THE IMPACT OF FARM SIZE ON VETERINARY HEALTH STRATEGIES AND DISEASE INCIDENCE IN CALVES: A QUANTITATIVE RESEARCH WITHIN THE ROMANIAN CATTLE LIVESTOCK SECTOR

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Abstract

This study investigates the influence of farm size on veterinary health strategies and the incidence of calf diseases in Romanian dairy cattle farms. Based on data collected through a structured questionnaire, the research highlights notable differences in disease prevalence and preventive practices across small, medium and large farms sizes. One of the key findings indicates that navel hygiene practices are consistently applied across all farms, regardless of farm size. In contrast, the incidence of enteritis and respiratory diseases shows a significant association with farm size in dairy cattle. Medium and large-sized farms demonstrated higher variability in enteritis occurrence, while small farms reported a statistically higher incidence of respiratory conditions in calves aged 0–3 months (p=0.013). Preventive practices such as deworming and vaccination were not significantly influenced by farm dimension. Preventive deworming was reported by 60% of farmers, and approximately one-third of the respondents vaccinated calves against major diseases, regardless of farm size.

These findings underscore the importance of adapting health management strategies to the specific needs of each production system, while also suggesting that certain preventive practices may be uniformly adopted across farms, irrespective of their size.

Key words: *farm size, calves health, disease incidence, preventive veterinary practices*

INTRODUCTION

The global cattle industry remains a cornerstone of food production and rural livelihoods. Global milk output rose by 2.2% in 2023, and over 80% of the world's population regularly consumes dairy products [1][2][3]. The sector is rapidly consolidating, with a shift toward larger, more intensive systems [2], raising new challenges for animal health and veterinary management.

In the EU, dairy production shows strong regional contrasts. Western countries rely on larger specialized farms, while smallholder systems dominate in Eastern Europe [4]. Herd sizes average 54 cows in Italy and over 100 in the Netherlands, compared with around five cows in Romania and Bulgaria [4][5]. Such diversity requires veterinary strategies adapted to farm scale.

Romania remains one of the most fragmented dairy sectors in the EU. Around 80% of farms own 1–2 cows, and only 0.3% exceed 50 cows [5]. The herd totals roughly 1.1–1.2 million cows, while farm numbers fell by 40% in a decade (from 655,000 to 389,000) [5][6].

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Farm size strongly affects management, larger farms typically implement structured health programs and routine veterinary checks [7], while smallholders often rely on traditional practices and limited resources [8]. These differences directly influence calf care and disease prevention.

Calf health is a key productivity factor. Pre-weaning mortality is 5–11%, with diarrhea and respiratory infections as leading causes [9]. Early-life disease lowers growth and lifetime milk yield, but preventive measures like colostrum feeding and hygiene can improve survival [9] [10].

In light of this context, this study evaluates how farm size-small (5–25 cows), medium (26–100), and large (>100)-affects veterinary strategies and calf disease incidence in Romanian dairy farms, based on nationwide questionnaire data from 2020–2021.

MATERIAL AND METHODS

A structured questionnaire was administered both online and in physical format, comprising 40 items grouped into five sections: herd characteristics, calving management, housing, unweaned calves feeding, health and veterinary care. The instrument was pre-tested on three pilot farms for clarity and validity. Data collection was conducted via online distribution and direct interviews (face-to-face or telephone), allowing respondents to clarify questions and provide additional observations. Farms with a minimum of five dairy cattle were included, with no upper size limit. A snowball sampling technique facilitated recruitment, and all responses were anonymous, with participants informed in advance about the study objectives, voluntary participation, and confidentiality.

A total of 97 farmers initially completed the questionnaire. After excluding four inconsistent responses and twelve surveys describing beef calf practices, data from 81 farms were retained for analysis. The chi-square test of independence (χ^2) was applied to assess relationships between calf health indicators and farm characteristics, namely herd size (small: 5–25, medium: 26–100, large: >100 for cattle). Statistical decisions were based on a significance threshold of $p<0.05$. Given the categorical nature of the data, the χ^2 test was considered appropriate as a non-parametric method to evaluate associations, while response categories without observations were excluded to ensure validity.

RESULTS AND DISCUSSIONS

Table 1.1 presents data regarding farm size influence on diarrhea and respiratory diseases incidence, in calves aged 0-3 months, according to the results from 81 cattle farms. Concerning the incidence of diarrhea, in small and medium-sized farms, the majority of farms, recorded a value below 5% for this disease. While, in large farms, the highest proportion is ranged 6-15%.

It is worth mentioning that 6.25% of small farms and 3.70% of large farms reported diarrhea incidences of over 36%, which represents a potential source of economic losses, both due to reduced calf growth rates and mortality losses, and especially the costs of veterinary treatments. No statistically significant differences were recorded between small and medium-sized farms and/or small and large farms ($p>0.05$), with significant differences ($p\leq0.05$) being recorded between medium-sized and large farms.

Thus, it can be observed that medium-sized farms (26-100 heads) record the lowest incidence of diarrhea in calves 0-3 months old. This may be due to management and husbandry factors, with farmers who operate a large number of heads (>100 heads) being able to allocate much less time to monitoring the health status of each animal or to check the sensor monitoring systems. Furthermore, raising calves in large groups represents a major risk factor for the transmission of viruses, bacteria and parasites that cause this condition [11].

Table 1.1. Farm size influence on the incidence of diarrhea and respiratory diseases of calves, from dairy cattle farms

Farm size	Diarrhea incidence (%)						Respiratory disease incidence (%)					
	<5 %	6-15 %	15-25 %	25-35 %	36 %	Not applicable	<5 %	5-15 %	15-25 %	25-35 %	36 %	Not applicable
Small farms (n = 32)	40,62	25	12,5	9,37	6,25	6,25	46,87	6,25	6,25	6,25	3,12	31,25
Medium farms (n = 22)	45,45	22,72	31,81	0	0	0	59,09	18,18	4,54	0	0	18,18
Large farms (n = 27)	37,03	40,74	3,70	11,11	3,70	3,70	59,25	18,51	18,51	0	0	3,70
TOTAL	**40,74**	**29,63**	**14,81**	**7,4**	**3,7**	**3,7**	**54,32**	**13,58**	**9,87**	**2.46**	**1,23**	**18,51**
Small vs. medium	NS (0,085)						NS (0,091)					
Medium vs. large	**** (0,034)***						NS (0,120)					
Small vs. large	NS (0,347)						**** (0,013)***					

*NS p>0,05; * p≤0,05; ** p≤0,01; *** p≤0,001.*

Diarrhea in calves 0-3 months of age is considered to be one of the most common conditions (Figure 1), the results obtained in the present study on the incidence of enteritis in calves agreeing with the values reported by [12][13], the main route of contamination of healthy calves being represented by the fecal-oral route. Moreover, rage between 20% and 40% incidence was obtain in the previous studies [13][14], which confirms the results obtained by the author of this study. The major risks in the establishment and onset of enteritis in calves are represented by environmental conditions, such as temperature, humidity and air currents [15], housing conditions [15][16], animal density and calf group size [17], as well as farm hygiene [16].

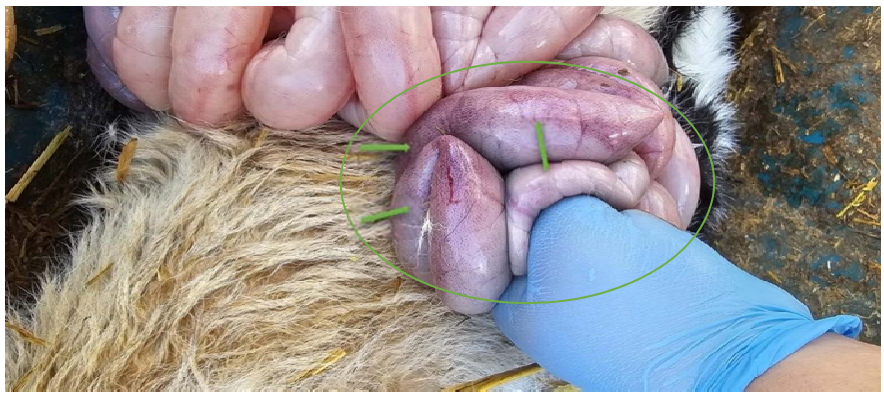

Figure 1. Hemorrhagic jejunal syndrome following enteritis in calves

Neonatal calves are most susceptible to developing enteritis in the first 14 days postpartum [12]. Keeping calves in shelters or cages with clean and dry bedding, with a

good ventilation rate, is the most effective method of preventing the onset of this condition [17].

In Romanian farms, according to the results of the questionnaire, respiratory diseases have an incidence of <5%, with a rate of 46.87% in small farms, 59.09% in medium farms and up to 59.25% in large farms. In small farms 3.12% showed an incidence of over 36% of respiratory diseases, and 31.25% never recorded this condition in calves 0-3 months old. In medium-sized farms, on the other hand, rates between 5-15% were recorded for 18.18%, and in large farms 18.51%. Statistical differences ($p>0.05$) were recorded between small and large farms.

Analyzing the data obtained in Table 1.1 we can observe that medium-sized farms (26>100 heads) have the lowest incidence rates of respiratory diseases in calves 0-3 months old, followed by large farms (>100 heads). This may be due to the veterinary prevention practices adopted in medium-sized farms [18] or due to the fact that farmers recognize diseases differently depending on their training. Another factor influencing the disease transmission between individuals may be the system of collective housing immediately after separation from the dam [19]. Respiratory diseases have multiple causative factors, and this represents a major health-economic concern for cattle farmers [20]. The results obtained in the present study are agreed with current research, similar results also obtained by [21] with a percentage of >10%.

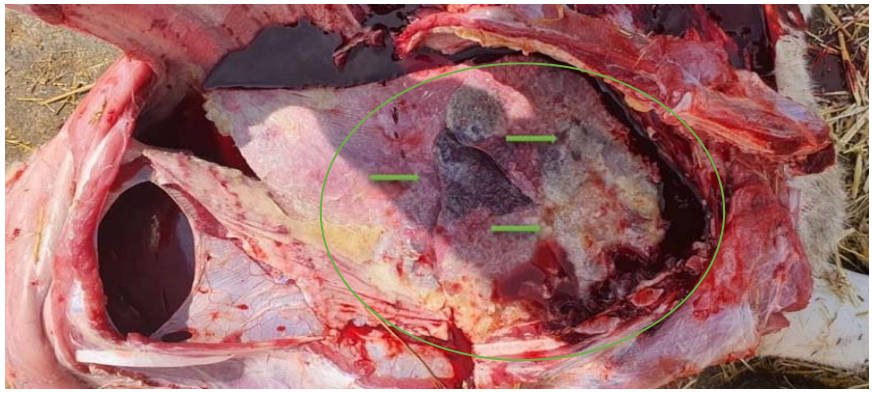

Figure 3. Aspects regarding respiratory diseases in calves, catarrhal bronchopneumonia

According to the results obtained in table 1.2, the incidence of navel diseases in young calves was found in a percentage of less than 5%, small farms having a rate of 56.25%, medium-sized farms 66.63%, and large farms being found in 66.66% of them. On the other hand, more than a third of the studied farms (35.2% small, 31.81% medium, 33.33% large) responded that they did not record navel diseases in calves 0-3 months old. The results are in accordance with the previous studies were the majority of the studies recorded incidences less then 10% [13], with intervals from 0.4% [22] and 6.2% [15].

Farm size shows an insignificant influence on the incidence of navel ill in calves up to weaning age. Among these illnes, the most common are considered to be omphalitis, which occurs mainly in the first week of calf's life [13] and can be influenced by poor hygiene management [23] or bucket feeding with an insufficient amount of milk, which does not satisfy the natural sucking behavior and thus the sucking tic appears between individuals [24].

The results of the present study, show a favorable evolution of hygiene management on farms. Numerous studies conducted over the time, shown that in 23% of calf mortality cases, navel inflammation was the main cause [25], while [26] obtained an incidence of 11%, and [27] a percentage of 14%. This difference may be based on the different adoption and implementation of welfare standards at global and/or European levels [28].

Analyzing the data presented in Table 1.2, we observe that the rickets incidence in calves from the studied farms is below <5%, with a range of 31.25% for small farms, 40.90% in medium-sized farms. A percentage exceeding half of the surveyed large farms (51.85%) shows that they have never had this condition. The results can be associated with the adoption of intensive growth management, given that in the dairy cattle industry, females are used to replace the queen herd [29]. In addition, rickets in calves generates negative effects on body development, decreases immunological capacity and influences productive activity [13]. Furthermore, rickets can be considered a genetic component of the sire which can be transmitted in a low proportion to the descendants [30]. Statistically, no significant differences were found.

Table 1.2 Farm size influence on the incidence of calves navel affections and rickets, from dairy cattle farms

Farm size	***Navel disease incidence (%)***				***Rickets incidence (%)***			
	<5 %	**5-15 %**	**15-25 %**	**Not applicable**	**<5 %**	**5-15 %**	**25-35 %**	**Not applicable**
Small farms (n = 32)	56,25	3,12	6,25	35,2	31,25	3,12	3,12	62,5
Medium farms (n = 22)	63,63	4,54	0	31,81	40,90	4,54	0	54,54
Large farms (n = 27)	66,66	0	0	33,33	51,85	0	0	48,14
TOTAL	**61,72**	**2,46**	**2,46**	**33,33**	**40,74**	**2,46**	**1,23**	**55,55**
Small vs. medium	NS (0,387)				NS (0,452)			
Medium vs. large	NS (0,494)				NS (0,432)			
Mici vs. mari	NS (0,318)				NS (0,255)			

*NS p>0,05; * p≤0,05; ** p≤0,01; *** p≤0,001.*

According to table 1.3, more than 59% of farmers prefer to deworm calves up to 3 months old. Thus, in small farms 59.37% have adopted this prevention/treatment method, in medium-sized farms is practiced in 63.63% of the holdings, and in large farms (>100 heads) deworming is a common practice so that 74.04% of them use this procedure for calves.

On the other hand, calf vaccination as a preventive method is still a nascent practice for farmers in the 81 farms studied, with 34.37% of small farms using this practice, 18.18% of medium farms and 33.33% of large farms. Vaccination is based on the young calf's health preventing and strengthening, involving effective management of rearing technology: colostrum, hygiene etc. [31].

The results obtained on calf deworming show that the interviewed farmers have adopted the tied livestock system, since usually the animals are dewormed 2 weeks before being put out to pasture, and for economic reasons they prefer to deworm calves and adult cows only when necessary. In contrast, the results on calf vaccination draw attention to a more efficient immunization of the farm herd, since the lack of vaccination helps to maintain and

transmit pathogens and the occurrence of the disease in the herd. In the case of deworming and vaccination of 0-3 months calves, we found that the farm size is not a factor that statistically influences the decision to implement these two actions.

Table 1.3 Farm size influence on the calves deworming, vaccination and dehorning practices, in dairy cattle farms

Farm size	*Deworming (%)*		*Vaccination (%)*		*Dehorning (%)*	
	Yes	**No**	**Yes**	**No**	**Yes**	**No**
Small farms (n = 32)	59,37	40,62	34,37	65,62	28,12	71,87
Medium farms (n = 22)	63,63	36,36	18,18	81,81	50	50
Large farms (n = 27)	74,04	25,92	33,33	66,66	74,04	25,92
TOTAL	**65,43**	**34,56**	**29,62**	**70,37**	**49,38**	**50,61**
Small vs. medium	NS (0,458)		NS (0,188)		**** (0,016)***	
Medium vs. large	NS (0,336)		NS (0,211)		**** (0,010)***	
Small vs. large	NS (0,234)		NS (0,469)		****** (0,000)***	

The data presented in Table 1.3 shows that 28.12% of small farms practice calves dehorning, while in medium-sized farms the proportion of those who dehorn is 50%, and in large farms dehorning is common, being 74.04%. These results suggest that farmers are aware of the injuries which can occur on the farm to animals and caretakers [32].

Dehorning is also practiced to reduce space inside the housing, especially to facilitate animal transport [33]. According to previous studies, in the European Union dehorning is a common practice (81%) in dairy farms [34], which results in the data obtained in the present study being in line with current research.

Figure 2. Dermatophytosis symptomatology in dairy calves (trichophytosis or ringworm)

However, in the current study, statistical differences were observed in the farm size influence on 0-3 months old calves dehorning, between small and medium farms ($p \leq 0.05$), medium and large farms ($p \leq 0.05$) and a highly significant difference between small and large farms ($p \leq 0.001$).

Table 1.4 shown our results where 50% of small farms have dehorning implemented at the age of 1-4 weeks; medium farms have a percentage of 37.5% for the same period; while in large farms, 63.15% of them, calves are dehorned at the age of 1-2 months. The results reveal a potential

technology that can be improved in large farms, because this procedure is painful, can affect the calf's welfare, and is recommended to be performed before 3 weeks old [35]. For example, in the Czech Republic legislation requires that for the calves under 4 weeks of age, they can be dehorned by doctors or veterinary technicians, and all those older than this threshold can only be dehorned by veterinarians, however only using analgesic medication [36].

The results obtained are consistent with studies conducted in the Czech Republic, where the average age of dehorning calves is 4-3 weeks [36]. Furthermore, in a study conducted by [37], in medium-sized dairy farms the average age was 32 days, an age included in the range of the current study. No significant differences were recorded ($p>0.05$).

Table 1.4 Farm size influence on the dehorning age of the calves and the method of this procedure, from dairy cattle farms

Farm size	***Dehorning age* (%)**				***Dehorning method* (%)**			
	1st week	**1-4 week**	**1-2 month**	**≥ 2 months**	**Caustic paste**	**Pen**	**Electrocautery**	**Barnes dehorner**
Small farms (n = 32)	25	50	0	25	33,33	33,33	16,66	16,66
Medium farms (n = 22)	12,5	37,5	25	25	0	0	100	0
Large farms (n = 27)	21,05	5,26	63,15	10,52	16,66	5,55	61,11	16,66
TOTAL	**23,33**	**23,33**	**26,66**	**26,66**	**18,75**	**9,37**	**62,5**	**9,37**
Small vs. medium	NS (0,333)				**** (0,012)***			
Medium vs. large	NS (5,412)				NS (0,201)			
Small vs. large	NS (3,020)				***** (0,005)***			

*NS p>0,05; * p≤0,05; ** p≤0,01; *** p≤0,001.*

According to the conducted questionnaire, the most commonly used methods for calves dehorning in small farms are the caustic paste and pencil; both being found in a percentage of 33.33% of respondents; the electrocautery and dehorning pliers being found in a percentage of 16.66%. In medium-sized farms, the highest proportion is held by the electrocautery with a percentage of 100%. On the other hand, in large farms the dehorning technique performed with electrocautery is the most used (61.11%), caustic paste and Barnes dehorner being used equally (16.66%).

It should be noted that the most widespread internationally method for calves dehorning is electrocautery [38]. Studies conducted exclusively on calves dehorning using the electrocautery method obtained values of 90.6% regardless of farm size [37] and 88.7% [39]; results close to those obtained in the present study.

Statistical differences were observed for the method of calves dehorning between small and medium-sized farms ($p\leq0.05$) on the one hand, and between medium and large farms ($p\leq0.01$) on the other hand. These results can be attributed to the fact that in medium-sized farms, the dehorning

method was exclusively based on the use of electrocautery, while small and large farms use several methods such as caustic paste, pencil and Barnes dehorner. Dehorning based on thermal cauterization is a classic method, which involves minimal consequences [40], nevertheless the use of local anesthesia and/or non-steroidal anti-inflammatory medication for postoperative pain management is recommended [41]. It should be emphasized that, in some countries (Denmark), there are specific law that requires dehorning to be performed only by veterinarians and only by using anesthesia before the operation [42].

CONCLUSIONS

Farm size also has statistical significance on the incidence of enteritis and respiratory diseases in 0-3-month-old calves from dairy farms. The incidence of diarrhea, respiratory diseases, is found below 5%. Navel diseases and rickets are not influenced by the small, medium or large size of the dairy farms.

Prevention practices adopted against diseases in 0-3 months old calves, such as deworming and/or vaccination are not influenced by the size of the farm. According to the results, 60% of farmers practice preventive deworming of calves, and a third vaccinate calves preventively against the main diseases;

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