



Research Article

Prevalence and Risk Factors of Umbilical Hernia in Calves in Selected Areas of Bangladesh

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Abstract | The study aimed to ascertain the prevalence and associated risk factors of umbilical hernia in calves in selected upazilas of Bangladesh. Retrospective data were collected from the Livestock Office and Veterinary Hospital of selected upazilas, namely Mymensingh Sadar, Gouripur; Mymensingh, Moheshkhali; Cox's Bazar, and Rangabali; Patuakhali, from April 2022 to August 2023. A total of 239 animals were examined during the study period. The clinical history, hernial ring detection, needle exploration of the navel swelling, and observation of the intestinal contents were used to diagnose an umbilical hernia. Then, the animals were categorized based on several factors that could contribute to umbilical hernia, including age, sex, breed, and season. Initially, bivariable and, finally, multivariable logistic regression were performed to determine the association between various risk factors and umbilical hernia. In comparison to the other three upazilas, the Gouripur Upazila Livestock Office and Veterinary Hospital in Mymensingh accounts for the majority of umbilical hernias (59.4%). The condition was most prevalent in the 1–3-month age group (55.0%), followed by the <1 month age group (48.1%), and was least common in the 3–6 months age group (39.0%). Compared to native calves, crossbred calves had a greater occurrence of umbilical hernia (44.2%). Umbilical hernia occurred most frequently in summer (50.4%), followed by winter (43.1%) and the rainy season (31.3%). According to this study, the incidence of umbilical hernias in calves was significantly influenced ($P<0.05$) by geographic location, age, and season.

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Keywords | Prevalence, Risk factor, Umbilical hernia, Calf, Bivariable, Multivariable



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Introduction

Congenital disorders such as umbilical hernia, atresia ani, and umbilical abscess are most common in calves and have been increasing in

frequency due to management practices and the geographic location of Bangladesh (Rahman *et al.*, 2017), which in turn increases the mortality rate of calves. The protrusion of the contents of a body cavity via a weak area in the body wall is known as

an umbilical hernia (Rahman *et al.*, 2017). This may be a normal anatomical opening that can't perform its physiological function fully because of muscle weakness, or it may be accidental. Congenital hernias may be small at birth and enlarge gradually with age. An umbilical hernia results from improper closure of the umbilicus at birth, which can be caused by developmental abnormality or hypoplasia of the abdominal muscles or by manual breakage or resection of the cord close to the abdominal wall (Turner and McIlwraith, 2013). If the urachus remains open, the organs will protrude out of the aperture because the umbilical opening was not properly closed at birth, forming a ring in the mid-ventral region of the abdomen immediately after birth (Tyagi and Singh, 2010; Sutradhar *et al.*, 2009; Al-Sobayil and Ahmed, 2007). Umbilical infections by bacterial contamination like *Arcanobacterium pyogenes* and *Escherichia coli* (Gilbert and Fubini, 2004) are one of the risk factors for umbilical hernias in calves (Steenholdt and Hernandez, 2004). Due to genetic components (Herrmann *et al.*, 2001), umbilical sepsis (Steenholdt and Hernandez, 2004), cutting off the umbilical cord too close, excess traction of the umbilical cord (Haile *et al.*, 2017), or umbilical remnant (Doijode, 2019), umbilical hernia is higher at an early age in calves.

Different authors identified many risk factors affecting the prevalence of umbilical hernia, such as umbilical infection, season, age, breed, sex, and so on (Haile *et al.*, 2017; Rahman *et al.*, 2017; Salim *et al.*, 2015; Radostits *et al.*, 2007). However, region-specific epidemiological data in Bangladesh that measure its prevalence and investigate multifactorial risk associations are conspicuously lacking. Most of the literature currently in publication concentrates on clinical or surgical case reports, ignoring more general herd-level or management-related factors. Furthermore, no previous research has examined biological and environmental risk factors in multiple geographic zones at the same time. By using a cross-sectional, field-based design and combining clinical confirmation with statistical risk analysis, this study closes that gap and produces reliable, useful data. It is anticipated to make a substantial contribution to the evidence required for developing localized control strategies and directing veterinary extension services in Bangladesh.

Materials and Methods

Study area

The study was conducted in the livestock office and veterinary hospital of four different upazilas in Bangladesh. Veterinary Teaching Hospital, Bangladesh Agricultural University, Mymensingh Sadar; Gouripur Upazila Livestock Office and Veterinary Hospital, Mymensingh; Moheshkhali Upazila Livestock Office and Veterinary Hospital, Cox's Bazar; and Rangabali Upazila Livestock Office and Veterinary Hospital, Patuakhali were included in the study. The study was conducted from April 2022 to August 2023.

Study population

This study includes a total of 239 calves from the four upazilas. Samples were selected by using a convenience-based selection method. Out of 239 calves, about 104 were affected by umbilical hernia. These affected calves were divided according to their age, sex, breed, and season of the year, and the data were obtained from the data sheet recorded by the hospital authority during the study period and directly from the owners. According to age, calves were divided into four groups: less than one month (<1 month), one to three months (1-3 months), three to six months (3-6 months), and more than 6 months (>6 months). There were 60 male and 44 female calves with a body weight of 20-50 kg. Considering the breed, calves were divided into indigenous and crossbred. According to the season of illness, the affected calves were allocated into three groups: summer, rainy, and winter.

Data collection

Data were recorded from the register book of the respective veterinary hospitals about the age, sex, and breed of every calf affected with umbilical hernia. The seasons in which the calves were affected were also recorded. The type of hernia and its surgical management, with post-operative care, were collected. The follow-up information was obtained weekly through direct conversations with the owners over the phone.

Clinical examination of calves

The preliminary diagnosis was made from the history, clinical signs, and palpation of the umbilical region. Needle exploration of the navel swelling was performed to confirm the hernia. Detection of the hernial ring with the index finger and demonstration

of intestinal content also aided diagnosis. In the case of a reducible hernia, the contents could be pushed back into the abdominal cavity, and the hernial ring became evident. On the other hand, in an irreducible hernia, the contents are adhered to the hernial sac.

Statistical analyses

All data were entered in the Microsoft Excel 2010 program spreadsheet. Firstly, the relationship between each dependent variable and umbilical hernia was ascertained using bivariable logistic regression. From this analysis, dependent variables having a P-value of ≤ 0.02 were taken into consideration for multivariable logistic regression analysis. A multivariable logistic regression model was finally built to determine the relationship between the candidate variables and umbilical hernia. The variables in the final model with a P-value of ≤ 0.05 were considered risk factors for umbilical hernia, and the correlations between the candidate variables were assessed during model building. Non-significant variables ($P \geq 0.05$) were removed from the model using a backward selection procedure. All analyses in this study were conducted using SPSS software (Version 22.00).

Results

Effects of different variables on the occurrence of umbilical hernia

Effects of geographical location: The prevalence of umbilical hernia varies with geographical location. Gouripur Upazila of Mymensingh district has the highest prevalence (59.4%; P -value=0.067), followed by Mymensingh Sadar (38.6%; P -value=0.013), Moheshkhali Upazila (33.3%; P -value=0.002), and the lowest prevalence was observed in Rangabali Upazila (26.7%; P -value=0.411), as shown in Figure 1. On the other hand, the rate of other surgical cases was higher in Rangabali Upazila (73.3%).

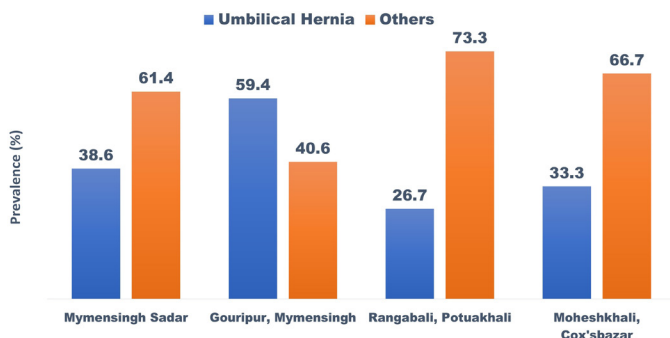


Figure 1: Prevalence of surgical diseases based on geographical location.

Effect of age

Figure 2 presents the prevalence of umbilical hernia based on age. The highest prevalence (55%) was found in the 1-3 months age group ($n=80$; P -value=0.329), while the lowest (39%) was observed in the 3-6 months age group ($n=59$; P -value=0.011). No calf of more than 6 months of age ($n=23$; P -value=0.419) was affected with umbilical hernia in these four upazila. However, other surgical diseases were found in the age group of calves > 6 months of age.

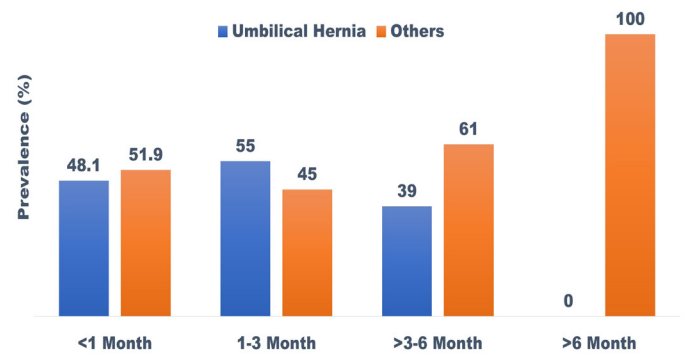


Figure 2: Prevalence of surgical diseases based on age.

Effect of breed

Figure 3 displays the impact of breed on calves' incidence of umbilical hernia. Of the 104 calves that were affected, 43 were native, and 61 were crossbred; their respective prevalences were 42.6% and 44.2%.

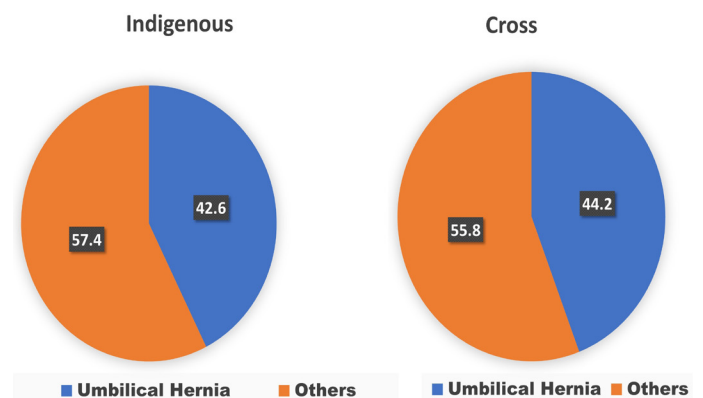


Figure 3: Prevalence of surgical diseases based on breed.

Effect of sex

The differences between male and female calves were negligible. According to Figure 4, the condition was more common in male calves (43.8%) than in female calves (43.1%).

Effect of season

The impact of season on the incidence of umbilical hernia in calves is displayed in Figure 5. Although the disease was found to be present throughout the

year, the summer season had the highest prevalence (50.4%; n=59, P-value=0.045), followed by winter (43.1%; n=25, P-value=0.021) and the rainy season (31.3%; n=20, P-value=0.035).

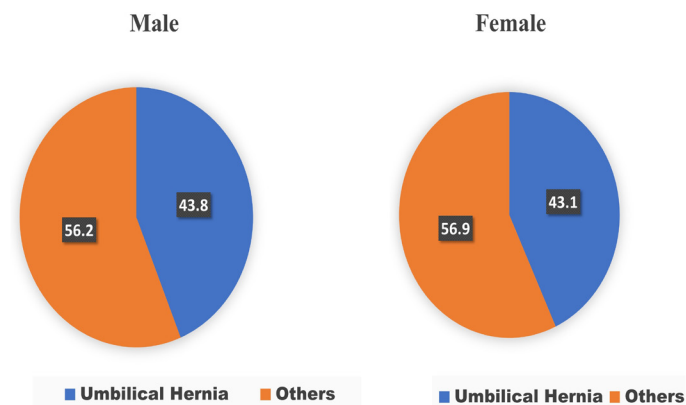


Figure 4: Prevalence of surgical diseases based on sex.

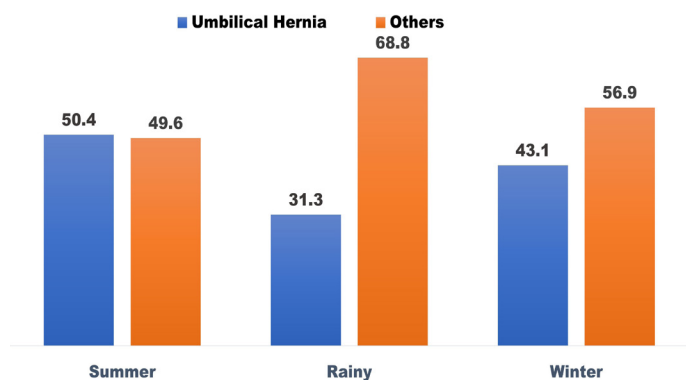


Figure 5: Prevalence of surgical diseases based on season.

Risk factors for the occurrence of umbilical hernia

Bivariable analysis: The bivariate study comprised

eight variables associated with umbilical hernia. Five of them were thought to be potential variables for bivariate analysis (Table 1). Age, sex, breed, season, and geometric position were the risk factors linked to calves' umbilical hernias.

Multivariable analysis

The risk factors for umbilical hernia identified in the final model are presented in Table 2. The most important risk factors identified in the model were geometric location, age, and season. The umbilical hernia was 3.675, 3.313, and 2.087 times higher at Gouripur, Moheshkhali, and Mymensingh Sadar upazila than at Rangabali upazila, Patuakhali. Calves of 3-6 months and 1-3 months of age were 1.759 and 1.330 times more susceptible to umbilical hernia than calves of <1 month of age. The summer and winter seasons were 1.403- and 0.553-times higher risk for umbilical hernia than the rainy season.

Discussion

An umbilical hernia is one of the most common congenital surgical diseases in calves (Mulon and Desrochers, 2005). The prevalence of umbilical hernia varies with geographical area, age, sex, breed (Rahman et al., 2017), and season. In this study, geographical area, age, and season were found to be statistically significant risk factors ($P < 0.05$) for umbilical hernia. However, no statistically significant association was found between umbilical

Table 1: Bivariate analysis of risk factors of umbilical hernia in calves.

Variable		No. of animals affected	OR	95% CI	P value
Area	Rangabali, Patuakhali	4	Ref		
	Mymensingh Sadar	54	1.727		0.370
	Gouripur, Mymensingh	41	4.027		0.028
	Moheshkhali, Cox's Bazar	5	1.375		0.691
Age	< 1 month	37	Ref		
	1-3 month	44	1.448	0.728-2.881	0.292
	3-6 month	23	1.913	0.965-3.791	0.063
Season	Winter	25	Ref		
	Summer	59	1.343	0.713-2.530	0.362
	Rainy	20	0.600	0.286-1.259	0.177
Sex	Female	44	Ref		
	Male	60	1.027	0.612-1.723	0.919
Breed	Indigenous	43	Ref		
	Crossbred	61	1.069	0.636-1.794	0.802

Here, OD, ref, and CI indicate odd ratio, reference, and confidence intervals, respectively.

Table 2: Multivariable model of the risk factors for hernia in calves.

Risk factors		OR	95% CI	P value
Area	Rangabali, Patuakhali	Ref		
	Mymensingh Sadar	2.087	0.607-7.178	0.243
	Gouripur, Mymensingh	3.675	1.021-13.229	0.046
	Moheshkhali, Cox's Bazar	3.313	0.538-20.403	0.197
Age	< 1 month	Ref		
	1-3 month	1.330	0.647-2.737	0.438
	3-6 month	1.759	0.850-3.641	0.128
Season	Rainy	Ref		
	Summer	1.403	0.709-2.776	0.331
	Winter	0.553	0.251-1.222	0.143

Here, OD, ref, and CI indicate odd ratio, reference, and confidence intervals, respectively.

hernia and sex or breed ($P > 0.05$) in our study, which was also corroborated by Haile *et al.* (2017). One significant risk factor for calves' umbilical hernias is age. Hernias typically happen early in life. According to this study, the incidence of umbilical hernias is lowest at 3-6 months of age (39%) and highest at 1-3 months of age (55%). The same results were reported by Salim *et al.* (2015). One of the main reasons for hernias is umbilical infection. Early infancy is when umbilical cord infections develop (Mazakazu, 2005). Chuang *et al.* (2000) reported that umbilical hernias occur below one month. In contrast, Rahman *et al.* (2001) obtained the same results, indicating that they are most common in calves between one and three months.

In the present study, it was found that there were no records of umbilical hernia in individuals above 6 months of age, which is in agreement with Jettennavar *et al.* (2010) and Haile *et al.* (2017).

Another risk factor for calves occurrence of umbilical hernias is sex (Salim *et al.*, 2015). According to Salim *et al.* (2015), male calves open herniorrhaphy outcomes were more challenging than those of female calves because of the proximity of the penis to the umbilicus, which made it more difficult to keep the bandage in place after surgery. Urine contamination may potentially be a contributing factor to problems following surgery. Male navel infections are also more common as a result of constant urine moistening. Umbilical hernias mostly affect male calves because of significant swelling in the umbilical region of the

preputial sheath. A hernial ring may emerge before birth as a result of improper ventral abdominal wall development during the development of such a massive preputial sheath (Rahman *et al.*, 2001). According to this study, male calves are more likely to have an umbilical hernia, consistent with other researchers' findings (Herrmann *et al.*, 2001; Rahman *et al.*, 2001; Fazili and Syed, 2003). Mazakazu (2005), however, disapproved of these results and discovered that females had a higher occurrence. However, Haile *et al.* (2017) found no difference in the incidence of umbilical hernias between male and female calves.

An umbilical hernia occurs almost every season of the year (Salim *et al.*, 2015). However, in our study, we found the highest incidence of umbilical hernia in the summer season. In comparison to Dehoux (1992) and Samad *et al.* (2002), the study demonstrates that umbilical hernias are more common in the summer and that their incidence was higher (50.4%) than in the rainy and winter seasons. In the summer, a variety of native grasses proliferate, and cattle frequently graze or are fed them. The increased calving rate may be explained by feeding these grasses, which raises the nutrient level. Consequently, the rate of calving is raised in the late winter or early summer. This could be one of the reasons why umbilical hernias are more common during the summer (Salim *et al.*, 2015). Moreover, due to environmental stressors and hygienic issues brought on by hot, muggy weather, calves born in the summer may have increased rates of umbilical hernia. High ambient temperatures cause heat stress, which raises cortisol levels and impairs immune function. This delays the healing of umbilical wounds and predisposes calves at risk for omphalitis (Lacetera *et al.*, 2005; Radostits *et al.*, 2007). Increased fly activity during the summer also makes it easier for bacteria to contaminate the umbilical site, and muddy or wet calving conditions during humid or rainy seasons encourage the growth of pathogens even more. The umbilical ring is further weakened by the increased susceptibility of summer-born calves to diarrheal illnesses, which lowers vitality and impairs tissue repair (Fubini and Ducharme, 2016).

This present study was conducted at four upazilas in Bangladesh. This study found that the occurrence of umbilical hernia varies with area. The Umbilical hernia was 3.675, 3.313, and 2.087 times higher at Gouripur, Moheshkhali, and Mymensingh Sadar

upazila than at Rangabali upazila, Patuakhali. Geography in Bangladesh affects the prevalence of umbilical hernias by fostering environmental conditions (wet, muddy, warm) that encourage umbilical contamination and infection; by elevating physiological stressors (heat, humidity) that hinder healing; and by influencing local husbandry, hygiene, and veterinary access (smallholder vs. commercial systems and breed distributions). When combined, these variables raise the risk of umbilical infection as well as the possibility that infection or inadequate healing will lead to herniation.

To better understand spatial risk patterns and guide targeted prevention strategies, it is recommended that future research should specifically investigate the influence of geographical and environmental factors such as climate, topography, seasonal conditions, and local husbandry practices on the prevalence of umbilical hernia in calves.

Conclusions

This study concludes that umbilical hernia mostly occurs at Gouripur Upazila Livestock Office and Veterinary Hospital, Mymensingh, than in the other 3 upazilas. The condition was most prevalent in the 1-3-month age range. The male and crossbred calves are at high risk of umbilical hernia. Umbilical hernia mostly occurs in the summer season rather than the winter season, and least in the rainy season. The associated risk factors for umbilical hernia in calves in the selected upazilas of Bangladesh were geographical area, age, and season.

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Novelty Statement

This study is unique since it is the first to examine environmental and biological risk variables across multiple distinct geographic zones of Bangladesh. This study provides the crucial evidence base required for creating localized control strategies and guiding veterinary extension services by employing a rigor-

ous cross-sectional, field-based design that combines clinical confirmation with statistical risk analysis to produce trustworthy and useful data that was previously unavailable.

Author's Contribution

PP: Performed this experiment, data collection, acquisition, and drafted the manuscript.

RAR: Designed and supervised the study, data analysis, edited, and provided critical evaluation of this manuscript.

SA: Reviewed the manuscript and arrangement of data.

LG: Reviewed and edited the manuscript.

MMA: Provided critical suggestions and reviewed the manuscript.

Generative AI and AI-assisted technology statement

During the preparation of this work the authors used Google Gemini tool in order to write the discussion. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication

Conflict of interest

The authors have declared no conflict of interest.

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