

ORIGINAL ARTICLE

Prognostic factors and outcome of neonatal tetanus.Atiya Anwar¹, Murtaza Ali Gowa², Hira Nawaz³, Nimra Fatima⁴, Afshan Asif⁵**Article Citation:** Anwar A, Gowa MA, Nawaz H, Fatima N, Asif A. Prognostic factors and outcome of neonatal tetanus. Professional Med J 2025; 32(12):1687-1694. <https://doi.org/10.29309/TPMJ/2025.32.12.9960>

ABSTRACT... Objective: To determine prognostic factors and outcome of neonatal tetanus (NT). **Study Design:** Analytical, Cross-sectional study. **Setting:** Neonatal Intensive Care Unit (NICU) of the National Institute of Child Health, Karachi, Pakistan. **Period:** January 2024 to March 2025. **Methods:** A total of 154 neonates (gestational age > 34 weeks) admitted to the NICU due to NT for more than 24 hours were studied. Outcomes in terms of discharged or mortality were assessed. Data were analyzed using IBM-SPSS version 26.0. For all inferential statistics computed by applying chi-square test, fisher's exact test or independent sample t-test (as appropriate), $p < 0.05$ was considered as statistically significant. **Results:** Of 113 neonates with tetanus, 18 (15.9%) were discharged while 95 (84.1%) died. Survivors had a higher mean age at presentation (12.11 ± 1.91 vs. 8.54 ± 3.08 days, $p < 0.001$), and longer incubation period (10.20 ± 2.18 vs. 4.38 ± 2.69 days, $p < 0.001$). Severe disease ($p < 0.001$), lack of maternal immunization ($p = 0.009$), and use of a blade for cord cutting ($p = 0.006$), were associated with higher mortality. Mechanical ventilation was required in all non-survivors (100% vs. 77.8%, $p < 0.001$). Survivors had a longer total hospital stay (18.94 ± 5.48 vs. 15.08 ± 4.75 days, $p = 0.003$). **Conclusion:** Neonatal tetanus remains a devastating disease in the Pakistani context, with a persistently high case fatality. Early age at presentation, short incubation period, severe clinical disease, non-immunized mothers, unsafe delivery practices, and use of unsterilized tools for cord cutting are the dominant prognostic factors for mortality.

Key words: Immunization, Mechanical Ventilation, Mortality, Neonatal Intensive Care Unit, Neonate, Tetanus.

INTRODUCTION

Neonatal tetanus (NT), a bacterial infection that occurs due to the involvement of *Clostridium tetani*, is an immensely fateful but a preventable disease that causes significant morbidity and mortality in developing countries.¹ Non-sterile methods of separating the umbilical cord or treating the umbilical cord stump with non-sterile conventional means are the most common causes of NT, which results in umbilical cord contamination with the spores of *Clostridium tetani*.^{2,3} Literature reports high variability in mortality rates, between 17.4% and 62.9%, among NT cases.⁴⁻⁶

NT is associated with prenatal, natal, and postnatal risk factors, such as inadequate antenatal care, lack of maternal immunization with tetanus toxoid (TT), and unhygienic methods of delivery and cord care.^{7,8} Important risk factors that lead the newborn to acquire tetanus during the first 28 days of life include the use of ghee, surma, or

mustard oil on the umbilical cord; home deliveries handled by untrained birth attendants; and a lack of mother education.^{9,10} While continuous progress is being made towards reduction in the incidence of tetanus cases, recent data has shown that many countries have still not reached the maternal and neonatal tetanus elimination (MNTE) status.¹¹

Tetanus affects both unimmunized and partially immunized individuals in a sporadic way, along with those who are fully inoculated but without receiving booster shots.¹² Therefore, it is crucial that all age groups complete the universal primary vaccination, with timely booster shots at the right times to maintain appropriate antitoxin levels. The established predictors of tetanus fatality comprise the short incubation period (less than 7 days), short onset time (less than 3 days), autonomic dysfunction, and cephalic tetanus.¹³

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The literature reports a wide range of mortality rates for NT, indicating a need for more precise and context-specific data to understand the factors contributing to these variations. While several risk factors have been identified, there is a need for comprehensive studies that evaluate the relative importance and interplay of these factors, such as the exact impact of specific antenatal, natal, and postnatal practices on neonatal tetanus outcomes. There is limited data on how regional practices, healthcare infrastructure, and socioeconomic factors influence the incidence and outcomes of NT, highlighting the need for multicenter studies that consider these variables. Therefore, the current study was planned with the objective of determining prognostic factors and the outcome of NT. The provision of updated, region-specific data on prognostic factors and outcomes, through assessing the effectiveness of current prevention and treatment strategies and exploring new potential predictors of morbidity and mortality in NT, would not only fill some of these gaps but also help to achieve improved disease outcomes.

METHODS

This cross-sectional study commenced at the Neonatal Intensive Care Unit (NICU) of the National Institute of Child Health, Karachi, Pakistan, from January 2024 to May 2025. Prior approval from the institutional ethical review committee was obtained (IERB-20/2024). A sample size of 113 was calculated considering the anticipated mortality rate of 75.0% in NT¹⁴, with a 95% confidence level, and 8% margin of error. The inclusion criteria were neonates of any gender with ages ranging between 3 and 28 days who were admitted to the NICU due to NT. Only those who had a stay in the NICU of more than 24 hours and had a gestational age of more than 34 weeks were considered for this study. The exclusion criteria were neonates with hypoxic ischemic encephalopathy, meningitis, or metabolic acidosis. Neonates with congenital heart disease or congenital malformations were also excluded from the study. Neonates who left against medical advice were also excluded. NT was labeled on the basis of clinical assessments as a neonate who had a normal ability to suck and

cry during the first two days of life and between 3 and 28 days of age could not suck normally and became stiff or had spasms (i.e., jerking of the muscles). A non-probability consecutive sample technique was used for sample selection. Parents/guardians were briefed about the objective and safety of the study before obtaining informed and written consent from them.

Once the patients were enrolled, demographic information like gender, age, gestational age, area of residence (urban or rural), mode of delivery, birth weight (as per medical record), birth order, incubation period, duration of NICU stay, need for mechanical ventilation, and duration of hospitalization were noted. The incubation period was defined as the time between the start of infection and the occurrence of the first symptom, usually trismus (lockjaw). Tetanus severity was classified as per Ablett Classification. Maternal history regarding immunization (2 doses of tetanus toxoid during pregnancy), delivery place (home or hospital), the type of tool used for cutting the cord (knife, scissors, or blade), and application on the cord after cutting was also recorded. All neonates were treated as per standard protocols for the management of tetanus. The treatment comprised antibiotic (i.e., penicillin or metronidazole) administration, wound care, human tetanus immune globulins (500 units I/M stat), and active immunization (tetanus toxoid injection at the time of admission). Diazepam, chlorpromazine, and magnesium sulfate were given for the control of spasm. Mechanical ventilation was instituted when required as per institutional criteria. On discharge, a repeated dose of tetanus toxoid was given to the patients. Outcomes in terms of prognostic factors and disease outcome (discharged or death) were assessed. Data collection was done using a preformed standard proforma.

The statistical analysis was performed using “IBM-SPSS Statistics” version 26.0. The qualitative variables were presented as frequencies and percentages. For the quantitative variables, means and standard deviations (SD) were computed. Data were stratified for neonatal, maternal and hospitalization factors with respect

to outcomes. Post-stratification chi-square test or Fisher's exact test were applied to compare categorical variables, or independent sample t-test for continuous variables, taking $p < 0.05$ as statistically significant.

RESULTS

In a total of 113 neonates, there were 61 (54.0%) male, and 52 (46.0%) female neonates. The mean age was 9.11 ± 3.20 days, ranging between 3-16 days. The mean birth weight was 2.73 ± 0.48 kg, ranging 1.8-3.6 kg. Of the 113 neonates diagnosed with neonatal tetanus, 18 (15.9%) were discharged, while 95 (84.1%) succumbed to the disease. The majority of the neonates were male, accounting for 61 (54.0%) of the total, with 11 (61.1%) males in the discharged group and 50 (52.6%) in the mortality group. The mean age at presentation was significantly higher among survivors (12.11 ± 1.91 days) compared to those who died (8.54 ± 3.08 days, $p < 0.001$). Birth weight was similar between the groups, with a mean of 2.72 ± 0.54 kg in discharged neonates and 2.73 ± 0.47 kg in those who died ($p = 0.933$). No significant difference was observed in birth order or gestational age. The mean incubation period was significantly longer in discharged neonates (10.20 ± 2.18 days) than in those who died (4.38 ± 2.69 days, $p < 0.001$). Regarding disease severity, mild tetanus was observed in 7 (38.9%) of the discharged group versus 13 (13.7%) in the mortality group, while severe cases comprised 57 (60.0%) of those who died and none in the discharged group ($p < 0.001$). All discharged neonates were born to unbooked mothers, compared to 82 (86.3%) in the mortality group, although this difference was not statistically significant. Vaginal delivery was the predominant mode of delivery, reported in 109 (96.5%) neonates overall, including all discharged cases. Home deliveries were more frequent in survivors (12/18, 66.7%) compared to those who died (43/95, 45.3%). Maternal immunization status was significantly associated with outcome, as 8 (44.4%) mothers of discharged neonates had received primary immunization, compared to 16 (16.8%) in the mortality group ($p = 0.009$). Use of a blade for cord cutting was reported in 66 (69.5%) neonates who died compared to 7

(38.9%) among survivors ($p = 0.006$). Table-I is showing association of neonatal and maternal characteristics with final outcome.

Mechanical ventilation was required in 109 (96.5%) neonates overall, with all 95 (100%) non-survivors requiring ventilation, compared to 14 (77.8%) in the discharged group ($p < 0.001$). The mean duration of mechanical ventilation was 14.48 ± 4.50 days, being slightly lower among discharged neonates (13.07 ± 4.25 days) compared to those who died (14.71 ± 4.53 days, $p = 0.220$). The mean NICU stay was similar between groups (16.44 ± 5.50 days for discharged, 15.08 ± 4.75 days for mortality group, $p = 0.280$). The total duration of hospitalization was significantly longer among survivors (18.94 ± 5.48 days) than non-survivors (15.08 ± 4.75 days, $p = 0.003$), and the details are shown in Table-II.

DISCUSSION

This study highlights the ongoing burden and severity of neonatal tetanus with an observed mortality of 84.1%. This exceptionally high case fatality aligns with the grim prognosis reported in the literature in low-resource contexts. Ahmed et al.¹⁴, in a recent retrospective review, reported a case fatality rate of 75%, while Davies-Adetugbo et al.¹⁵, described a mortality of 57.5% among 174 cases. The case fatality observed in the present cohort thus underscores the persistently severe prognosis in Pakistan, reflecting ongoing gaps in preventive public health measures, delayed presentation, and limited critical care resources. The persistent high mortality rate despite the availability of standard supportive care protocols highlights the limits of hospital-based interventions in altering the natural course of severe neonatal tetanus. The findings emphasize that preventive strategies, particularly maternal immunization, safe delivery practices, and community health education, are essential for meaningful reduction in morbidity and mortality. Interventions targeting cultural practices such as application of ghee or surma and unsafe cord cutting must be scaled up, with community engagement to ensure behavioral change.

Neonatal and Maternal Characteristics		Discharged (n=18)	Mortality (n=95)	P-Value
Gender	Male	11 (61.1%)	50 (52.6%)	0.508
	Female	7 (38.9%)	45 (47.4%)	
Age (days)		12.11±1.91	8.54±3.08	<0.001
Birth weight (kg)		2.72±0.54	2.73±0.47	0.933
Birth order		3.17±1.47	2.85±1.62	0.445
Incubation period (days)		10.20±2.18	4.38±2.69	<0.001
Tetanus severity	Mild	7 (38.9%)	13 (13.7%)	<0.001
	Moderate	11 (61.1%)	25 (26.3%)	
	Severe	-	57 (60.0%)	
Maternal age (years)		24.83±5.67	25.66±4.52	0.495
Gestational age (weeks)		37.56±1.04	37.67±0.93	0.628
Antenatal booking	Booked	-	13 (13.7%)	0.095
	Unbooked	18 (100%)	82 (86.3%)	
Mode of delivery	Cesarean section	-	2 (2.1%)	0.675
	Vaginal delivery	18 (100%)	91 (95.8%)	
	Instrumental delivery	-	2 (2.1%)	
Delivery place	Home	12 (66.7%)	43 (45.3%)	0.074
	Hospital	3 (16.7%)	9 (9.5%)	
	Local clinic	3 (16.7%)	43 (45.3%)	
Maternal immunization status	None	10 (55.6%)	79 (83.2%)	0.009
	Primary	8 (44.4%)	16 (16.8%)	
Cord cutting tool	Blade	7 (38.9%)	66 (69.5%)	0.006
	Knife	11 (61.1%)	23 (24.2%)	
	Scissor	-	6 (6.3%)	

Table-I. Association of neonatal and maternal characteristics with outcomes of neonatal tetanus (N=113)

Variables		Discharged (n=18)	Mortality (n=95)	P-Value
Need for mechanical ventilation	Yes	14 (77.8%)	95 (100%)	<0.001
	No	4 (22.2%)	-	
Duration of mechanical ventilation (days)		13.07±4.25	14.71±4.53	0.220
Duration of Neonatal intensive care unit stay (days)		16.44±5.50	15.08±4.75	0.280
Duration of total hospitalization stay (days)		18.94±5.48	15.08±4.75	0.003

Table-II. Association of final outcome with mechanical ventilation requirement, and hospital stay variables (N=113)

A key prognostic factor identified was the age at presentation. Survivors presented significantly later compared to non-survivors (12.11±1.91 days vs. 8.54±3.08 days, $p<0.001$). This observation echoes the findings of Lambo and Anokye.⁹, who demonstrated that an age at onset of symptoms ≤ 6 days greatly increased the risk of mortality, and Lam et al.¹⁶, who found younger age to be independently associated with poor outcomes. Early presentation likely reflects a more fulminant disease course, with rapid progression

to respiratory failure and autonomic dysfunction, overwhelming the compensatory mechanisms of the neonate.¹⁷ Early onset of symptoms has been described as a proxy for heavy bacterial load or profound maternal immunization deficits, leading to more severe intoxication.¹⁸

Birth weight did not differ significantly between discharged and deceased neonates in the present study, with mean values of 2.72±0.54 kg and 2.73±0.47 kg, respectively. This result

diverges from the findings of Lambo and Anokye.⁹, and Davies-Adetugbo et al.¹⁵, where low birth weight was a strong independent predictor of mortality. The lack of association in the current study may relate to a relatively narrow range of birth weights among the enrolled neonates, as those with extreme prematurity or low gestational age were excluded. Uniformity in the cohort's nutritional status may have minimized detectable differences.

The study highlighted a significant relationship between the length of the incubation period and outcome. Survivors had a longer mean incubation period than non-survivors (10.20 ± 2.18 days vs. 4.38 ± 2.69 days, $p < 0.001$), reflects the findings from both Davies-Adetugbo et al.¹⁵, and Kosam et al.⁵, who observed that a short incubation period signals a more severe disease with higher toxin burden. The period of onset has long been recognized as a critical prognostic factor, as a rapid progression from exposure to symptoms indicates poor maternal antibody transfer and high bacterial virulence. Interventions that lengthen the incubation period, through improved maternal immunization and sterile cord care, could therefore significantly impact outcomes. Disease severity was highly predictive of mortality as severe tetanus was observed in 60.0% of those who died, with none among the discharged neonates. Gudeloglu and Demirel.⁶, in their study similarly documented contractures and the requirement for ventilator support as indicators of poor prognosis, reinforcing the relevance of clinical severity scoring systems in risk stratification and guiding intensive management.

The present study also emphasized the persistent influence of maternal and perinatal factors on neonatal tetanus outcomes. Maternal immunization was significantly protective, with 44.4% of mothers in the survivor group having received primary tetanus toxoid immunization compared to only 16.8% among non-survivors. This pattern is corroborated by Zafar et al.¹⁹, who observed that up to 95% of mothers of affected neonates were non-immunized. Rashid et al.²⁰, and Kosam et al., also confirmed that non-immunization remains a dominant risk

factor, as maternal antibodies are critical for neonatal protection until active immunization can be instituted. Antenatal immunization is not only a cornerstone for the elimination of neonatal tetanus, but also a readily addressable intervention that could reduce mortality by 94% as estimated by some researchers.^{21,22}

Home deliveries accounted for a greater proportion of survivors (66.7%) than non-survivors (45.3%) in this cohort, but this difference was not statistically significant. Previous studies, including those by Zafar et al.¹⁹, and Davies-Adetugbo et al.¹⁵, have consistently demonstrated that home births increase the risk of neonatal tetanus and adverse outcomes, largely due to non-sterile delivery conditions and lack of skilled birth attendants. In the present study, nearly all neonates were delivered vaginally, reflecting cultural and systemic healthcare preferences. The proportion of home births may not have shown significant impact on survival in this context because the vast majority of deliveries occurred outside health facilities, diluting the discriminatory power of this variable.

Another critical risk factor was the tool used for umbilical cord cutting. Use of blades was significantly more frequent among non-survivors than survivors (69.5% vs. 38.9%, $p = 0.006$). This aligns with the experience of Zafar et al.¹⁹, and Rashid et al.²⁰, where unsterilized tools (blade, kitchen knife, scissors) were implicated in a large majority of neonatal tetanus cases, emphasizing the urgent need for educational campaigns and provision of safe delivery kits, especially in rural communities. The application of potentially harmful substances such as ghee or surma to the umbilical stump, as documented by Zafar et al.¹⁹, further exacerbates the risk of infection and calls for culturally sensitive interventions to change these practices. The clinical management of neonatal tetanus in the present study adhered to standard protocols, with antibiotics, immune globulin, sedation, and mechanical ventilation provided as required. The near-universal requirement for mechanical ventilation (96.5% overall) highlights the severity of illness among admitted neonates. The association between

need for ventilation and mortality (100% of non-survivors versus 77.8% of survivors, $p < 0.001$) is consistent with findings from Gudeloglu and Demirel,⁶ who demonstrated that ventilator support is an independent predictor of mortality. In settings where ventilatory resources are limited, this reinforces the need for preventive strategies, as resource allocation for critical care alone is unlikely to shift overall mortality significantly. The mean duration of mechanical ventilation was not statistically different between groups, suggesting that once respiratory support is required, the course of illness is protracted regardless of ultimate outcome. Duration of NICU stay also did not differ significantly, though survivors had a longer mean hospital stay (18.94 ± 5.48 days versus 15.08 ± 4.75 days, $p = 0.003$), likely reflecting prolonged recovery among those who survived the acute phase. This finding mirrors Lam et al.¹⁶, who found that a combined endpoint of death or prolonged hospital stay was associated with younger age and lower birth weight. The present study found that all discharged neonates were born to unbooked mothers, a factor that may reflect barriers in healthcare access, limited health literacy, or reluctance to seek antenatal care. Rashid et al.²⁰, noted a similar pattern, associating lack of antenatal visits with poor outcomes. The solution to this challenge lies in strengthening community-based antenatal care and deploying trained birth attendants, particularly in rural and underprivileged regions.

Clinical implications of the present findings are profound. The identification of age at onset, incubation period, disease severity, maternal immunization status, and delivery practices as key prognostic factors provides a road-map for targeted preventive interventions. Antenatal care programs must prioritize tetanus toxoid immunization and include education on sterile delivery and cord care practices. Early recognition of symptoms and prompt referral to tertiary care can also influence outcomes, as delays in presentation remain a common feature among non-survivors. Health policymakers and program implementers must address barriers to antenatal care and skilled birth attendance, particularly in rural and marginalized populations.

The study is not without limitations. Being a single-center study, the findings may not be generalizable to all regions of Pakistan or other countries with differing healthcare infrastructures. The sample size, while larger than some previously published cohorts, remains relatively small, which may limit the power to detect associations with less common risk factors. The cross-sectional design precludes assessment of long-term neurological outcomes among survivors, which is an important consideration for resource allocation and parental counseling. Future studies should employ multicenter designs with larger sample sizes to validate the identified prognostic factors and should include follow-up to assess long-term sequelae. Qualitative research exploring barriers to antenatal care, immunization, and skilled delivery could inform the design of culturally appropriate interventions.

CONCLUSION

Neonatal tetanus remains a devastating disease in the Pakistani context, with a persistently high case fatality despite adherence to standard management protocols. Early age at presentation, short incubation period, severe clinical disease, non-immunized mothers, unsafe delivery practices, and use of unsterilized tools for cord cutting are the dominant prognostic factors for mortality. An overall public health response including incorporating universal maternal immunization, health education, promotion of hygienic delivery practices, and enhanced access to antenatal and skilled birth services, is required to handle the menace of neonatal tetanus.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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AUTHORSHIP AND CONTRIBUTION DECLARATION

1	Atiya Anwar: Data collection, final approval.
2	Murtaza Ali Gowa: Conception design, critical revision.
3	Hira Nawaz: Methodology.
4	Nimra Fatima: Literature review.
5	Afshan Asif: Design.