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Concomitant Risk Factors of Worm Infestation Prevalence in Sahiwal Calves under Different Management Conditions

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ABSTRACT

The dairy industry relies heavily on the successful rearing of calves, as their progeny are essential for livestock production and sustainability. The early life stages of calves present numerous challenges that require proper husbandry practices. Among these, worm infestations pose a significant threat to calf survival. This study aimed to identify risk factors such as age, sex, and husbandry practices that contribute to worm infestations in Sahiwal calves. The study compares worm infestation risk factors in Sahiwal calves under different management conditions, specifically farm, peri-urban, and rural settings. Calves from various farm, peri-urban, and rural settings were selected for the research. Data were collected using a pretested and validated questionnaire, covering factors such as age, sex, water quality, manger and water trough conditions, bedding, flooring, housing, feeding practices, skin and belly condition, history of diarrhoea, pica, teeth grinding, hydration status, and deworming. Faecal samples were analysed using the McMaster technique to determine the number of eggs per gram (EPG). Statistical analysis revealed that age was a significant factor ($p<0.05$) in worm infestations, while sex had no statistically significant effect ($p>0.05$). Management practices also significantly impacted the prevalence of worm infestations, with calves raised under traditional practices showing higher infestation rates compared to those raised with improved practices. These findings emphasize the need for better management practices to prevent and control worm infestations. Addressing these risk factors can help reduce the economic losses caused by worm infestations and improve the growth and performance of Sahiwal calves, ultimately supporting the dairy industry's growth in Pakistan.

INTRODUCTION

The dairy industry holds considerable importance, particularly due to the global prevalence of milk consumption and the associated health benefits (Volpato *et al*., 2017). Cattle are extensively reared, representing a sophisticated and lucrative enterprise. In addition to enhancing nutritional status, they play a significant role in the economies of developing nations, providing support to small and landless farmers (Rufai *et al*., 2019). The livestock industry fosters financial growth by creating employment opportunities for both direct and indirect workers. Furthermore, draught work performed by animals is a critical aspect of rural livelihoods, and animal manure is a valuable source of organic fertilizer. The leather industry also benefits from by-products such as hides and skins produced by the livestock industry, providing a sustainable source of raw materials (Vithyashankar *et al*., 2021).

The viability of the dairy industry is reliant on the successful rearing of calf progeny, which necessitates the adoption of scientifically informed practices. Effective calf management practices are crucial for ensuring the survival and thriving of calf progeny, and thereby supporting the success of the dairy business (Sreedhar and Sreenivas, 2015). Key aspects of calf management include

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comprehensive health management and the provision of well-balanced and appropriate nutrition, which not only support the dairy industry but also preserve high-quality genetic material in the form of healthy calves (Lorenz *et al*., 2011).

The early stages of a calf's life are the most precarious, with a high mortality rate that can have negative impacts on the profitability and sustainability of dairy farming. The most common causes of death during this period are respiratory and gastrointestinal problems, which are frequently reported (Mee, 2013). Farmers tend to overlook the issue of worm infestation since affected calves often appear healthy, but it can have a latent impact on production performance. Furthermore, worm infestation can decrease immunity, making calves more susceptible to other illnesses, leading to increased treatment costs and decreased animal value, creating a financial burden for dairy farmers (Gunathilaka *et al*., 2018). Worm infestation is frequently classified as a production problem due to reduced feed intake, scours, and occasional mortality (Tavassoli, 2018). Elevated feeding costs, combined with higher mortality rates during the pre-weaning phase, pose significant obstacles to increasing productivity, resulting in a reduced number of heifer and bull calves available for meat and milk production (Bhatti *et al*., 2012).

Worm infestation is a significant problem in Pakistan, resulting in substantial economic losses for the dairy industry, estimated at over $26.5 million annually (Haleem *et al*., 2016). In addition to hampering animal growth and performance, worm infestation impedes the expansion of the dairy sector in the country. Slow growth, decreased production, and the rejection of various edible parts and hides lead to increased costs and decreased revenue, significantly impacting the economy (Bilal *et al*., 2009).

Although much information is available on worm infestation and its risk factors in cow calves from other countries, there is little knowledge about worm infestation in Sahiwal calves under local management conditions. Therefore, this study aimed to investigate the occurrence and associated risk factors of worm infestation in Sahiwal calves under various management conditions.

MATERIALS AND METHODS

Animals and research design

The study was approved by Institute of Animal and Dairy Sciences, University of Agriculture Faisalabad Pakistan and all procedures were carried out considering University rules and regulation of conducting research. The study employed a sample size determination method as described by Thrusfield (2007) to ensure statistical validity. The samples (n=210) were drawn from three distinct groups, A, B, and C, with 70 Sahiwal calves randomly selected each from dairy farms, peri-urban, and rural areas in each group (Fig. 1). The selected calves were further categorized based on their origin, specifically, farm (category A), peri-urban (category B) and rural (category C). A pretested and validated questionnaire was used to collect data in interviews with farmers and farm managers to gather information on husbandry practices and environmental factors related to worm infestation including drinking water, manger and water trough condition, animal bedding, floor condition, housing, skin condition, belly condition, history of scour, teeth grinding, hydration status of calves, pica, use of anthelmintics, and ongoing husbandry practices.

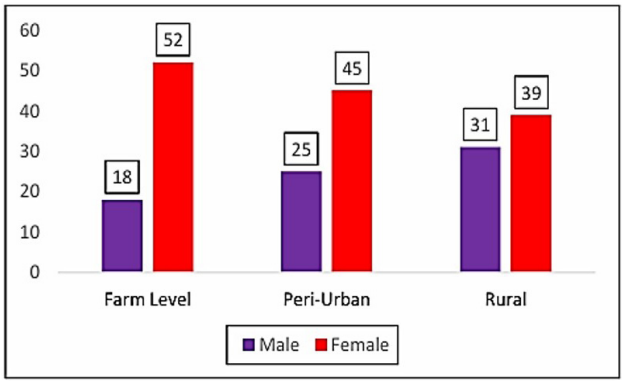

Fig. 1. Sahiwal male vs female calves used in this study.

Collection of faecal samples

Stool samples were collected from Sahiwal calves in a manner that ensured animal welfare and minimized any potential harm. Prior to collection, animals were restrained appropriately to prevent any injury. Collection was performed using gloves and liquid paraffin was utilized to obtain samples from the rectum. In cases where faecal material was not present, rectal mucosa was stimulated with a finger to obtain a sample. Samples were carefully weighed and labelled before being placed in zip-locked bags for analysis. To minimize delay and ensure freshness, samples were analysed as soon as possible after collection. In instances where immediate analysis was not possible, 10% formalin was added to preserve the sample, which was then stored in a refrigerator at 4-6 °C for no more than 7 days prior to analysis. Furthermore, fresh stool samples were also collected from the floor surface immediately after defecation.

Analysis of faecal samples

The stool samples collected were subjected to analysis at the Livestock Management Laboratory of UAF. The

analysis was carried out using the McMaster technique, as described by Afridi *et al*. (2007). This technique is widely accepted and commonly used for the detection of internal parasite infections in ruminants. The main objective of the analysis was to determine the total number of eggs per gram (EPG) of faeces. The EPG values obtained from the analysis provided a quantitative measure of the worm burden in the calves. The data obtained from the analysis were recorded and analysed statistically to determine the prevalence and intensity of worm infestation in the Sahiwal calves age and gender wise (Fig. 1) in relation to different management practices.

Statistical analysis

The data collected in this study were analysed using descriptive statistics, including calculating the frequency and percentage of animals that were infested with worms. Furthermore, chi-square tests were conducted using the IBM SPSS (25) software package to assess the association between different factors, such as age and gender with worm infestation in the Sahiwal calves along with associated risk factors.

RESULTS

None of the farms used cages for rearing Sahiwal calves, instead opting to rear them on the floor. Calf pens were present in all farms (100%) and 71.4% of periurban areas. Dung heaps were observed in 73% of peri-urban and 96% of rural level. Cracks and crevices were noted in 20%, 71.4%, and 87.1% of farms, peri-urban, and rural areas, respectively. In terms of flooring, 17%, 72.9%, and 15.71% of the Sahiwal calves were reared on paved floors using bricks at the farm, peri-urban, and rural levels, respectively. Concrete floors were used for rearing of the animals at the farm 82.9% and peri-urban levels 27.14%. However, this practice was not commonly observed at the village level (Table I).

At the farm and peri-urban levels, animals did not have access to grazing, but at the rural level, 64.3% were fed through stall feeding, while 35.7% were fed through a combination of stall feeding and grazing systems (Table II).

The majority of farmers followed the practice of teat washing before suckling the calves, however, no bedding material was used, except for sand in resting areas. Groundwater was the source of drinking water for animals at the farm and peri-urban levels, whereas canal water was used during grazing at the rural level. At the farm level, a regular routine of cleaning managers was observed, and most feeding managers were relatively clean and free of dung/soil, in contrast to the peri-urban and rural levels, as indicated in Table III. The study findings indicate that no fungal growth was observed during the study period across all levels. The farm level had a specific schedule for manger area cleaning, while no schedule was followed in the rural areas. The animals were provided with fresh water on a daily basis, and water troughs were cleaned at a one-week interval.

Table I. Housing of Sahiwal calves under different housing, shed and floor conditions.

Farm type	Calf housing			Shed condition		Floor condition		
	Floor No (%)	Calf pen No (%)	Cage No (%)	Dung heap No (%)	Cracks in wall No (%)	Paved using bricks No (%)	Concrete No (%)	Kacha floor No (%)
Farm	70 (100)	70 (100)	0	0	14 (20)	12 (17)	58 (82.9)	0
Peri-Urban	70 (100)	50 (71.4)	0	51 (73)	50 (71.4)	51 (72.9)	19 (27.1)	16 (11.2)
Rural	70 (100)	9 (12.8)	0	67 (96)	61 (87.1)	11 (15.7)	0	59 (84.2)

Table II. Different husbandry practices at various farm types.

Farm type	Feeding system			Teat washing before suckling No (%)	Bedding used No (%)	Water for drinking	
	Grazing No (%)	Stall feeding No (%)	Stall + Grazing No (%)			Ground No (%)	Pond/ canal No (%)
Farm	0	70 (100)	0	70 (100)	0	70	0
Peri-Urban	0	70 (100)	0	63 (90)	0	70	0
Rural	0	45 (64.2)	25 (35.7)	60 (85.7)	0	62 (88.5)	8 (11.4)

Table III. Condition of water trough and manger at different farm types.

Farm type	Condition of manger		Cleaning frequency of manager		Condition of water trough		Frequency of water change	
	Clean No (%)	Dirty No (%)	Clean weekly No (%)	No schedule No (%)	Clean No (%)	Dirty No (%)	Weekly No (%)	None No (%)
Farm	70 (100)	0	70 (100)	0	70 (100)	0	70 (100)	0
Peri-Urban	54 (77.1)	16 (22.8)	55 (78.5)	15 (21.4)	57 (81.4)	13 (18.5)	70 (100)	0
Rural	22 (31.4)	48 (68.5)	12 (17.1)	58 (82.8)	10 (14.2)	60 (85.7)	70 (100)	0

Table IV. Use of anthelminthic and antiseptics.

Farm type	Use of anthelminthic	Frequency of anthelminthic		Use of antiseptics	Kind of antiseptic		Using frequency	
	No (%)	Once No (%)	Twice No (%)	No (%)	$KMnO_4$ No (%)	Lime No (%)	Weekly No (%)	15 Days No (%)
Farm	70 (100)	0	70 (100)	70 (100)	0	70 (100)	0	70 (100)
Peri-Urban	70 (100)	65 (95.8)	5 (7.1)	11 (15.7)	0	70 (100)	0	0
Rural	70 (100)	70 (100)	0	4 (5.7)	0	70 (100)	0	0

Table V. Worm infestation related observations in calves maintained in different types of farm.

Farm type	Loss of condition No (%)	Scour No (%)	Pot belly No (%)	Teeth grinding No (%)	Dehydration No (%)	Pica No (%)
Farm	12 (17.1)	9 (12.8)	5 (7.1)	6 (8.5)	10 (14.2)	11 (15.7)
Peri-Urban	17 (24.2)	11 (15.7)	10 (14.2)	8 (11.4)	7 (18.5)	16 (22.8)
Rural	24 (34.2)	17 (24.2)	18 (25.7)	16 (22.8)	19 (27.1)	20 (28.5)

Table VI. Eggs per gram (EPG) describing worm load in calves maintained in various farm conditions.

Farm type	EPG 1-400 No (%)	EPG 401-800 No (%)	EPG 801-1200 No (%)	EPG 1201-1600 No (%)	EPG 1601 or more No (%)
Farm level	9 (12.85)	5 (7.14)	3 (4.29)	1 (1.43)	0
Peri-Urban	13 (18.57)	6 (8.57)	4 (5.71)	2 (2.86)	1 (1.43)
Rural	21 (30)	14 (20)	9 (12.85)	5 (7.14)	3 (4.29)

Dewormers were used to control worm infestation in all three levels, but the regularity of deworming varied across levels. At the farm level, deworming was performed twice a year for all animals, while at peri-urban and rural levels, anthelmintics were used once a year for all animal groups. Additionally, anthelmintic drug groups were changed to improve efficacy against different worms and ensure optimal results in animals as described in Table IV. During the study, antiseptics were used in water troughs and routine procedures as needed, without a specific schedule, at all levels. Lime was the primary antiseptic used at all levels to prevent the growth of harmful microorganisms in water troughs. However, there was no specific schedule for lime application at the rural and peri-urban levels. At the farm level, lime was used every 15 days to prevent the growth of fungus and other harmful organisms in water troughs.

The study revealed that many calves exhibited symptoms of pica at different levels, which can be caused by mineral deficiency. However, worm infestation can worsen mineral deficiency, leading to pica and other health problems. The affected calves showed symptoms such as pot belly, dehydration, scour, anorexia, loss of body condition, distended belly, and teeth grinding, which may suggest that the animals were suffering from a worm load that had detrimental effects on their growth and development, as shown in Table V. The study found that worm load was lower at the farm and peri-urban levels compared to the rural level, which had the highest EPG count, as described in Table VI. This indicates that the management practices at the farm and peri-urban levels were more effective in controlling worm infestation compared to the rural level.

Table VII provides information on the mean EPG

(eggs per gram of feces) of calves in different age groups. The results show that the mean EPG is highest in calves less than 6 months old and decreases with increasing age. The analysis of variance indicate that there is a significant association between the age group of calves and the occurrence of worm infestation ($p<0.05$) Table VIII. This implies that the prevalence of worm infestation differs significantly across various age groups of calves. Specifically, the highest prevalence was observed in calves aged less than 6 months, followed by calves aged between 6 and 12 months, while the lowest prevalence was observed in calves older than 12 months. These results provide valuable insights into the epidemiology of worm infestation in calves and can inform targeted intervention strategies to minimize the prevalence and impact of this disease on animal health and productivity.

Table VIII presents the distribution of worm infestation, measured in egg per gram (EPG), among male and female calves. To evaluate the potential association between gender and worm infestation, a chi-square test was conducted.

Table VII. Worm infestation (in terms of EPG) among various age groups of Sahiwal calves.

Range of age	EPG						Total
	1-400	401-800	801-1200	1201-1600	1601-1800	Negative	
1-3 months	29	17	13	8	3	36	106
4-6 months	11	6	6	2	1	78	104
Total	40	23	19	10	4	114	210
				Chi-square test			
			Value	df	Asymptotic Significance (2-sided)		
Pearson chi-square			35.998	5	0.00000095*		
Likelihood ratio			37.248	5	0.00000053		
Linear by linear association			29.599	1	0.000000053		
N of valid cases			210				
				Analysis of variance			
Age groups			Sum of squares	Degree of freedom	Mean square	F value	P value
Between groups			130.359	1	130.359	34.317	0.00000002*
Within groups			790.122	208	3.799		
Total			920.481	209			

*Significant ($p<0.05$).

Table VIII. Worm infestation in terms of EPG among the female and male Sahiwal calves.

Gender	Farm level	Peri Urban	Rural	Total			
Male	24	23	29	76			
Female	46	47	41	134			
Total	70	70	70	210			
EPG	1-400	401-800	801-1200	1201-1600	1601-1800	Negative	Totals
Male	15	9	5	2	1	44	76
Female	25	14	14	8	3	70	134
Total	40	23	19	10	4	114	210
Chi-square test			Value	Degree of freedom		Asymptotic significance (2-sided)	
Pearson chi-square			2.556	5		0.768*	
Likelihood ratio			2.716	5		0.744	
Linear by linear association			0.075	1		0.785	
N of valid cases			210				

*Significant ($p<0.05$).

The results of the test show that there is no statistically significant difference in the occurrence of worm infestation between male and female calves. Thus, our study suggests that gender does not have a significant effect on the occurrence of worm infestation in calves. These findings imply that both male and female calves have an equal likelihood of being affected by worm infestation, and gender is not a contributing factor in the occurrence of worm infestation in calves.

DISCUSSION

The present study provides evidence to suggest that the type of flooring used for animal rearing may have an impact on worm load in calves. Our findings indicate that mud floors were predominantly used in rural areas (84.28%), whereas concrete floors were constructed for animal rearing at the farm level (82.9%). This discrepancy in the type of flooring may contribute to the increased worm load observed in rural areas, as compared to farm and peri-urban areas. The use of kacha and paved floors may also increase the risk of worm load, as compared to rearing animals on concrete floors, which appear to have a lower risk of worm load. The same is described by Castro *et al*. (2002) and Mohammed *et al*. (1999).

The findings of this study are consistent with previous research on the impact of grazing on worm infestation in animals. Sriasih *et al*. (2021), Nurcahyo *et al*. (2021), Conceicao *et al*. (2021), Kimeli *et al*. (2020), Paharpur (2018), Haftu and Gebrehiwot (2014), and Bilal *et al*. (2009) have reported similar observations, where grazing was found to have a significant impact on worm infestation in animals. Specifically, the current study found that grazing was only offered at the rural level, and animals that grazed had a higher incidence of worm infestation, as measured by EPG, compared to animals reared without grazing. These results suggest that grazing may contribute to the spread and persistence of worm infestation in animals, highlighting the importance of effective worm control strategies in grazing systems.

The present study highlights the importance of deworming practices in animal husbandry, particularly in rural and peri-urban areas. The findings suggest that deworming animals twice a year, as practiced at the farm level, can result in a lower worm intensity in terms of EPG, compared to the once-a-year deworming practices in rural and peri-urban areas. This is consistent with the observations made by Nurcahyo *et al*. (2021), who reported that frequent deworming leads to a reduction in worm load, thus improving the overall health and weight gain of animals.

Furthermore, the study indicates that neonatal calves are at a higher risk of worm infestation compared to older animals, and prevalence in terms of EPG is higher in rural areas than in peri-urban and farm settings. The same is described by Gholve *et al*. (2024) that neonatal calves are more prone to worm infestation which is consistent with previous studies conducted by Chowdhury *et al*. (2017), Paharpur (2018), Regea (2019), Vithyashankar *et al*. (2021), Nurcahyo *et al*. (2021). These studies suggest that the occurrence rate of worms is lower in older animals, higher in young calves, and moderate in adults.

The results of this study are in agreement with previous research studies conducted by Paharpur (2018), Lalrinkima (2016), Shoaib *et al*. (2016), and Raza *et al*. (2013), which reported that worm infection was highest in 1-2 month-old calves and lowest in calves more than 6 months old. These studies provide further evidence that young calves are at higher risk of worm infestation. Moreover, the findings of our study are also consistent with the findings of Sriasih *et al*. (2021), who investigated the occurrence of worms in 3-12 weeks old calves and found that the occurrence rate was lower in older calves than in neonatal ones. This could be attributed to various factors, such as weaker immunity against diseases in calves, the growing dietary needs that compete with existing nutrients for the development of disease resistance, and poor husbandry practices for calf rearing that lead to a high burden of worm load in early life. Overall, the results of our study indicate that age is a significant factor influencing the occurrence rate of worms in different age groups, with higher rates in calves compared to young and adult stock. These findings have important implications for calf rearing practices and disease management programs to reduce the incidence of worm infestation in calves.

Our study also found no significant influence of gender on the occurrence rate of worms in calves, with male and female calves equally susceptible to worm infestation. These results are consistent with Lalrinkima (2016) and Elele *et al*. (2013) and Gholve *et al*. (2024) who reported no influence of gender on the occurrence rate of worms in male and female calves. These studies suggest that both males and females have a similar risk of getting infected by worms. However, the findings of our study differ from those of Obi *et al*. (2020), Raza *et al*. (2013) and Afridi *et al*. (2007) who reported a higher occurrence rate in males and lower in females. Additionally, Vithyashankar *et al*. (2021) and Shoaib *et al*. (2016) found that female animals have a higher chance of worm infestation compared to male animals. Paharpur (2018) also reported that gender had a significant effect on the occurrence rate of worms, with males having a higher occurrence rate than their female counterparts. These discrepancies in findings may be attributed to variations in sample size, geographical

location, and management practices employed in the different studies.

Our study revealed that calves raised in rural areas had a higher prevalence of worm infestation, as measured by EPG, compared to those reared in peri-urban or farm settings. This observation is attributed that the high worm burden in rural areas due to poor management practices, limited access to veterinary care, and inadequate sanitation facilities.

CONCLUSION

The study highlights that worm infestation in Sahiwal calves is significantly influenced by age and management practices (including mud floors, cracks and crevices in walls, dung heaps, grazing, unclean mangers, and water troughs), with younger calves and those raised under rural conditions showing higher levels of infestation. Effective management strategies, such as frequent deworming, improved housing, and better hygiene practices, particularly in peri-urban and farm settings, were associated with lower worm loads. Gender was not found to significantly impact worm prevalence. These findings underscore the need for tailored interventions, particularly in rural areas, to reduce worm infestations and enhance calf health and productivity. By adopting improved management practices, the economic losses due to worm infestations can be mitigated, promoting the overall growth of the dairy industry in Pakistan.

DECLARATIONS

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Ethical statement

Study was approved by Institute of Animal and Dairy Sciences, University of Agriculture Faisalabad Pakistan Institutional research committee. The research was conducted under strict observance of animal rights.

Statement of animal rights

No animals was harmed or injured during research.

Availability of data and materials

The datasets used or analyzed during the current study are available from the corresponding author on request.

Statement of conflict of interest

The author have declared no conflict of interest.

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