabi *et al*, 2024; Amer *et al*, 2025). Age was also a factor, as younger respondents reported poorer practices, possibly due to limited resources or experience. Regional differences were present, but good practices were scattered across districts without a consistent trend. Similar inconsistencies between knowledge and behavior have been observed in zoonotic disease KAP studies worldwide.

Comparing knowledge, attitude, and practice sections revealed important gaps. Knowledge strongly influenced attitudes, but this relationship was weaker for practices. Respondents with higher knowledge were more likely to have positive attitudes, yet many still failed to adopt good preventive measures. This discrepancy suggests that barriers beyond awareness, such as cultural habits, financial limitations, or lack of enforcement, hinder behavior change. Similar findings have been reported in KAP studies on brucellosis in previous studies, where knowledge did not consistently predict safe practices (Sibhat *et al*, 2024). The weak correlation between knowledge and practices highlights the need for integrated interventions that combine education with practical support. Awareness campaigns should be complemented by accessible resources, incentives, and monitoring systems. Engaging both veterinarians and animal owners is essential, as both groups influence transmission dynamics. Addressing risky practices such as raw milk consumption and lack of quarantine could significantly reduce disease burden.

Declaration of Competing Interest

The authors declare that they have no competing or conflict of interests.

Author Contributions

ZA: Conceptualization, Methodology, formal analysis, Writing—original draft preparation. **MAH:** Conceptualization, Methodology. **MA:** Writing—review and editing. All authors have read and agreed to the published version of the manuscript.

References

1. Abunna, F., G. Gebresenbet, and B. Megersa. (2024). *Assessment of knowledge, attitude and practices (KAP) of farmers about transmission of zoonotic diseases in Ada'a district, Oromia, Ethiopia*. Heliyon 10(4):e25713. doi: 10.1016/j.heliyon.2024.e25713
2. Ahmed, N., S. Jabeen, F. Rashid, N. Lal, M. Ali, A. Sattar, A. Ali, A. Ali, M. Arshad, Y. Fu, F. Zhang, and S. I. Malik. (2024). *Valuation of knowledge, attitude, practices of tuberculosis among the health care workers from Islamabad Pakistan*. Acta Trop 257:107317. doi: 10.1016/j.actatropica.2024.107317
3. Amer, F. A., N. Jonathan, H. A. Nofal, R. Tash, N. M. Hammad, M. G. Gebriel, E. R. Shao, I. Eldaghayes, D. Meriane, A. A. Allam, H. M. Ali, R. A. Hafez, M. Elahmady, H. E. S. Khalil, M. A. Saeed, S. W. Shaltout, S. Samake, A. Dicko, C. Walyaro, G. A. Arthur, B. Jarrar, and A. Mahamar. (2025). *Assessing the knowledge of key one health elements among African higher education students: African multi-center cross-sectional study*. BMC Public Health 25(1):1846. doi: 10.1186/s12889-025-22935-6
4. Ansari-Lari, M., and E. Oroji. (2023). *Knowledge, attitudes and practices of dog and cat owners toward zoonotic diseases in Shiraz, southern Iran*. Prev Vet Med 215:105926. doi: 10.1016/j.prevetmed.2023.105926
5. Cloete, A., C. Gerstenberg, N. Mayet, and S. Tempia. (2019). *Brucellosis knowledge, attitudes and practices of a South African communal cattle keeper group*. Onderstepoort J Vet Res 86(1):e1-e10. doi: 10.4102/ojvr.v86i1.1671
6. da Silva, D. A. V., H. Brendebach, J. Grutzke, R. Dieckmann, R. M. Soares, J. T. R. de Lima, L. B. Keid, D. Hofreuter, and S. Al Dahouk. (2020). *MALDI-TOF MS and genomic analysis can make the difference in the clarification of canine brucellosis outbreaks*. Sci Rep 10(1):19246. doi: 10.1038/s41598-020-75960-3
7. Gajdacs, M., and S. Jamshed. (2024). *Editorial: Knowledge, attitude and practices of the public and healthcare-professionals towards sustainable use of antimicrobials: the intersection of pharmacology and social medicine*. Front Antibiot 3:1374463. doi: 10.3389/frabi.2024.1374463
8. Hlaing, S. S., S. Kubota, K. Makita, Y. T. Win, H. T. Myint, and H. Kono. (2024). *Association of farmers' knowledge, attitude and practices with bovine brucellosis seroprevalence in Myanmar*. Anim Biosci 37(3):547-554. doi: 10.5713/ab.23.0273
9. Kgasi, A. T., and A. L. Michel. (2025). *A knowledge, attitude and practices assessment of control measures for bovine tuberculosis and brucellosis towards a more effective approach to national control programs in South Africa*. Trop Anim Health Prod 57(1):15. doi: 10.1007/s11250-024-04274-7
10. Monje, F., J. Erume, F. N. Mwiine, H. Kazoora, and S. G. Okech. (2020). *Knowledge, attitude and practices about rabies management among human and animal health professionals in Mbale District, Uganda*. One Health Outlook 2:24. doi: 10.1186/s42522-020-00031-6
11. Moutos, A., C. Doxani, I. Stefanidis, E. Zintzaras, and G. Rachiotis. (2022). *Knowledge, Attitude and Practices (KAP) of Ruminant Livestock Farmers Related to Zoonotic Diseases in Elassona Municipality, Greece*. Eur J Investig Health Psychol Educ 12(3):269-280. doi: 10.3390/ejihpe12030019
12. Njenga, M. K., E. Ogolla, S. M. Thumbi, I. Ngere, S. Omulo, M. Muturi, D. Marwanga, A. Bitek, B. Bett, M. A. Widdowson, P. Munyua, and E. M. Osoro. (2020). *Comparison of knowledge, attitude, and practices of animal and human brucellosis between nomadic pastoralists and non-pastoralists in Kenya*. BMC Public Health 20(1):269. doi: 10.1186/s12889-020-8362-0

13. Nyokabi, N. S., L. Phelan, J. F. Lindahl, S. Berg, E. Muunda, A. Mihret, J. L. N. Wood, and H. L. Moore. (2024). *Exploring veterinary students' awareness and perception of zoonoses risks, infection control practices, and biosecurity measures in Ethiopia*. *Front Vet Sci* 11:1385849. doi: 10.3389/fvets.2024.1385849
14. Reynes, E., G. Lopez, S. M. Ayala, G. C. Hunter, and N. E. Lucero. (2012). *Monitoring infected dogs after a canine brucellosis outbreak*. *Comp Immunol Microbiol Infect Dis* 35(6):533-537. doi: 10.1016/j.cimid.2012.05.004
15. Sabuncuoglu, N., and O. Çoban. (2008). *Attitudes of Turkish veterinarians towards animal welfare*. *Animal Welfare* 17doi: 10.1017/S096272860003195X
16. Sadiq, M. B., N. A. Hamid, U. K. Yusri, S. Z. Ramanoon, R. Mansor, S. A. Affandi, M. Watanabe, J. Kamaludeen, and S. S. Syed-Hussain. (2021). *Ruminant farmers' knowledge, attitude and practices towards zoonotic diseases in Selangor, Malaysia*. *Prev Vet Med* 196:105489. doi: 10.1016/j.prevetmed.2021.105489
17. Shayan, N. A., A. Rahimi, S. Stranges, and A. Thind. (2025). *Identifying the factors affecting quality of life among brucellosis patients in Herat, Afghanistan: a case-control study*. *Infect Ecol Epidemiol* 15(1):2441566. doi: 10.1080/20008686.2024.2441566
18. Silveira, A., J. P. Carvalho, L. Loh, and M. Benusic. (2023). *Public health risks of raw milk consumption: Lessons from a case of paediatric hemolytic uremic syndrome*. *Can Commun Dis Rep* 49(9):375-379. doi: 10.14745/ccdr.v49i09a03
19. Singh, B. B., R. Kaur, G. S. Gill, J. P. S. Gill, R. K. Soni, and R. S. Aulakh. (2019). *Knowledge, attitude and practices relating to zoonotic diseases among livestock farmers in Punjab, India*. *Acta Trop* 189:15-21. doi: 10.1016/j.actatropica.2018.09.021
20. Wubaye, A. M., S. Mitiku, D. T. Lataa, Y. G. Ambaw, M. T. Mekonen, and S. A. Kallu. (2024). *Seroprevalence of small ruminant brucellosis and owners knowledge, attitude and practices in Chiro and Burka Dhintu Districts, West Hararghe, Ethiopia*. *Heliyon* 10(18):e37708. doi: 10.1016/j.heliyon.2024.e37708
21. Zhang, N., H. Zhou, D. S. Huang, and P. Guan. (2019). *Brucellosis awareness and knowledge in communities worldwide: A systematic review and meta-analysis of 79 observational studies*. *PLoS Negl Trop Dis* 13(5):e0007366. doi: 10.1371/journal.pntd.0007366