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Knowledge, attitude, practices (KAP), and risk factors of lumpy skin disease among livestock owners in Pakistan

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ABSTRACT: Lumpy skin disease (LSD), caused by the LSDV virus, affects cattle and water buffalo, resulting in skin nodules, weight loss, and reduced milk production. In current study, a cross-sectional survey was conducted to evaluate the knowledge, attitude, practices (KAP), and risk factors associated with lumpy skin disease (LSD) in cattle among livestock owners in the Chakwal district, Punjab, Pakistan. A total of 383 livestock owners participated in the study from five different villages of district Chakwal. Data analysis was performed using SPSS, Jamovi software, while Graphpad Prism aided in creating graphical representations. The results showed that most of the participants were from Sohawa village (29%), Muslim (98.2%), male (66.8%), age group 51-60 years old (36%), Punjabi (94.3%), married (85.1%), illiterate (78.6%), and monthly income above 50,000 (42.0%). Most of the participants (77.3%) were aware of LSD while 54% knew the risks involved. Regarding attitude, 67.2% of cattle owners believed that their animals were at risk while 84.1% wanted their cattle checked for illness, and 96.3% would appreciate free care if their cattle had lumpy skin disease. Concerning risk factors, 74.4% participants did not view economic instability as a significant concern, but 68.7% thought an unregulated animal husbandry system as a risk. Furthermore, 42% of respondents agreed that there is a connection between a higher disease risk and larger herd sizes while 75.2% believed that insects may spread the virus. The knowledge, attitudes, and practices of cattle owners regarding lumpy skin disease (LSD) were elucidated by the KAP study revealed that cattle owners have a LSD knowledge, risk factors awareness and positive attitude towards prevention and control, emphasizing the importance of immunization and biosecurity measures. To effectively manage LSD, educational programs, enhanced biosecurity procedures, and improved disease management strategies are recommended.

Keyword: Livestock owners; Cattle health; Control disease; Economic impact; Biosecurity.

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INTRODUCTION

Lumpy skin disease (LSD) is a serious illness that causes multi-focal cutaneous nodules in cattle and water buffalo, which occurs through exposure by the lumpy skin disease virus (LSDV), a virus that is part of the Capri poxvirus genus (Flannery et al., 2022). LSDV spreads by hematophagous vectors such as ticks, mosquitos and flies, which allows the virus to spread quickly in ideal climatic conditions (Bianchini et al., 2023). However, skin lesions have been observed following experimental infection in sheep, goat, giraffe, Giant gazelles, and impalas. Natural infection of sheep and goat has not been documented, even in close contact with diseased cattle and buffaloes (Biswas et al., 2020). Fever, swollen lymph nodes, small nodules on the skin that cause severe anorexia, decreased milk supply, and infertility are the disease's hallmarks. Overall, it has an impact on the economic worth of animals since it will have an impact on the production of meat and milk, the animals' ability to pull heavy loads, and reproductive (abortion and infertility) effectiveness (Gumbe, 2018).

In 1929, Zambia reported the first LSD clinical symptoms, which were later reported in southern and northern African nations. Israel, Kuwait, Oman, and Yemen later became affected by it (Wainwright et al., 2013; Al-Salihi, 2014;). According to recent studies from epidemic regions in the Middle East and Europe, disease morbidity ranges from 5 to 45% while livestock death is typically under 10% (Pankaj et al., 2023). Because of recent outbreaks in neighboring countries such as Malaysia and Thailand, and due to the transportation of animals to and from Pakistan, the LSD could produce a breakout in Pakistan (Agrebi and Larbi, 2020). Historically free of the LSDV, incidences have just been identified in Pakistan, with over 20,000 animals infected in Sindh. Karachi has the most recorded cases, with approximately 54 animals dying in the province and 4751 recovering across the province (K AL Tae et al., 2020). LSD use has spread across the country, with reports of cases in Sindh, Punjab, Balouchistan, and Khyber Pakhtunkhwa (KPK). So far, 74,590 animals in Khyber Pakhtunkhwa (KPK), 53,668 in Sindh, 35,000 in Punjab, 22,225 in Balouchistan, and 6351 in Azad Jammu and Kashmir have been infected (Khan et al., 2021).

The infectious origin of the disease was discovered in these epidemics until 1988, the disease was only present in larger Africa; it thereafter extended

to the Middle East, Eastern Europe, and the Russian Federation (Khatri et al., 2023). In 2019, additional cases were reported in South and East Asia as the outbreak progressed (Gharban et al., 2019). Extremely low weight, injured skin, male and female infertility, mastitis, poor milk supply, and miscarriages all contribute to significant losses (Bhosale et al., 2022). In private commercial cattle farming, post-LSD productivity losses have been estimated to range from 45 to 65% (Khan et al., 2022). According to estimates, a herd-level LSD outbreak in Ethiopia resulted in significant drops in milk output and high mortality rates, as well as US\$ 1,176 in economic losses. The etiological agent Capri poxvirus, which causes sheep and goat pox, is of tremendous economic relevance since it severely restricts international trade (Molla et al., 2017; Hurisa et al., 2018).

Since LSD exists and has already been registered in Pakistan, present study was conducted to determine the knowledge, attitude, practices and risk factors associated with lumpy skin disease in cattle across different socio-demographic variables among livestock owners of district Chakwal.

MATERIALS AND METHODS

Study Area

Current study was conducted in a rural area of the Chakwal district comprising of five villages (Thirpal, Jhatla, Jaswal, Sohawa, and Balkassar). The total number of people in the Chakwal district are 967,707. District Chakwal is 498 meters above sea level, with a semi-hilly landscape at 32.93' latitude to the north and 72.85' longitude to the east (Zafar et al., 2019). These areas were selected due to their significance in the district's livestock ownership (Figure 1).

Study design and sampling procedure

Cross-sectional study design with a stratified purposive sampling method was employed to assess the knowledge, attitudes, practices (KAP), and risk factors associated with lump skin disease (LSD) in cattle among livestock owners having different socio-demographic backgrounds, including language, religion, and gender, thereby capturing the diverse population of the district.

Data collection

Data was collected from March 2023 to May 2023 by using standardized questionnaire, from livestock owners in face-to-face interviews. Rao soft calculator was used for the calculation of sample size,

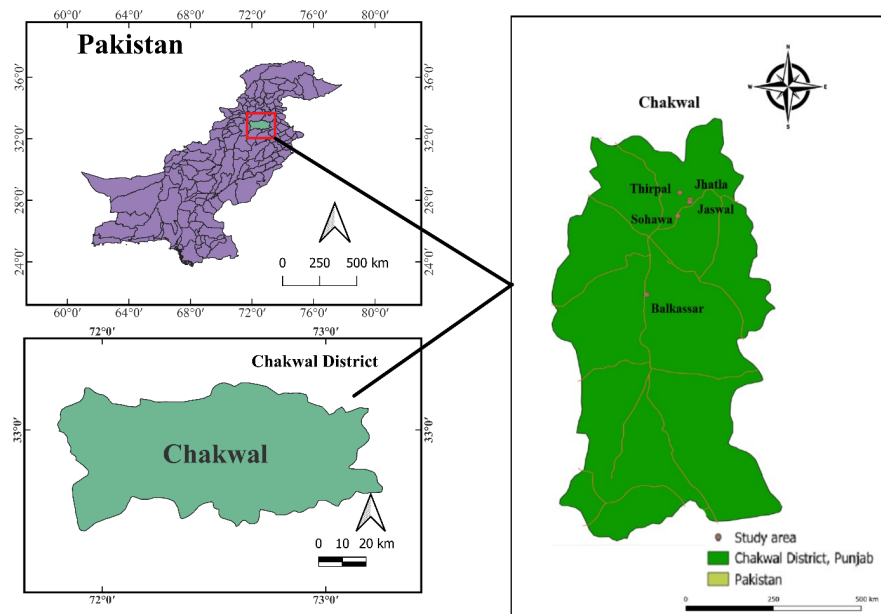


Figure 1. Showing the map of study area located in Chakwal districts, Pakistan.

with a 95% confidence interval (CI), a 5% error margin, and a Z-score of 1.96. The questionnaire was divided into five parts comprising of different 36 questions. The first part included 8 questions related to socio-demographics characteristics of the livestock owners, the second part included 7 questions related to knowledge about LSD, the third part comprised of 6 questions on the attitude of participants towards LSD, the fourth part included 9 questions about LSD prevention practices, and the fifth part comprised of 6 questions related to the potential risk factors. People older than 18 years of age who owned domestic animals were included in this study. All incomplete or incorrectly completed questionnaires and intellectually challenging participants were excluded from the study.

Data Analysis

The database was established using MS Excel. Descriptive statistics were used to initially analyze the data, and the variables were classified into independent and dependent variables. The socio-demographic variables were assigned to be independent variables while knowledge, attitude, practices and risk factors were dependent variables. Statistical analysis was performed by using Jamovi software (2.4.11 version) (Koirala et al., 2022) and graphs were made through GraphPad prism software Prism (10.0.1) for better visualization of results (Khatri et al., 2023). The socio-demographic characteris-

tics were used as explanatory variables in logistic regression analyses against each of the binary outcome variables (knowledge, attitude, practices, and risk factors). Variables no longer associated with the outcome were removed, and only the variables with P-value ($P < 0.05$) were retained in the study.

RESULTS

Socio-demographic characteristics

A total of 383 livestock owners participated in the study from five villages of district Chakwal. The village of Sohawa had the most respondents (29%), followed by Dheedwal (24.2%), Thirpal (20.6%), Jaswal (13.1%), and Jhatla (13.1%) (Table 1). Out of 383, the majority (98.2%) of respondents were Muslims while rest were Christians. The number of male respondents were higher (66.8%) as compared to females (33.2%). The age-wise, majority (36%) of participants belonged to the age group 51–60, followed by 41–50 (31.6%), 31–40 (11%), 61–70 (9.9%), and 20–30 (11.5%). With respect to marital status, the majority (85.1%) were married, while 14.9% were unmarried. Education-wise, majority (78.6%) were uneducated, followed by those with primary education (15.7%), a secondary education (3.1%), and a post-secondary (higher-secondary) (2.6%). Based on the respondents' average monthly income, the highest percentage (42%) respondents have "above 50,000" income, followed by "31,000-50,000" (40%), and "below 30,000" (18%) (Figure 2).

Table 1. Socio-demographic background of livestock owners.

Variables	Characteristics	Number (N)	Frequency (%)
Village	Dheedwal	93	24.2
	Jaswal	50	13.1
	Jhatla	50	13.1
	Sohawa	111	29
	Thirpal	79	20.6
Religion	Christian	7	1.8
	Muslim	376	98.2
Gender	Female	127	33.2
	Male	256	66.8
Age	20-30	44	11.5
	31-40	42	11
	41-50	121	31.6
	51-60	138	36
	61-70	38	9.9
Ethnicity	Pathan	18	4.7
	Punjabi	361	94.3
Marital status	Urdu speaking	4	1
	Married	326	85.1
	Unmarried	57	14.9
Education level	Illiterate	301	78.6
	Post-secondary	10	2.6
	Primary	60	15.7
Average monthly income	Secondary	12	3.1
	Below 30,000	69	18
	31,000-50,000	153	40
	Above 50,000	161	42

Respondent's knowledge regarding LSD

Present study assessed the participant's knowledge which revealed that 77.3% of respondents had heard of lumpy skin disease in cattle, while fifty-two percent (52.0%) of participants had not seen the disease in cattle. Most participants (54.0%) were aware that lumpy skin disease in cattle can be dangerous. 61.7% believed that close contact with sick animals may lead to get you infected with the disease. Skin nodules (25.6%) were the most frequently observed symptom, followed by fever, and decreased milk production (19.6%, 13.8%), respectively while 41% observed all the symptoms (Table 2). 48.3% of respondents identified mosquitoes and biting flies and insects that spread lumpy skin disease. 28.7% did not know the right course of therapy, whereas 18.3%

named antibiotics, 26.1% stated both antibiotics and vaccines, and 26.9% identified vaccination as a potential course of treatment (Figure 3).

Participant's Attitudes towards LSD

Most (67.2%) of the cattle owners thought their animals were at risk of developing lumpy skin disease. Moreover, 72.3% thought that their cattle would contact the disease by being among sick ones while 84.1% stated they would like to have their cattle checked for illness. (Table 3). The majority (96.3%) of farmers would be grateful for free care if their cattle suffered from lumpy skin disease. Most of the participants (63.4%) were willing to have a medical checkup for infected livestock while 47.5% of farmers believed that financial constraints could be the leading cause of no medical checkup followed

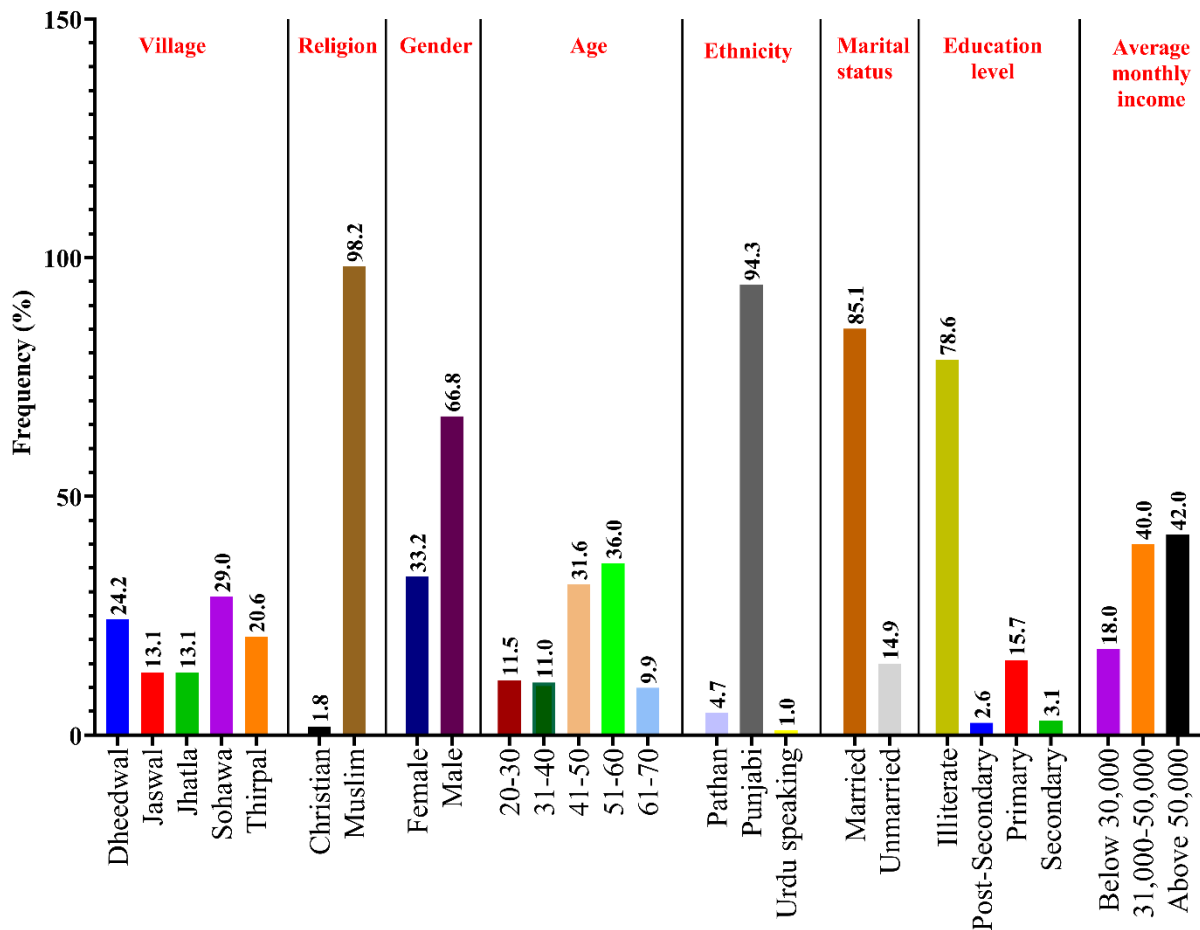


Figure 2. Socio-demographic background of livestock owners.

by no medical examination satisfaction and other co-infection diseases (Figure 4).

Respondent's Practices towards LSD

Among all, 37.1% of respondents owned combined (buffalo, cattle, goat) animals while 10.4%, 29%, 23.5% kept individually goat, cattle, and buffalo respectively (Table 4). 56.4% of owners never allow their animals to roam free, compared to 3.1% who unleash animals during the day, 34% at night, and 6.5% both during the night and day. 43.3% of respondents kept a moderately sized herd comprised of 4 to 6 animals; 28% of respondents kept a small herd of up to 3 animals; and a large herd of 7 or more animals was kept by 28.7% of owners. 39.2% of owners reported using pesticides more than a year ago, 14.6% had used them during the previous six months, and 46.2% were unable to recall their most recent usage of pesticides. Furthermore, 24.8% of participants never separated sick animals from the herd, while 75.2% owners separated the sick animal from herd.

78.6% never sold sick animals to butchers while 25.6% sold their sick animals to other owners. Of those surveyed, twenty-three percent (23%) said they didn't wash their hands after handling sick animals while 90.6% of respondents stated that their cattle had not received an LSD vaccination (Figure 5).

Respondent's knowledge regarding risk factors

Most respondents (74.4%) did not think that economic instability was a dangerous thing to be concerned about. Further investigation revealed that 68.7% of participants consider an unregulated animal husbandry system to be a risk while 82.8% concurred that lack of awareness is a risk factor. The majority (53.3%) of participants believed that there is a possibility that insects might transmit the virus (Table 5). Among all, 75.2% believe that there are higher chances of outbreaks when animals are relocated. Furthermore, the majority (42.0%) of participants accepted that there is a link between larger herds and a higher risk of disease while 26.1% disagreed with this concept (Figure 6).

Table 2. Knowledge regarding LSD of livestock owners.

Variables	Characteristics	Number (N)	Percentage (%)
Ever heard about lumpy skin disease in cattle?	Yes	296	77.3
	No	87	22.7
Ever seen the disease in cattle?	Yes	184	48.0
	No	199	52.0
Aware of the danger of lumpy skin disease in cattle?	Yes	207	54.0
	No	176	46.0
Do you think close contact with infected cattle could get you infected with disease?	Yes	237	61.7
	No	146	38.3
	All the above	157	41.0
	Fever	75	19.6
What are the symptoms of lumpy skin disease in cattle?	Reduction in milk yield	53	13.8
	Skin nodules	98	25.6
	Ants	49	12.8
Do you know which insects are primarily responsible for the spread of the disease?	Mosquitoes & biting Flies	185	48.3
	Other insects	132	34.5
	Spiders	17	4.4
	Antibiotics	70	18.3
Do you know the correct/ effective treatment/ medication for the disease?	Both	100	26.1
	Don't know	110	28.7
	Vaccination	103	26.9

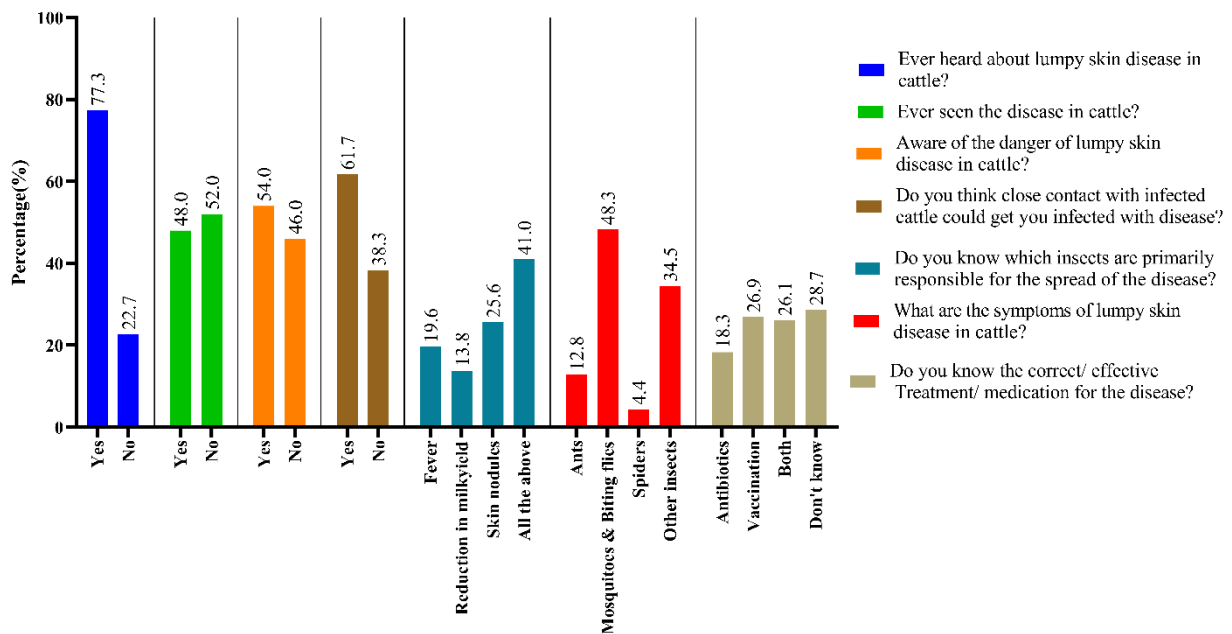
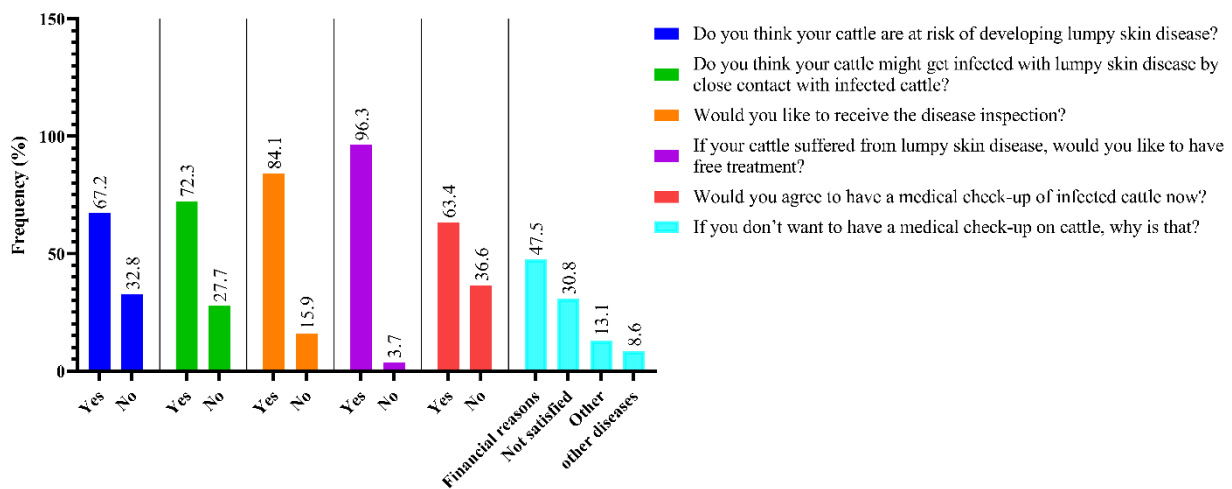
**Figure 3.** Knowledge regarding lumpy skin disease (LSD) of livestock owners.

Table 3. Attitude towards lumpy skin disease.

Variables	Characteristics	Number (n=383)	Frequency (%)
Do you think your cattle are at risk of developing lumpy skin disease?	Yes	258	67.2
	No	125	32.8
Do you think your cattle might get infected with lumpy skin disease by close contact with infected cattle?	Yes	277	72.3
	No	106	27.7
Would you like to receive the disease inspection?	Yes	322	84.1
	No	61	15.9
If your cattle suffered from lumpy skin disease, would you like to have free treatment?	No	14	3.7
	Yes	369	96.3
Would you agree to have a medical check-up of infected cattle now?	Yes	243	63.4
	No	140	36.6
	Financial reasons	182	47.5
	Not satisfied	118	30.8
If you don't want to have a medical check-up on cattle, why is that?	Other	50	13.1
	There may be other diseases, not suitable for medication	33	8.6

**Figure 4.** Attitude towards lumpy skin disease (LSD).

Analysis of knowledge, attitude, and practices (KAP), and risk factors of LSD based on various socio-demographic variables

In current study, binomial linear regression models that accurately predicted participant's knowledge, risk factors, and behavior related to lumpy skin disease were employed. Sample representativeness was validated using age-based techniques, and the findings of study revealed several factors impacting

these aspects. p -value < 0.05 was assumed to be a statistically significant link between variables.

The participants knowledge and its association with socio-demographics revealed that the majority ($n=167$) of respondents who had good knowledge were illiterate livestock owners with an odd ratio (2.306, $P < 0.008^*$), followed by people with secondary education with an odd ratio (6.2989, $P < 0.013$).

Table 4. Practice towards lumpy skin disease.

Variables	Characteristics	Number (n=383)	Frequency (%)
What animals do you keep?	All	142	37.1
	Buffalo	90	23.5
	Cattle	111	29.0
	Goats	40	10.4
How are they kept?	Free only at night	12	3.1
	Free only daytime	130	34
	Free throughout	25	6.5
What is the size of herd?	Not free anytime	216	56.4
	Large (7 above animals)	110	28.7
	Medium (4-6 animals)	166	43.3
When did you use an insecticide last time?	Small (Up to 3 animals)	107	28
	Before one year	150	39.2
	Before six months	56	14.6
Do you segregate an infected animal from the herd?	Cannot remember	177	46.2
	No	95	24.8
Do you sell any infected animal to a butcher?	Yes	288	75.2
	No	301	78.6
Do you sell any infected animal to another owner?	Yes	82	21.4
	No	285	74.4
Do you wash your hands after touching infected cattle?	Yes	98	25.6
	No	88	23.0
Have your cattle ever received vaccination against LSD?	Yes	295	77.0
	No	347	90.6
	Yes	36	9.4

Gender-wise, males were more aware (n=129) as compared to females (n=56). Participants in Dheedwal village had good knowledge (n=56), followed by Sohawa (n=53), Thirpal (n=44), and Jhatla and Jaswal (n=27), respectively, with $P > 0.05$ (Table 6).

The association between attitude and socio-demographic factors revealed that the residents of Jaswal Village (odds ratio 1.983, $p=0.018^*$) and the age group 20-30 (odds ratio 2.269, $p=0.012^*$) showed a significant association (Table 7). In summary, positive attitudes were linked to people residing in Jaswal Village, being in the 20-30 age group, and having secondary education. The odd ratios indicated the strength of these associations, and low p-values confirm their significance, implying that these characteristics predicted positive attitudes, potentially with interrelationships among them.

The association between practices and socio-de-

mographic variables revealed that poor practice was significantly linked to respondents from Village Sohawa (odds ratio 0.314, $p=0.044^*$). The age group 41-50 was significantly associated with bad practice (odds ratio 1.967, $p=0.033^*$). Illiteracy was also significantly related to bad practice (odds ratio 0.487, $p=0.039$). In summary, Village Sohawa residents tend to have better practices, while the 41-50 age group and illiterate individuals are more likely to exhibit bad practices. The odd ratios quantify these associations, and low p-values confirm their statistical significance, highlighting these factors as predictors of poor practices (Table 8).

For risk factors, association with socio-demographic variables participants from different villages had different responses. The livestock owners of Sohawa village had a significant association with risk factors, with an odd ratio of 5.640 ($P < 0.004$).

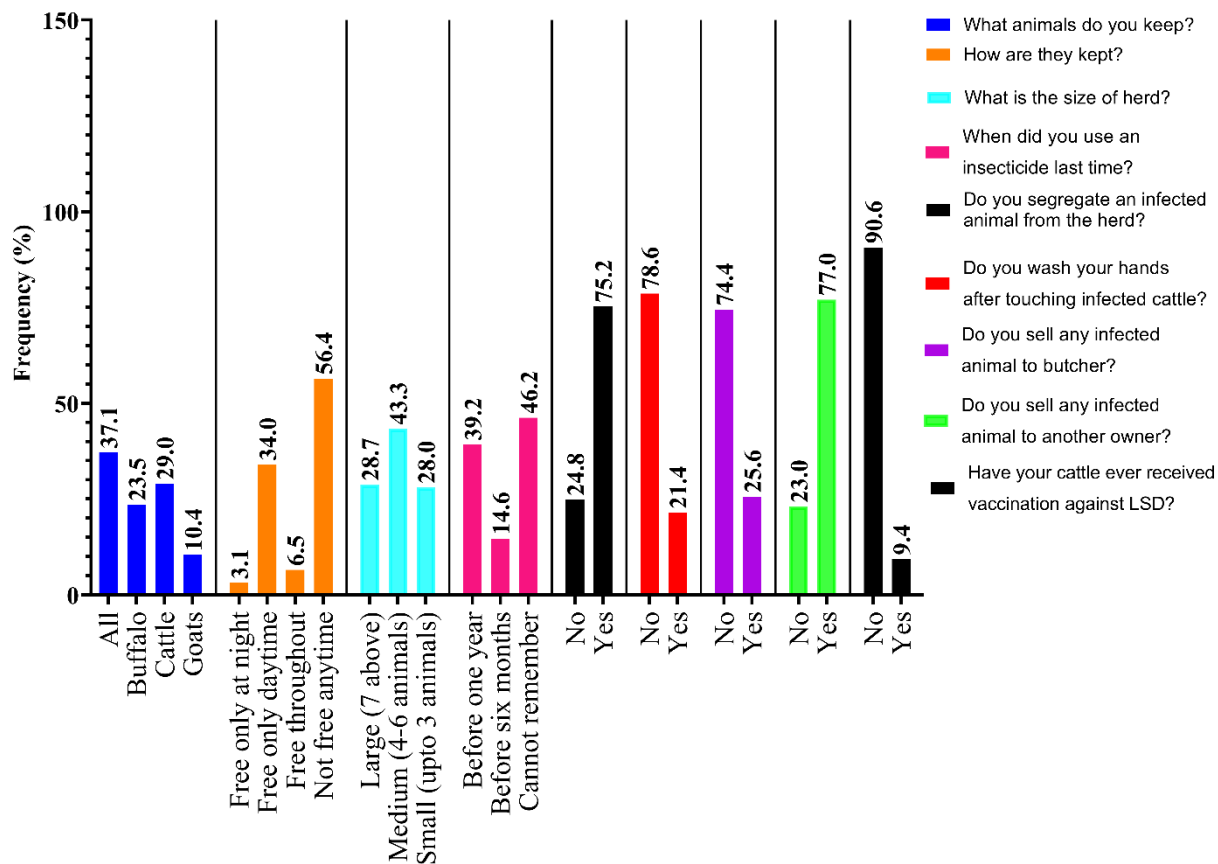


Figure 5. Practices towards lumpy skin disease (LSD).

Table 5. Respondent's knowledge regarding risk factors of LSD.

Variables	Characteristics	Number (n=383)	Frequency (%)
Economic instability?	Yes	285	74.4
	No	98	25.6
Unregulated system of animal husbandry?	Yes	263	68.7
	No	120	31.3
Lack of awareness?	Yes	317	82.8
	No	66	17.2
	May be	144	37.6
Transmission of virus by insects?	No	35	9.1
	Yes	204	53.3
Infected cattle movement have been associated with an increased risk of outbreak?	No	95	24.8
	Yes	288	75.2
Larger herds are associated with increased risk of disease?	Yes	161	42.0
	No	100	26.1
	May be	122	31.9

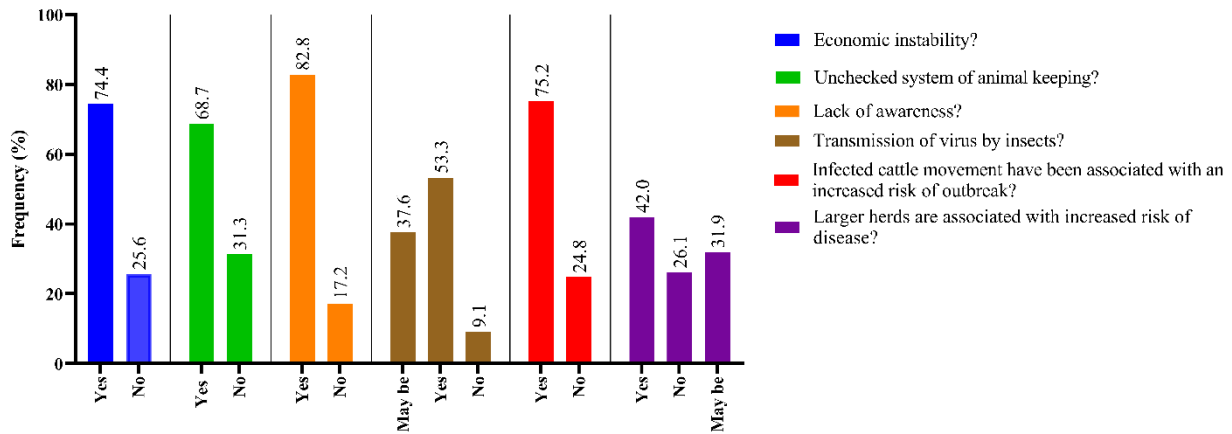


Figure 6. Respondent's knowledge regarding risk factors of lumpy skin disease (LSD).

Gender-wise, no significant association was detected, while age-wise, different age groups had different responses, but participants in the age group of 41 to 50 had showed a significant association with risk factors (odds ratio 0.609, $p < 0.0157$). Ethnicity wise, Punjabi livestock owners showed a strong association (odds ratio 21.165, $p < 0.018$) while monthly income below 30,000 was also significantly associated (odds ratio 1.855, $p < 0.005$). These findings indicated significant correlations between the risk factor and various socio-demographic characteristics (Table 9).

DISCUSSION

Lumpy Skin Disease (LSD) in cattle is a new, fatal viral illness that is spreading throughout Pakistan (Jamil et al., 2022). In 1929, Zambia revealed the discovery of the first LSD clinical signs (Koirala et al., 2022). Because of recent outbreaks in neighbouring countries such as Malaysia and Thailand, as well as the transportation of animals from and to Pakistan, the LSD has the potential to trigger an outbreak in Pakistan (Khatri et al., 2023). LSD has also affected Pakistan, where large number of animals has been infected at various livestock farms in Karachi, and more than 200 animals have died because of it (Jamil et al., 2022). In district Chakwal, Pakistan, we conducted a community-based examination of socio-demographics, knowledge, risk factors, attitudes, and practices linked to lumpy skin disease in cattle. It was worth noting the high proportion belongs to illiterate respondents (78.6%) that is consistent with research indicating that lower education levels may contribute to a lack of awareness and comprehension of livestock diseases (Bhattacharya et al., 2024).

Our results showed that most respondents (77.3%) were aware of LSD. This is a good indicator because

awareness regarding LSD plays an important role in illness control and prevention. These findings are consistent with previous research indicating that illness awareness campaigns and educational activities can effectively raise disease knowledge (Corrales, 2023). The fact that 76.5% of respondents believed that close contact with sick animals may spread the disease is consistent with scientific understanding of LSD transmission, which is possible through contact with diseased animals (Datten et al., 2023). According to our findings, 48.3% of respondents recognized mosquitoes and biting flies as the insects responsible for LSD transmission, followed by other insects (34.5%), ants (12.8%), and spiders (4.4%). These findings support previous research indicating the primary vectors of LSD transmission are insects, with biting flies and mosquitoes being the main vectors (Liang et al., 2022; Bianchini et al., 2023). In terms of treatment, 18.3% of respondents thought antibiotics were the correct/effective treatment for LSD, 26.1% said both antibiotics and vaccines were the correct/effective treatment, 28.7% said they didn't know the correct treatment. The percentage of respondents who said that they didn't know the correct treatment (28.7%) highlights an opportunity for education and awareness campaigns to clarify the best approaches to managing LSD. The mention of antibiotics and vaccinations demonstrates some understanding of the complexities of infectious disease management. Different studies in Ethiopia and Bangladesh, reported that vaccination can minimize milk and animal product loss owing to illness, mortality, myiasis, and miscarriage (Gari et al., 2010; Roess et al., 2013).

Participants' attitudes towards LSD are also essential because they can influence their desire to take

Table 6. Association of participants' knowledge and socio-demographic factors regarding LSD.

Variables	Category	Knowledge		Estimate	SE	Z- value	P-value	Odd ratio (95% CI)
		Good	Poor					
Village	Thirpal	44	35					
	Jhatla	27	23	-0.2535	0.650	-0.3900	0.697	0.7761 (0.21712.77)
	Jaswal	27	23	0.2469	0.465	0.5309	0.595	1.2801 (0.5144-3.18)
	Dheedwal	56	37	-0.0671	0.586	-0.1145	0.909	0.9351 (0.2965-2.95)
	Sohawa	53	58	-0.0696	0.463	-0.1504	0.880	0.9328 (0.3767-2.31)
Religion	Christian	1	6					
	Muslim	206	170	1.9836	1.098	1.8063	0.071	7.2686 (0.844762.55)
Gender	Female	56	78					
	Male	129	120	-.1391	0.267	-0.5221	0.602	0.8701 (0.51601.47)
Age	20-30	26	18	-0.1240	0.753	-0.164	0.869	0.883 (0.2019-3.86)
	31-40	24	18					
	41-50	60	61	-0.2442	0.723	-0.337	0.736	0.7833 (0.1898-3.23)
	51-60	68	70	-0.1659	0.815	-0.203	0.839	0.8472 (0.1713- 4.19)
	61-70	29	9	1.2346	0.961	1.284	0.199	3.437 (0.5221-22.62)
Ethnicity	Pathan	8	10	-0.3583	1.219	-0.2939	0.769	0.6988 (0.0640-7.63)
	Punjabi	197	164	0.1409	1.101	0.1280	0.898	1.1513 (0.1331-9.96)
	Urdu speaking	2	2					
Marital status	Unmarried	32	25					
	Married	175	151	-0.0217	0.318	-0.0684	0.945	0.9785 (0.524-1.82)
Education level	Illiterate	167	134	0.8359	0.315	2.6526	0.008*	2.306 (1.2439-4.28)
	Post-secondary	7	3	1.278	0.764	1.6746	0.094	3.5928 (0.8042-16.05)
	Primary	24	36					
	Secondary	9	3	1.8404	0.745	2.471	0.013*	6.2989 (1.463-27.10)
Average monthly income	Below 30,000	41	28	0.4069	0.672	0.6056	0.545	1.5021 (0.4025-5.61)
	31,000-50,000	77	76					
	Above 50,000	89	72	-0.2067	0.427	-0.4844	0.628	0.8132 (0.3523-1.88)

*; Statistically significant

preventive action and seek treatment. The majority (67.2%) of participants thought that their cattle were at risk of developing lumpy skin disease, which is a good sign because it shows that they are aware of the possible harm. It is worth noting that a sizable proportion of farmers (96.3%) expressed gratitude for free care if their cattle became ill with LSD. This

implies that cost barriers may be a major concern for cattle owners. According to a study, financial issues can influence healthcare-seeking behavior (Hussain et al., 2019).

Different prevention practices and how respondents handle their cattle is also indicated in our study. The result indicates that 78.6% of respondents never

Table 7. Association of participants' attitudes with socio-demographic factors.

Variables	Category	Attitudes		Estimate	SE	Z-value	P-value	Odds ratio (95% CI)
		Good	Poor					
Village	Thirpal	52	27					
	Jhatla	34	16	0.1801	0.670	0.2689	0.788	1.197 (0.3222-4.45)
	Jaswal	40	10	0.6846	0.521	1.3130	0.018*	1.983 (0.713- 5.51)
	Dheedwal	57	36	-0.4725	0.602	-0.7849	0.433	0.623 (0.1915- 2.03)
	Sohawa	75	36	-0.0648	0.478	-0.1355	0.892	0.937 (0.366- 2.39)
Religion	Christian	4	3					
	Muslim	254	122	0.6853	0.797	0.8593	0.390	1.984 (0.4157-9.47)
Gender	Female	50	31					
	Male	208	94	0.2152	0.271	0.7936	0.427	1.240 (0.7288-2.11)
Age	20-30	29	15	0.5218	0.758	0.6883	0.012*	2.269 (1.19- 4.31)
	31-40	27	15					
	41-50	80	41	0.1585	0.785	0.2021	0.840	1.172 (0.251-5.45)
	51-60	98	40	-0.1168	0.785	-0.138	0.894	0.89 (0.16-4.92)
	61-70	24	14	0.0757	1.009	0.0750	0.940	1.079 (0.1494- 7.79)
Ethnicity	Pathan	12	6	1.6805	1.353	1.2419	0.214	5.368 (0.3784- 76.15)
	Punjabi	245	116	1.9592	1.241	1.5787	0.114	7.094 (0.6230- 80.77)
Marital status	Urdu speaking	1	3					
	Unmarried	40	17					
	Married	218	108	-0.2705	0.341	0.7928	0.428	0.763 (0.3909- 1.49)
Education level	Illiterate	205	96	-0.0336	0.320	0.1048	0.917	0.967 (0.5162- 1.81)
	Post- secondary	8	2	0.5851	0.851	0.6878	0.492	1.795 (0.338- 9.51)
	Primary	39	21					
Average monthly income	Secondary	6	6	-0.8034	0.675	-1.199	0.023*	0.448 (0.119- 1.68)
	Below 30,000	44	25	-0.5609	0.702	-0.7938	0.424	0.571 (0.14413- 2.26)
	31,000-50,000	101	52					
Above 50,000	113	48	0.0659	0.442	0.149	0.881	1.068 (0.4491- 2.54)	

*; Statistically significant

Table 8. Association of socio-demographic factors regarding practices of LSD.

Variables	Category	Practices		Estimate	SE	Z-value	P-value	Odd ratio (95% CI)
		Good	Poor					
Village	Thirpal	44	35					
	Jhatla	27	23	-0.4460	0.730	-0.611	0.541	0.640 (0.153-2.76)
Religion	Jaswal	27	23	-0.1832	0.529	-0.3464	0.729	0.83 (0.295-2.348)
	Dheedwal	56	37	-0.9612	0.705	-1.3641	0.173	0.382 (0.096-1.522)
Gender	Sohawa	53	58	-1.1589	0.574	-2.0189	0.044*	0.314 (0.101-0.96)
	Christian	1	6					
Age	Muslim	206	170	-1.1293	0.804	-1.4053	0.160	0.323 (0.066-1.562)
	Female	56	78					
Ethnicity	Male	129	120	-0.2006	0.317	-0.6319	0.527	0.818 (0.439-1.524)
	20-30	26	18	-0.2857	0.826	-0.3459	0.729	0.751 (0.148-3.794)
Marital status	31-40	24	18					
	41-50	60	61	0.6765	0.803	0.8428	0.033*	1.967 (0.4079-4.84)
Education level	51-60	68	70	0.3903	0.984	0.3967	0.692	1.477 (0.214-10.16)
	61-70	29	9	0.3512	1.188	0.2956	0.768	1.421 (0.138-14.58)
Average monthly income	Pathan	8	10	-16.4034	919.4	-0.0178	0.986	7.52 (0.000- Inf)
	Punjabi	197	164	-0.4456	1.122	-0.3973	0.691	0.640 (0.071-5.771)
Ethnicity	Urdu speaking	2	2					
	Unmarried	32	25					
Marital status	Married	175	151	-0.3673	0.349	-1.0514	0.293	0.693 (0.349-1.374)
	Illiterate	167	134	-0.7194	0.348	-2.0693	0.039*	0.487 (0.246-0.963)
Education level	Post-secondary	7	3	-0.4126	0.873	-0.4726	0.637	0.662 (0.119-3.665)
	Primary	24	36					
Average monthly income	Secondary	9	3	-0.5511	0.759	-0.7264	0.468	0.576 (0.130-2.549)
	Below 30,000	41	28	-0.0276	0.781	-0.0354	0.972	0.973 (0.210-4.498)
Average monthly income	31,000-50,000	77	76					
	Above 50,000	89	72	-0.3898	0.644	-0.6050	0.545	0.677 (0.191-2.394)

*; Statistically significant

Table 9. Association of socio-demographic factors related to risk factors of LSD.

Variables	Category	Risk factors		Estimate	SE	Z-value	P-value	Odd ratio (95% CI)
		Yes	No					
Village	Thirpal	63	16					
	Jhatla	42	8	1.1014	0.808	1.364	0.173	3.008 (0.6180-14.64)
	Jaswal	39	11	0.7766	0.515	1.509	0.131	2.174 (0.793-5.96)
	Dheedwal	77	16	1.4229	0.740	1.923	0.055	4.149 (0.972-17.70)
	Sohawa	96	15	1.729	0.596	2.901	0.004*	5.640 (1.752-18.15)
Religion	Christian	6	1					
	Muslim	311	65	-0.5609	1.138	-0.493	0.622	0.571 (0.0613-5.31)
Gender	Female	70	11					
	Male	247	55	-0.4481	0.382	-1.173	0.241	0.639 (0.3021-1.35)
Age	20-30	40	4	1.8191	1.111	1.637	0.102	6.166 (0.698-54.41)
	31-40	36	6					
	41-50	99	22	-0.4953	0.889	-0.557	0.0157*	0.609 (0.106- 3.48)
	51-60	109	29	-0.1698	1.037	-0.598	0.550	0.538 (0.070- 4.11)
	61-70	33	3	-0.5964	1.235	-0.483	0.629	0.551 (0.048- 6.19)
	Pathan	14	4	2.3996	1.434	1.673	0.094	11.01 (0.662-183.14)
Ethnicity	Punjabi	301	60	3.0523	1.292	2.362	0.018*	21.16 (1.680-266.51)
	Urdu speaking	2	2					
Marital status	Unmarried	46	11					
	Married	271	55	0.0827	0.411	0.201	0.841	1.086 (0.485-2.43)
	Illiterate	249	52	0.2179	0.427	0.510	0.610	1.244 (0.538-2.87)
Education level	Post-secondary	9	1	0.3593	1.142	0.314	0.753	1.432 (0.1526-13.44)
	Primary	50	10					
	Secondary	9	3	-0.2536	0.796	-0.318	0.750	0.776 (0.1629- 3.70)
Average monthly income	Below 30,000	62	7	0.6178	0.941	0.657	0.005*	1.855 (0.293-11.72)
	31,000-50,000	125	28					
	Above 50,000	130	31	0.5903	0.625	0.948	0.343	1.805 (0.532- 6.12)

*; Statistically significant

sold unwell animals to butchers is positive, indicating a responsible attitude towards preventing disease spread via the meat supply chain. Only 23.0% of respondents reported cleaning their hands after handling sick animals, which is alarming. It could be the potential flaw in biosecurity practices, as sufficient hygiene precautions are required to avoid disease spread (Bagale et al., 2023). A sizable number (42.0%) of respondents agreed that larger herds were associated with a higher risk of disease. This view is consistent with previous evidence, which implies that larger cattle herds may experience increased disease risks due to higher population densities and increased disease transmission chances (Altizer et al., 2011). Strategies need to emphasize clearing up misunderstandings, addressing financial restrictions, and promoting confidence and cooperation between livestock owners and veterinary specialists. Implementing regular vector control measures, including the use of appropriate insecticides, can help reduce the risk of disease spreading among cattle.

Our findings revealed numerous risk factors associated with LSD incidence in the Chakwal district. Skin nodules were the most common (25.6%), identified symptom of LSD in our study, followed by fever (19.6%) and decreased milk production (13.8%). These findings are consistent with LSD's clinical presentation in cattle (Gharban et al., 2019). Our findings on risk factors show that a sizable majority of respondents were aware of concerns such as unregulated animal husbandry systems and the potential role of insects in disease transmission. It is worth noting that the vast majority (75.2%) stated that relocating sick animals could result in epidemics. This is consistent with the idea that the mobility of infected animals can be a significant risk factor in disease transmission (Gari et al., 2010; Singh et al., 2019). According to our findings, a small percentage of respondents (25.6%) recognized economic

insecurity as a risk factor for LSD. This shows that the majority of respondents did not correlate the sickness with economic insecurity. This result "economic insecurity" of the study is contradicted with the earlier studies that states, economic concerns, such as livestock loss and decreasing production, can have a significant impact on farmers' income, and there is a need for more understanding in this region (Molla et al., 2017).

CONCLUSION

The knowledge, attitudes, and practices (KAP) study on lumpy skin disease (LSD) in cattle among owners of livestock in Chakwal district provides useful data on the behavior of cattle owners regarding the condition. According to this study, livestock owners in district Chakwal have an average level of understanding of LSD in cattle. They have a fundamental awareness of the condition, its clinical signs and symptoms, and the related hazards. However, there are some knowledge gaps regarding disease transmission, prevention, and control techniques. According to our findings, livestock owners have a generally good attitude towards the prevention and control of LSD in cattle. They recognize the significance of immunization and biosecurity measures in limiting disease spread. Our findings indicate the need for focused educational programs, improved biosecurity procedures, and improved disease management strategies to efficiently control and prevent the development of LSD.

CONFLICT OF INTEREST

None declared

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