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## Incidence, Risk Factors, Clinical Outcomes, and Complications of Navel Infections in Neonatal Calves in Mirzapur, Tangail

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### Abstract

Omphalitis (navel infection) is an important cause of sickness, poor welfare, and reduced growth in neonatal calves, especially in small- and medium-holder dairy farms, yet field evidence from Bangladesh is limited. This cross-sectional study described incidence patterns, management-related risk factors, and short-term clinical outcomes of omphalitis in Mirzapur upazila, Tangail. We enrolled 49 calves aged  $\leq 2$  months showing navel swelling, hardening on palpation, and/or purulent discharge with heat and pain. Farm- and calf-level information on calving management, colostrum feeding, hygiene, clinical signs, treatment, and outcomes was collected using a structured questionnaire and clinical examination. Most cases occurred in calves 11–30 days old (61.17%), males (67.3%), and crossbreds (87.7%), mainly from small herds and often following summer calving. Management practices were frequently inadequate: difficult/assisted calving was common, umbilical cord cutting was delayed  $> 1$  hour in 46.9%, navel disinfection was rarely practiced (8.2%), 93.9% received  $< 1$  L of colostrum and 95.9% of pens had standing water or manure. All calves had visible navel swelling or pus; 61.2% were febrile, and lameness/joint swelling was common, with many developing joint ill. Recorded complications included umbilical abscess (89.8%), joint involvement (28.6%), umbilical hernia (26.5%), tetanus (16.3%), diarrhoea (18.3%), liver abscess (10.2%), myiasis (6.1%), and pneumonia/febrile disturbances (8.2%). Treatment was mainly surgical and/or antibiotic (penicillin alone or with streptomycin), and no mortality was recorded. In multivariable logistic regression, fever was the only independent predictor of joint ill (adjusted OR 6.18; 95% CI 1.39–27.50;  $p=0.016$ ). Overall, omphalitis in Mirzapur appears strongly linked to modifiable failures in calving hygiene, navel care, and colostrum management, and it often progresses to systemic and joint disease with growth impairment, emphasizing the need for low-cost prevention and urgent treatment of febrile cases.

**Keywords:** Omphalitis, Neonatal calves, Incidence, Risk factors, Clinical outcomes, and Complications.

### 1. Introduction

Omphalitis (navel infections) are among the most common health problems in newborn calves and are

an important cause of early morbidity, welfare impairment, and financial loss in cattle herds. Navel ill occurs shortly after birth when bacteria from the

environment gain entry through the open umbilical cord, before it has dried and sealed (NADIS, 2017; The Cattle Site, 2022). Clinically, affected calves may show a warm, swollen, painful navel, sometimes with purulent discharge, together with fever, depression, reduced suckling and poor growth. In more severe cases, infection extends via the umbilical vessels into the abdomen, or spreads haematogenously, leading to omphalophlebitis, peritonitis, liver abscesses, septic-aemia and arthritis (“joint ill”), all of which can have long-term impacts on productivity and survival (NADIS, 2017; The Cattle Site, 2022; Hasan *et al.*, 2024). Because many of these later problems are not always linked back to an earlier navel infection, the overall impact of omphalitis on herd performance is often under-estimated at farm level.

Recent epidemiological work has shown that umbilical disease is more widespread than farmers’ treatment records suggest. In a large cross-sectional study of German dairy farms, Meier *et al.* (2024) reported that 30.9% of calves between 5 and 21 days of age had omphalitis based on clinical examination, even though only a small proportion had been treated for navel disease according to farm documentation. This discrepancy highlights substantial under-recognition of cases and suggests that many mild or moderate infections remain untreated until complications appear. Similar observations from other regions indicate that navel ill contributes directly and indirectly to calf mortality and hidden economic costs via extra labour, veterinary treatment, reduced average daily gain and increased risk of premature culling.

Omphalitis is widely recognised as a multifactorial disease in which environmental hygiene, calving management, colostrum intake and navel care interact with animal-level factors. Poor hygiene in calving pens and calf housing, wet or heavily contaminated bedding, and prolonged stay of newborn calves in dirty maternity areas all increase exposure of the fresh umbilical stump to environmental bacteria. Inadequate colostrum management, particularly delayed feeding or insufficient volume, compromises passive transfer of immunity and increases susceptibility to omphalitis and other neonatal diseases. Immediate and consistent disinfection of the navel stump with an effective antiseptic (such as iodine or chlorhexidine-based UniversePG | [www.universepg.com](http://www.universepg.com)

products) is therefore considered a key preventive measure; farms that do not use navel disinfectants, or apply them irregularly, tend to have a higher prevalence of umbilical infections (Meier *et al.*, 2024; NADIS, 2017). Other reported risk factors include dystocia, assisted or prolonged calving, and contamination of the umbilical cord with manure, low birth weight and poor body condition of the dam at calving.

In Bangladesh and other South Asian countries, calf health is strongly influenced by smallholder production systems, informal housing structures and variable access to veterinary services. Most of the available data on navel disease come from hospital-based studies of surgical affections rather than systematic field surveys. Das, (2022), working in three upazilas of Bagerhat district, reported that navel ill (often complicated with myiasis) was one of the most frequent surgical conditions in newborn calves, and they associated these problems with poor peri-partum hygiene and lack of immediate navel antiseptics. Similarly, a study on surgical affections in calves at Dhunot and Bogura Sadar upazilas found that omphalitis, abscess and fracture were the three major acquired surgical conditions, again emphasizing the importance of basic husbandry and early intervention (Zaman *et al.*, 2020). These hospital-based data suggest that umbilical infections are common and clinically important in Bangladeshi calves, but they do not provide true incidence estimates at farm level or a detailed picture of management-related risk factors.

There is also a lack of information on how navel infections actually present and progress under field conditions in Bangladesh. Important questions remain about the typical clinical signs seen in village and smallholder herds, how frequently omphalitis leads to complications such as joint ill, what types of treatments (if any) are provided by farmers, paravets and veterinarians, and what short-term outcomes can be expected for affected calves. Without such context-specific data, it is difficult to design targeted extension messages or practical, low-cost control strategies that fit the realities of local farming systems.

Mirzapur upazila in Tangail district is an important cattle-rearing area where both smallholder and semi-intensive production systems coexist, yet no published

work has systematically documented Omphalitis (navel infections) its complication in neonatal calves in this setting. The incidence of omphalitis, the relative contribution of calf, dam- and management-related risk factors, and the pattern of clinical outcomes remain largely unknown. Addressing these gaps is essential to support evidence-based recommendations for improving umbilical health, calf welfare and farm profitability in Mirzapur and similar areas of Bangladesh.

The present study was therefore designed to (i) estimate the incidence of Omphalitis (navel infections) in neonatal calves in Mirzapur, Tangail, (ii) identify calf, dam and management related risk factors associated with the occurrence of omphalitis, and (iii) describe the clinical characteristics, complications including joint ill and others, treatment practices and short-term outcomes of affected calves under field conditions.

## 2. Materials and Methods

This cross-sectional study was carried out in Mirzapur upazila, Tangail, on dairy and mixed livestock farms. We identified farms and screened calves up to 2 months of age that had navel swelling or discharge. Calves were diagnosed with omphalitis if they had visible navel swelling and/or pus plus heat and pain on touch, with or without extension along the umbilical cord. In total, 49 such calves were enrolled. With swelling of navel area, discharge pus, painful joints swelling is a calf already diagnosed with omphalitis.

For each case, data were collected during a single farm visit using a structured, pre-tested questionnaire and a clinical examination sheet. Information was recorded on: (i) calf and farm details (age, sex, breed, calving season, farm type, herd size, dam parity); (ii) calving, colostrum and housing practices (place and type of calving, difficult calving, umbilical cord cutting time and method, navel disinfection, timing and amount of colostrum, calf cleaning, bedding, standing water or manure in the pen); and (iii) clinical signs, treatment-seeking and outcomes (fever, lameness/joint swelling, weakness, loss of appetite, extension of swelling, joint ill, pneumonia, diarrhoea, umbilical abscess, growth pattern and death). Where possible, farmers also reported the total number of calves born during the

study period to help estimate the incidence of clinically diagnosed omphalitis.

All data were entered into a spreadsheet, checked for errors and analysed in IBM SPSS Statistics v27. Descriptive statistics were used to summarise farm, management and clinical features. To identify risk factors for joint ill and others complications among omphalitis cases, chi-square tests were first run between joint ill (yes/no) and selected clinical signs (fever, lameness/joint swelling, weakness, loss of appetite, extension of swelling). Variables with  $p < 0.20$  or strong biological relevance were then included in a multivariable binary logistic regression model with joint ill as the outcome. Adjusted odds ratios with 95% confidence intervals and p-values were reported, and  $p < 0.05$  was considered statistically significant. Informed consent was obtained from all farmers, and owners were advised or referred for appropriate treatment of affected calves.

## 3. Results

**Table 1** summarizes the background characteristics of 49 neonatal calves diagnosed with omphalitis and their farms in Mirzapur, Tangail. Most cases were observed in calves aged 11–30 days (61.17%), with fewer in the 1–10 day (16.32%) and 31–60 day (22.42%) groups. Male calves were more commonly affected (67.3%) than females (32.7%). The majority were crossbred (87.7%), and most cases occurred during the summer season (69.4%). Most affected calves came from dairy farms (87.8%), typically with small herd sizes of 1–3 cows (61.2%). Regarding parity, first calving was most frequent (30.60%), followed by second (24.48%) and third (20.40%) calvings.

**Table 2** shows those calving practices, colostrum management, and housing conditions among 49 neonatal calves with omphalitis in Mirzapur, Tangail. Most calves were born in a stall/barn (61.2%), and over half of calving's were assisted by farmers (53.1%); difficult calving was also common (59.2%). In most cases, a farmer attended the calving (71.4%), but umbilical cord care was generally poor: cord cutting was delayed beyond 1 hour in 46.9% of calves, and the cord was most often left to break naturally (65.3%). Post-birth navel disinfection was rarely practiced (8.2%).

**Table 1:** Characteristics of farms and neonatal calves with omphalitis in Mirzapur, Tangail (n = 49).

Variable	Category	n	%
Age group	1–10 days	8	16.32
	11–30 days	30	61.17
	31–60 days	11	22.42
Gender	Male	33	67.3
	Female	16	32.7
Breed	Indigenous	6	12.3
	Crossbred	43	87.7
	Summer	34	69.4
Calving season	Monsoon	8	16.3
	Winter	7	14.3
	Dairy	43	87.8
Farm type	Mixed livestock	6	12.2
	1–3	30	61.2
	4–6	16	32.7
Number of cows	≥7	3	6.1
	1	15	30.60
	2	12	24.48
	3	10	20.40
	4	8	16.31
	5	4	8.16

Colostrum was usually given within 1–6 hours (83.7%), yet almost all calves received an inadequate amount in the first 24 hours (<1 litter, 93.9%), even though all calves suckled the dam (100%). Hygiene and housing conditions were mostly unfavourable,

with cleaning typically done every 2–3 days (81.6%), bedding either straw or none (each 44.9%), and standing water/manure present in nearly all pens (95.9%).

**Table 2:** Calving, colostrum management and housing characteristics of neonatal calves with omphalitis in Mirzapur, Tangail (n = 49).

Variable	Category	n	%
Place of calving	Open field	19	38.8
	Stall/barn	30	61.2
Type of calving	Natural	23	46.9
	Assisted by farmer	26	53.1
Difficult calving	Yes	29	59.2
	No	20	40.8
Person attending calving	Farmer	35	71.4
	No one	14	28.6
	Immediately (<5 min)	4	8.2
Time to umbilical cord cutting	Within 30 min	22	44.9
	More than 1 hour	23	46.9
	Clean knife/scissors	6	12.2
Method of cord cutting	New blade	6	12.2
	Old blade	5	10.2
Navel disinfected after birth	Natural break	32	65.3
	Yes	4	8.2
	No	45	91.8
Time of first colostrum	Within 1 hour	7	14.3
	1–6 hours	41	83.7
	More than 6 hours	1	2

Adequate colostrum in first 24 h	Small amount (<1 liter)	46	93.9
	Medium amount (1–2 liters)	3	6.1
Calf suckled dam	Yes	49	100
	Every day	6	12.2
How calf was cleaned	Every 2–3 days	40	81.6
	Weekly	3	6.1
	Straw	22	44.9
Bedding type	Sawdust	1	2
	Sand	4	8.2
	None	22	44.9
Standing water/manure in pen	Yes	47	95.9
	No	2	4.1

**Table 3:** Clinical signs, complications, treatment and outcomes of omphalitis cases (n = 49).

Variable	Category	n	%
Visible swelling/pus at navel	Yes	49	100
	Yes	11	22.4
Extension of swelling	No	38	77.6
	Yes	30	61.2
Fever	No	19	38.8
	Yes	14	28.6
Lameness / joint swelling	No	35	71.3
	Yes	41	83.6
Weakness	No	8	16.4
	Yes	46	93.9
Loss of appetite	No	3	6.1
	Yes	49	100
Vet consulted	Yes	20	40.8
	No	29	59.2
Para vet involved	Yes	12	24.5
	No	37	75.5
Home remedy used	Yes	49	100
	Yes	49	100
No treatment	Yes	14	28.6
	No	35	71.3
Calf cured	Yes	4	8.2
	No	45	91.8
Joint ill	Yes	9	18.3
	No	40	81.7
Pneumonia	Reduced	43	87.8
	Not growing	6	12.2
Diarrhoea	Yes	0	0.0
	No	49	100
Weight gain pattern	Yes	3	6.1
	No	46	93.9
Death due to infection	Yes	5	10.2
	No	44	89.8
Myiasis	Yes	44	89.8
	No	5	10.2
Open wound	Yes	13	26.5
	No	36	73.5
Umbilical abscesses	Yes	5	10.2
	No	44	89.8
Umbilical Hernia	Yes	5	10.2
	No	44	89.8
Liver abscess	Yes	8	16.3
	No	47	83.7
Tetanus	Yes	8	16.3
	No	47	83.7

**Table 3** summarizes the clinical presentation, complications, and outcomes among 49 omphalitis cases. All calves showed visible swelling and/or pus at the navel (100%), and about one-fifth had swelling extending beyond the navel region (22.4%). Systemic signs were common, including weakness (83.6%), loss of appetite (93.9%), and fever (61.2%). Some calves also showed a sign consistent with joint involvement, as lameness or joint swelling was reported in 28.6%.

Veterinary consultation occurred in all cases (100%), though para-veterinarians were involved in 40.8% and home remedies were used in 24.5%. Several complications were recorded, particularly umbilical abscesses (89.8%) and umbilical hernia (26.5%), with additional problems such as diarrhoea (18.3%), tetanus (16.3%), liver abscess (10.2%), pneumonia (8.2%), myiasis (6.1%), and open wounds (10.2%). Growth was negatively affected in most calves, with reduced weight gain in 87.8% and no growth in 12.2%. No deaths due to infection were reported (0%).

**Table 4:** Bivariate (Chi-square) analysis of risk factors associated with joint ill among omphalitis cases (n = 49).

Risk factor	Category	Joint ill Yes n (%)	Joint ill No n (%)	$\chi^2$	p-value
Fever	Yes	19 (82.6)	11 (42.3)	9.43	<b>0.002</b>
	No	4 (17.4)	15 (57.7)		
Lameness / joint swelling	Yes	22 (95.7)	20 (76.9)	3.98	<b>0.046</b>
	No	1 (4.3)	6 (23.1)		
Weakness	Yes	20 (87.0)	18 (69.2)	2.53	0.11
	No	3 (13.0)	8 (30.8)		
Loss of appetite	Yes	22 (95.7)	24 (92.3)	0.06	0.8
	No	1 (4.3)	2 (7.7)		
Extension of navel swelling	Yes	10 (43.5)	5 (19.2)	3.13	0.077
	No	13 (56.5)	21 (80.8)		

**Table 4** shows that fever and lameness/joint swelling were significantly associated with joint ill among omphalitis cases. Calves with fever were much more likely to develop joint ill (82.6%) than those without fever (17.4%;  $p = 0.002$ ). Similarly, calves showing lameness or joint swelling had a higher proportion of joint ill (95.7%) compared to those without lameness (4.3%;  $p = 0.046$ ). Extension of navel swelling and

weakness tended to be more common in calves with joint ill (43.5% vs 19.2% and 87.0% vs 69.2%, respectively), but these associations did not reach statistical significance ( $p = 0.077$  and  $p = 0.11$ ). Loss of appetite was very frequent in both groups and showed no meaningful association with joint ill ( $p = 0.80$ ).

**Table 5:** Multivariable logistic regression analysis of risk factors associated with joint ill (n = 49).

Predictor	Adjusted OR	95% CI	p-value
<b>Fever (Yes)</b>	6.18	1.39 – 27.50	0.016**
Lameness / joint swelling (Yes)	4.34	0.75 – 25.20	0.098
Extension of swelling (Yes)	2.88	0.87 – 9.50	0.082
Weakness (Yes)	2.2	0.55 – 8.86	0.264
Liver abscess (Yes)	6.7	1.28-8.37	0.084
Pneumonia (Yes)	1.89	1.05-6.52	0.168
Diarrhoea (Yes)	3.26	2.70-5.223	0.095
Weight gain pattern (Reduce growth)	2.64	0.87-4.90	0.061

**Table 5** presents the multivariable logistic regression results for factors associated with joint ill among 49 omphalitis cases. After adjustment for other variables, fever was the only predictor that showed a statistically significant association with joint ill (Adjusted OR =

6.18; 95% CI: 1.39–27.50;  $p = 0.016$ ), indicating calves with fever had substantially higher odds of developing joint ill. Other factors such as lameness/joint swelling, extension of swelling, reduced weight gain, and diarrhoea showed elevated

odds ratios but were not statistically significant ( $p > 0.05$ ), suggesting weaker or uncertain evidence of independent association in this sample.

#### 4. Discussion

The present study provides field-based evidence that navel infections (omphalitis) are a significant health problem in neonatal calves in Mirzapur, Tangail, and that they are closely linked with basic, modifiable management practices around birth and early life. The findings support the view that omphalitis is rarely a localised condition; rather, it frequently progresses to systemic illness, joint involvement and growth retardation, as described in previous reports from other production systems (NADIS, 2017; The Cattle Site, 2022; Hussen *et al.*, 2023).

A key observation is that most affected calves were 1–2 months old, rather than in the first weeks of life. This suggests that either infections develop gradually and are recognised late, or that early, mild omphalitis is missed until complications such as lameness and poor growth become obvious. Similar under-recognition has been described in large dairy herds, where clinical surveys find far more umbilical lesions than farm records indicate (Meier *et al.*, 2024). The predominance of crossbred, male calves from small dairy farms likely reflects both the structure of the local cattle population and possible differences in management attention between calves of different sex and production value. The concentration of cases in summer is consistent with the role of heat and humidity in maintaining wet, contaminated environments that favour bacterial proliferation around the umbilical stump.

Management data from this study strongly support the multifactorial model of omphalitis, in which environmental hygiene, calving management, colostrum intake and navel care interact to influence risk. Difficult and assisted calvings were common, cord cutting was frequently delayed or left to occur naturally, and navel disinfection was almost never performed. At the same time, housing conditions were poor: most pens had standing water or manure, bedding was inadequate or absent, and calves were cleaned infrequently. Colostrum management was also suboptimal, with most calves receiving only small

volumes in the first 24 hours. These findings mirror earlier hospital-based Bangladeshi studies that linked navel ill and related surgical problems to poor peripartum hygiene and lack of immediate navel antiseptics (Das *et al.*, 2022; Zaman *et al.*, 2020), but extend them by documenting the situation under farm conditions in a defined area. Together, they indicate that simple changes in calving hygiene, umbilical care and colostrum feeding could substantially reduce the burden of disease.

Clinically, the study confirms that omphalitis in Mirzapur is often severe. All cases had visible navel swelling or pus, and most showed fever, weakness, loss of appetite, lameness, Liver abscess, Myiasis and Hernia. More than half developed joint ill, and many had concurrent diarrhoea or, less frequently, pneumonia. Although the recorded mortality was relatively nil almost all calves experienced reduced or absent growth during the illness. This pattern agrees with previous descriptions that, beyond acute deaths, the main impact of umbilical infections is through chronic lameness, pain, poor weight gain and early culling (NADIS, 2017; The Cattle Site, 2022). From a production perspective, these “hidden” losses are particularly important for smallholders who depend on each calf for future milk or draught power.

The analytical results highlight fever as a key clinical predictor of joint ill among calves with omphalitis. In the multivariable logistic regression model, fever was the only variable that remained significantly associated with joint ill, with febrile calves having approximately six-fold higher odds of joint disease than non-febrile calves. This is biologically plausible: fever signals systemic inflammatory response and probable bacteraemia, which are prerequisites for bacteria to spread from the umbilicus to distant joints. Lameness/joint swelling and extension of navel swelling also showed elevated odds ratios but did not reach statistical significance after adjustment, likely due to the small sample size and overlap between these signs and the outcome definition. Weakness, while common, did not independently predict joint ill once other variables were considered, suggesting it is a non-specific marker of systemic illness.

These findings have clear clinical and extension implications. First, omphalitis with fever should be treated as a high-risk condition that warrants prompt, aggressive systemic therapy and close follow-up, rather than being regarded as a minor local infection. Second, the high frequency of poor hygiene, delayed cord care and inadequate colostrum intake among affected calves indicates where extension messages and training for farmers, paravets and local veterinarians should focus. Practical recommendations emerging from this study include: ensuring clean, dry calving areas; cutting the umbilical cord promptly with a clean instrument; dipping or spraying the navel with an effective antiseptic immediately after birth; providing early and adequate colostrum; and improving drainage and bedding to minimise standing water and manure in pens. These interventions are relatively low-cost and feasible in smallholder systems if awareness and motivation can be improved.

Despite these constraints, this work provides rare, context-specific evidence on omphalitis in Bangladeshi calves at the farm level and identifies clear, actionable targets for prevention and clinical management. Future research should include larger, longitudinal studies with appropriate control calves to estimate incidence more precisely, model risk factors more robustly and formally evaluate the impact of improved hygiene, navel care and colostrum programmes. For now, the results strongly support integrating umbilical health into routine calf health programmes in Mirzapur and similar smallholder systems, with particular emphasis on early detection and intensive treatment of febrile cases to prevent joint ill and long-term productivity losses.

### Limitations

The study has some limitations that must be acknowledged. The design was cross-sectional and included only clinically recognised omphalitis cases; no healthy control group was enrolled, which limits the ability to quantify population-level risk and to test management factors as causal predictors of omphalitis itself. The sample size ( $n = 49$ ) was modest, resulting in wide confidence intervals and limited power to detect associations in multivariable analysis. In addition, several management variables were based on farmer recall, which may be affected by memory bias, UniversePG | [www.universepg.com](http://www.universepg.com)

particularly for timing and volumes of colostrum. Finally, the study was confined to a single upazila and may not capture variation in management and disease patterns across other regions of Bangladesh.

### 5. Conclusion

This study shows that navel (omphalitis) infections in Mirzapur, Tangail are closely linked to simple, preventable management failures around birth and early calf care. Most affected calves were crossbred males from small dairy farms, often born to first-calving dams and during the summer, and raised in wet, dirty environments with delayed cord cutting, almost no navel disinfection, and inadequate colostrum intake. Clinically, omphalitis was rarely a “local” problem: fever, weakness, loss of appetite and lameness were very common, and more than half of the calves developed joint ill, with clear negative effects on growth even when they survived. The analytical findings underline fever as a crucial warning sign, with febrile omphalitis calves having markedly higher odds of joint ill. This highlights the need for early recognition and aggressive treatment of systemically ill calves, rather than waiting for lameness and chronic joint changes to appear. Taken together, the results point to clear, low-cost priorities for control in smallholder and dairy systems: clean and dry calving areas, timely umbilical cord cutting with clean instruments, routine navel antiseptics, and early, adequate colostrum feeding. If these basic measures are consistently applied, the burden of navel infections, joint ill, poor growth and hidden economic loss in Bangladeshi calves could be substantially reduced. Future studies with larger sample sizes and healthy comparison groups are needed to quantify the benefits of specific interventions, but the present work already offers a practical roadmap for veterinarians, paravets and farmers in Mirzapur and similar settings.

### 6. Author Contributions

S.H.: and M.S.R.; conceived and designed the study, organized the data, performed the data analysis, and drafted and revised the manuscript. S.H.: and F.I.; contributed to the study design, data organization, and manuscript preparation. M.S.R.; S.P.; and F.I.; coordinated field activities and conducted data collection. S.A.; supported data organization and data analysis. All authors read and approved the final

manuscript and take responsibility for the integrity of the work, ensuring that any questions related to accuracy are properly investigated and resolved.

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### 8. Conflicts of interest

Authors confirm that they have no conflicts of interest related to this work.

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