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Original Research Article

Gaps in Early Physiotherapy Referral for High-Risk Neonates Discharged from Rural NICUs: An Observational Study

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Abstract:

Background: High-risk neonates require timely physiotherapy referral to support early identification and management of developmental impairments. However, gaps in referral and access to rehabilitation services remain a concern, particularly in rural healthcare settings. This study assessed early physiotherapy referral patterns and associated barriers among high-risk neonates discharged from rural NICUs.

Materials and Methods: This prospective observational study included 167 high-risk neonates discharged from participating rural NICUs. Sociodemographic, perinatal, and clinical information was collected using a structured proforma. Physiotherapy referral status, post-discharge service utilisation, and barriers to timely referral were assessed. Statistical analysis included chi-square testing and multivariable logistic regression.

Results: Physiotherapy referral was documented before discharge in 60 neonates (35.9%), while 75 (44.9%) had no referral within 28 days. Physiotherapy consultation was not received by 90 neonates (53.9%). Inadequate discharge counselling (56.9%), lack of caregiver awareness (54.5%), and absence of routine referral protocols (49.1%) were the leading barriers. Missed referrals were significantly associated with rural residence (p=0.018) and maternal education up to primary level (p=0.006). Multivariable analysis identified inadequate discharge counselling (adjusted OR=3.12; p=0.003), absence of routine referral protocols (adjusted OR=2.91; p=0.006), and lack of caregiver awareness (adjusted OR=2.67; p=0.008) as significant predictors.

Conclusion: Substantial gaps existed in early physiotherapy referral and service utilisation among high-risk neonates. Standardised referral protocols, improved discharge counselling, and structured follow-up were essential to strengthen early rehabilitation services.

Keywords: High-risk neonates, Physiotherapy referral, Rural NICU, Early intervention, Neonatal rehabilitation, Referral barriers.

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Introduction

High-risk neonates are vulnerable to neurodevelopmental complications that may adversely affect neurological development, motor function, and long-term functional outcomes. Prematurity, low birth weight, hypoxic-ischaemic encephalopathy, neonatal seizures, severe infections, and respiratory complications are important risk factors for developmental impairment. Therefore, structured developmental surveillance and timely rehabilitation are essential for early identification of motor abnormalities and prevention of further functional limitations.

Physiotherapy plays an important role in neonatal rehabilitation through developmental assessment, appropriate positioning, facilitation of motor activities, caregiver education, and guidance on handling techniques. Early intervention programmes aim to promote neuromotor development and improve functional outcomes, particularly among preterm infants and neonates with neurological complications. Recent evidence supports early developmental interventions and family-centred approaches in infants at increased risk of adverse neurodevelopmental outcomes [1,2].

However, continuity of rehabilitation following NICU discharge remains a major challenge. Effective coordination among neonatologists, physiotherapists, paediatricians, and caregivers is necessary to ensure timely developmental assessment and intervention. Disruptions during this transition may result in delayed referrals and missed opportunities for early rehabilitation. Recent

evidence highlights the importance of therapist-supported interventions extending from the NICU to the home environment, particularly in infants at risk of cerebral palsy and other developmental disabilities [3,4].

In resource-limited settings, utilisation of neonatal rehabilitation services is influenced by factors such as inadequate referral pathways, limited availability of trained professionals, poor caregiver awareness, financial constraints, and geographical barriers. These challenges may be more pronounced in rural areas, where specialised physiotherapy and coordinated follow-up services are often difficult to access. Indian evidence highlights the need to strengthen post-discharge neonatal follow-up, while recent research emphasises parental involvement in developmental support for very preterm infants [5,6].

Despite the established importance of early intervention, gaps in physiotherapy referral and continuity of rehabilitation after NICU discharge remain insufficiently explored, particularly in rural healthcare settings. Identifying missed referrals and associated clinical, socioeconomic, and healthcare-related barriers is essential to improve service utilisation. Therefore, the present study aimed to assess gaps in early physiotherapy referral among high-risk neonates discharged from rural NICUs, evaluate post-discharge utilisation of physiotherapy services, and identify factors associated with missed referrals and delayed rehabilitation.

Materials and Methods

Study Design and Study Setting: The study was designed as a hospital-based, prospective observational study that assessed the gaps in early physiotherapy referral among high-risk neonates discharged from rural NICUs in Maharashtra. The study evaluated the proportion of high-risk neonates who received physiotherapy referrals before hospital discharge, the proportion who accessed physiotherapy services after discharge, and the clinical and socioeconomic factors associated with delayed or missed referrals.

Sample Size Calculation: The sample size was calculated using the standard formula for estimating a single population proportion in an observational study: $n = (Z^2 \times p \times q) / d^2$. In the absence of a sufficiently comparable published estimate for the proportion of high-risk neonates who missed early physiotherapy referral, an expected proportion of 50% was selected as a conservative assumption. The standard prevalence-estimation approach was supported by published methodological literature [7]. Therefore, the minimum required sample size was 167 neonates.

Study Population: The study population comprised high-risk neonates who were admitted to the participating rural NICUs and subsequently discharged after receiving neonatal intensive care.

Inclusion Criteria: The study included neonates who fulfilled one or more of the following criteria

1. Preterm birth with gestational age less than 37 completed weeks.
2. Low birth weight below 2500 g, particularly very low birth weight below 1500 g.
3. History of moderate or severe hypoxic-ischaemic encephalopathy.
4. Neonatal seizures or documented neurological abnormalities.
5. History of neonatal meningitis or severe neonatal sepsis.
6. Requirement for prolonged mechanical ventilation or significant respiratory support.
7. Documented abnormal neurological examination or suspected neuromotor impairment at discharge.
8. Other neonatal conditions that warranted developmental surveillance or early rehabilitation intervention, as determined by the treating neonatologist.

Exclusion Criteria: The following neonates were excluded-

1. Neonates with major congenital anomalies that independently required specialised surgical or rehabilitation pathways.
2. Neonates with confirmed genetic or chromosomal syndromes associated with established developmental abnormalities.
3. Neonates transferred to another hospital before discharge from the participating NICU.
4. Neonates whose parents or primary caregivers declined participation.
5. Cases with insufficient medical documentation to establish eligibility or referral status.

Sampling Technique: A consecutive sampling technique was employed. All eligible neonates discharged from the participating NICUs during the study period were considered for inclusion until the required sample size was achieved.

Data Collection Procedure: Data were collected using a structured, predesigned data collection proforma. Information was obtained from NICU admission records, discharge summaries, clinical examination findings, referral documentation, and interviews with parents or primary caregivers. The following parameters were recorded: Sociodemographic characteristics, Perinatal and neonatal characteristics, Physiotherapy referral-related characteristics.

Assessment of Physiotherapy Referral Status: The primary outcome was the proportion of eligible high-risk neonates who did not receive a documented physiotherapy referral before

discharge. Referral status was categorised into three groups:

1. Timely referral: Physiotherapy referral was documented before NICU discharge.
2. Delayed referral: Physiotherapy referral was initiated after discharge but within 28 days.
3. Missed referral: No physiotherapy referral was documented or initiated within 28 days following discharge.

The actual timing of the first physiotherapy consultation was also recorded separately to distinguish referral documentation from service utilisation.

Assessment of Factors Associated with Referral Gaps: Potential barriers to early physiotherapy referral were assessed through caregiver interviews and review of hospital documentation. These included:

- Lack of awareness regarding neonatal physiotherapy.
- Absence of routine physiotherapy screening protocols in NICUs.
- Inadequate communication between neonatologists and physiotherapists.
- Financial constraints affecting access to rehabilitation services.
- Long travel distances to physiotherapy centres.
- Non-availability of trained neonatal physiotherapists.
- Inadequate discharge counselling.
- Lack of transportation facilities.
- Family-related or cultural barriers affecting healthcare-seeking behaviour.

Multiple barriers were recorded whenever applicable.

Study Outcomes: The primary outcome was the proportion of high-risk neonates who did not receive a documented physiotherapy referral before NICU discharge. The secondary outcomes included:

1. Proportion of neonates who received physiotherapy consultation during NICU admission.
2. Proportion of neonates who accessed physiotherapy services within 28 days after discharge.
3. Distribution of referral gaps according to neonatal risk factors.
4. Association between sociodemographic characteristics and missed physiotherapy referrals.
5. Identification of major healthcare-related and family-related barriers to early physiotherapy referral.

Statistical Analysis: Data were analysed using SPSS version 26.0. Categorical variables were presented as frequencies and percentages, while continuous variables were expressed as mean ± SD or median (IQR), as appropriate. Associations were assessed using the chi-square or Fisher's exact test for categorical variables and the independent-sample t-test or Mann–Whitney U test for continuous variables. Binary logistic regression was performed to identify independent predictors of missed physiotherapy referrals. Results were reported as odds ratios (ORs) with 95% confidence intervals (CIs). A p-value of less than 0.05 was considered statistically significant.

Results

A total of 167 high-risk neonates were included in the study. The largest proportion of neonates was discharged between 8–14 days of age (34.7%), followed by 15–21 days (26.9%). Males constituted 56.9% of the study population, while females accounted for 43.1%. Most neonates belonged to rural areas (73.1%), and 52.7% of mothers had received education up to the primary level. Prematurity was the most frequently observed neonatal risk factor (78.4%), followed by respiratory complications (45.5%), neonatal sepsis (34.7%), birth asphyxia/HIE (25.1%), and neonatal seizures (17.4%) (Table 1).

Physiotherapy referral was documented before hospital discharge in 60 neonates (35.9%), whereas 32 (19.2%) received referrals within 28 days following discharge. No referral was initiated within 28 days in 75 neonates (44.9%). Physiotherapy consultation during NICU admission was received by 39 neonates (23.4%), while 54 (32.3%) accessed physiotherapy services within 28 days after discharge. A further 23 neonates (13.8%) received their first consultation after 28 days, whereas 90 (53.9%) did not receive any physiotherapy consultation. Parental counselling was documented in 72 cases (43.1%), while it was not documented in 95 cases (56.9%) (Table 2).

Inadequate discharge counselling was the most frequently reported barrier to early physiotherapy referral, affecting 95 neonates (56.9%). Lack of caregiver awareness was reported in 91 cases (54.5%), followed by the absence of a routine referral protocol in 82 cases (49.1%). Financial constraints and long distances to rehabilitation facilities were identified in 32.9% and 29.3% of cases, respectively. Other reported barriers included the lack of physiotherapy consultation in NICUs (28.7%), non-availability of trained physiotherapists (25.7%), transportation difficulties (22.8%), and family-related barriers (15.6%) (Table 3).

Missed physiotherapy referral before discharge was observed in 107 neonates (64.1%). A significantly higher proportion of missed referrals was observed among neonates from rural areas compared with

semi-urban areas (69.7% versus 48.9%, p=0.018). Similarly, missed referrals were more frequent among neonates whose mothers had received education up to the primary level than among those whose mothers had attained secondary education or above (75.0% versus 51.9%, p=0.006). No statistically significant association was observed between missed referral and gestational age (p=0.412). Among the neonatal risk factors, birth asphyxia/HIE, neonatal seizures, neonatal sepsis, and respiratory complications were not significantly associated with missed referrals (p>0.05) (Table 4).

Multivariable logistic regression analysis demonstrated that inadequate discharge counselling was associated with the highest odds of missed physiotherapy referral (adjusted OR=3.12, 95% CI: 1.48–6.59; p=0.003). Absence of a routine referral protocol (adjusted OR=2.91, 95% CI: 1.36–6.21; p=0.006) and lack of caregiver awareness (adjusted OR=2.67, 95% CI: 1.29–5.54; p=0.008) were also significant predictors. Rural residence (adjusted OR=2.14, 95% CI: 1.02–4.49; p=0.043) and maternal education up to the primary level (adjusted OR=2.38, 95% CI: 1.19–4.76; p=0.014) were independently associated with missed referrals. Preterm birth, birth asphyxia/HIE, neonatal seizures, neonatal sepsis, respiratory complications, financial constraints, and long distance to rehabilitation facilities did not demonstrate statistically significant associations (p>0.05) (Table 5).

Table 1: Sociodemographic and Clinical Characteristics of the Study Population (n = 167)

Variables	Frequency (n)	Percentage (%)
Age at discharge		
≤7 days	31	18.6
8–14 days	58	34.7
15–21 days	45	26.9
>21 days	33	19.8
Sex		
Male	95	56.9
Female	72	43.1
Place of residence		
Rural	122	73.1
Semi-urban	45	26.9
Maternal education		
Up to primary education	88	52.7
Secondary education and above	79	47.3
Gestational age		
14 days	86	51.5
Neonatal risk factors*		
Prematurity	131	78.4
Birth asphyxia/HIE	42	25.1
Neonatal seizures	29	17.4
Neonatal sepsis	58	34.7
Respiratory complications	76	45.5

Table 2: Physiotherapy Referral Status and Post-discharge Service Utilisation (n = 167)

Referral-related parameters	Frequency (n)	Percentage (%)
Physiotherapy referral status		
Referral documented before discharge	60	35.9
Referral initiated after discharge (within 28 days)	32	19.2
No referral within 28 days	75	44.9
Physiotherapy service utilisation		
Consultation during NICU admission	39	23.4
First consultation within 28 days after discharge	54	32.3
First consultation after 28 days	23	13.8
No physiotherapy consultation	90	53.9
Parental counselling		
Counselling documented	72	43.1
Counselling not documented	95	56.9

Table 3: Barriers to Early Physiotherapy Referral and Service Utilisation (n = 167)

Identified barriers	Frequency (n)	Percentage (%)
Inadequate discharge counselling	95	56.9
Lack of caregiver awareness	91	54.5
Absence of routine referral protocol	82	49.1
Financial constraints	55	32.9
Long distance to rehabilitation facility	49	29.3
Lack of physiotherapy consultation in NICU	48	28.7
Non-availability of trained physiotherapists	43	25.7
Transportation difficulties	38	22.8
Family-related barriers	26	15.6

Table 4: Association of Sociodemographic and Neonatal Characteristics with Missed Physiotherapy Referral Before Discharge (n = 167)

Variables	Total (n)	Missed referral n (%)	Referral received n (%)	p-value
Place of residence				
Rural	122	85 (69.7)	37 (30.3)	0.018
Semi-urban	45	22 (48.9)	23 (51.1)	
Maternal education				
Up to primary education	88	66 (75.0)	22 (25.0)	0.006
Secondary education and above	79	41 (51.9)	38 (48.1)	
Gestational age				
Preterm	131	86 (65.6)	45 (34.4)	0.412
Term	36	21 (58.3)	15 (41.7)	
Neonatal risk factors				
Prematurity	131	86 (65.6)	45 (34.4)	0.412
Birth asphyxia/HIE present	42	32 (76.2)	10 (23.8)	0.084
Neonatal seizures present	29	22 (75.9)	7 (24.1)	0.181
Neonatal sepsis present	58	40 (69.0)	18 (31.0)	0.389
Respiratory complications present	76	53 (69.7)	23 (30.3)	0.195
Overall	167	107 (64.1)	60 (35.9)	

Table 5: Multivariable Logistic Regression Analysis of Factors Associated with Missed Physiotherapy Referral Before NICU Discharge (n = 167)

Variables	Adjusted OR	95% CI	p-value
Rural residence	2.14	1.02–4.49	0.043
Maternal education up to primary level	2.38	1.19–4.76	0.014
Preterm birth	1.42	0.62–3.25	0.407
Birth asphyxia/HIE	1.76	0.76–4.09	0.188
Neonatal seizures	1.53	0.59–3.98	0.382
Neonatal sepsis	1.28	0.61–2.68	0.512
Respiratory complications	1.61	0.79–3.29	0.190
Inadequate discharge counselling	3.12	1.48–6.59	0.003
Lack of caregiver awareness	2.67	1.29–5.54	0.008
Absence of routine referral protocol	2.91	1.36–6.21	0.006
Financial constraints	1.84	0.86–3.94	0.116
Long distance to rehabilitation facility	1.73	0.79–3.78	0.169

Discussion

The present study assessed gaps in early physiotherapy referral among 167 high-risk neonates discharged from rural NICUs. Only 35.9% received documented physiotherapy referrals before discharge, while 44.9% had no referral within 28 days and 53.9% had not accessed physiotherapy services. These findings indicated substantial gaps in the transition from neonatal intensive care to rehabilitation, despite the presence of recognised developmental risk factors.

Prematurity was the predominant neonatal risk factor (78.4%), followed by respiratory complications (45.5%) and neonatal sepsis (34.7%). However, only 23.4% received physiotherapy consultation during NICU admission, suggesting inadequate integration of rehabilitation into neonatal care. Smith et al. emphasised multidisciplinary discharge planning, family preparation, and

coordination with community healthcare providers to ensure continuity of care [8]. These findings support incorporating physiotherapy assessment and referral into routine neonatal discharge procedures.

The major barriers identified were inadequate discharge counselling (56.9%), lack of caregiver awareness (54.5%), and absence of routine referral protocols (49.1%). These findings suggested contributions from both institutional and caregiver-related factors. Similarly, Patil et al. demonstrated that structured counselling, telephone reminders, standard operating procedures, and integration with district early intervention services increased first-visit follow-up attendance from 38% to 100% among NICU graduates [9]. This highlights the potential benefits of standardised referral pathways and caregiver education.

Rural residence was significantly associated with missed referrals, with higher proportions observed among rural than semi-urban neonates (69.7% versus 48.9%; p=0.018). Geographical barriers and limited rehabilitation facilities might explain this difference. Lakshmanan et al. reported that maternal education and distance from follow-up clinics influenced participation in high-risk infant follow-up programmes. They also demonstrated that initial follow-up attendance was strongly associated with subsequent visits [10]. These findings emphasise the importance of accessibility and early engagement in maintaining continuity of neonatal care.

Maternal education also showed a significant association with missed referral. Neonates whose mothers had primary-level education had higher missed referral rates than those whose mothers had secondary education or above (75.0% versus 51.9%; p=0.006). Limited awareness regarding developmental risks and early rehabilitation might have influenced healthcare-seeking behaviour. Harris et al. identified transportation difficulties, caregiver educational needs, and inadequate coordination between healthcare services as important barriers to post-discharge care among infants with bronchopulmonary dysplasia [11]. This supports providing clear and culturally appropriate discharge counselling irrespective of maternal educational background.

Interestingly, neonatal risk factors were not significantly associated with missed physiotherapy referrals. Although higher missed referral proportions were observed among neonates with birth asphyxia/HIE (76.2%), seizures (75.9%), and respiratory complications (69.7%), these differences were statistically insignificant. This suggests that healthcare delivery and accessibility may have a greater influence on referral continuity than individual neonatal diagnoses. Arwehed et al. reported variations in discharge procedures, delayed communication, limited parental involvement, and restricted homecare access among socially vulnerable families [12]. Their findings further support standardised discharge practices and caregiver participation in post-discharge planning.

The importance of parental involvement in developmental support has also been demonstrated in intervention-based studies. Silveira et al. reported benefits associated with parent-guided developmental interventions among very-low-birth-weight infants [13]. Similarly, McGowan et al. demonstrated improvements in the language environment following a NICU-based parental intervention, with favourable receptive language outcomes at two years [14]. Although these interventions did not specifically address physiotherapy referrals, they highlight the contribution of informed caregivers to early developmental support. The high prevalence of inadequate counselling in the present study indicates an opportunity to strengthen parental education regarding developmental surveillance and rehabilitation.

Multivariable analysis identified inadequate discharge counselling, absence of routine referral protocols, lack of caregiver awareness, rural residence, and primary-level maternal education as significant factors associated with missed referral. Inadequate discharge counselling showed the highest adjusted odds ratio (3.12), followed by absence of referral protocols (2.91) and lack of caregiver awareness (2.67). These findings highlight the need for routine physiotherapy screening, documented referral recommendations, structured caregiver counselling, and coordinated follow-up. Improved communication between neonatologists, physiotherapists, and community rehabilitation providers may further strengthen continuity of care.

The study had certain limitations. Its restriction to participating rural NICUs may limit generalisability. The 28-day assessment period did not capture long-term physiotherapy utilisation or developmental outcomes. Caregiver interviews were potentially subject to recall and reporting bias. Additionally, overlapping barrier responses limited direct comparison of individual barrier frequencies. Nevertheless, the study identified important gaps in neonatal physiotherapy referral and highlighted modifiable institutional and caregiver-related factors affecting early rehabilitation access.

Conclusion

The study demonstrated substantial gaps in early physiotherapy referral among high-risk neonates discharged from rural NICUs. A considerable proportion of neonates did not receive documented physiotherapy referrals before hospital discharge, and more than half did not access physiotherapy services. Inadequate discharge counselling, lack of

caregiver awareness, and absence of routine referral protocols emerged as major barriers to timely referral. Rural residence and lower maternal educational attainment were also associated with missed referrals. The findings highlighted the need for standardised NICU-based physiotherapy referral protocols, improved communication between neonatologists and physiotherapists, structured parental counselling, and strengthened post-discharge follow-up mechanisms to facilitate timely identification and rehabilitation of high-risk neonates.

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