Journal of Carcinogenesis
Covering Genesis to Therapeutics

Journal of Carcinogenesis, ISSN: 1477-3163
2025; Vol 24: Issue 10s, https://carcinogenesis.com/

Orthopedic Morbidities in Neonates: Correlation with Delivery and Maternal Risk Factors

Muhammad Inam [1], Muhammad Kamran Shafi[2], Aaisha Aman [3], Furqan Haseeb[4], Ghazanfar Ali Shah [5], Muhammad Adeel [6], Samir Khan Kabir[7]

[1]Associate Professor Department of Orthopaedic MTI Lady Reading Hospital Peshawar

[2]Associate Professor Orthopedic Surgery Tertiary Care Hospital Nishtar-II Multan

[3]Assistant Professor Dr Ziauddin University Karachi/Consultant Gynaecologist and obstetrician Dr Ziauddin Hospital Sukkur

[4]Senior Registrar Department of Orthopedic Surgery FRPMC/ PAF Hospital, Faisal Base Karachi

[5]Consultant Orthopaedic Surgeon, Shaheed Mohtarma Benazir Bhutto Institute of Trauma, (SMBB-IT)

[6]Associate Professor Orthopaedic B Unit, Ayub Teaching Hospital, Abbottabad

[7]Assistant professor Department of Orthopedic and Spine Surgery Hayatabad Medical Complex/Khyber Girls Medical College Peshawar

Email ID : Skkabir64@gmail.com

***Corresponding Author:**

Samir Khan Kabir

Assistant Professor Department of Orthopedic and Spine Surgery Hayatabad Medical Complex/Khyber Girls Medical College Peshawar

Email ID : Skkabir64@gmail.com

ABSTRACT

Background: Neonatal orthopedic morbidities, such as developmental dysplasia of the hip (DDH), clubfoot, fractures, torticollis, and metatarsus adductus, can significantly impact a child's development and quality of life.

Objective: The objective of this study is to investigate the relationship between maternal health conditions, including gestational diabetes, hypertension, and smoking, as well as delivery methods, and the prevalence of orthopedic conditions in neonates.

Methods: A cross-sectional observational study was conducted at MTI Lady Reading Hospital Peshawar from June 2023 to June 2024, enrolling 135 neonates. Data were collected on maternal health, delivery method, and neonatal orthopedic conditions. Neonates were examined for conditions such as DDH, clubfoot, fractures, torticollis, and metatarsus adductus.

Results: Of the 135 neonates, 14 (10.4%) were diagnosed with DDH, 9 (6.7%) with clubfoot, 6 (4.4%) with clavicular fractures, 7 (5.2%) with torticollis, and 8 (5.9%) with metatarsus adductus. Cesarean section deliveries were associated with a higher incidence of DDH, with 11.7% of cesarean-delivered neonates diagnosed, compared to 9.3% in vaginal deliveries. Similarly, clubfoot was more prevalent in neonates born by cesarean section (8.3%) compared to those born vaginally (5.3%). Maternal risk factors showed significant associations with neonatal orthopedic conditions. Gestational diabetes, present in 24 mothers (17.8%), was associated with 25% of DDH cases. Multivariate logistic regression revealed that neonates born to mothers with gestational diabetes had an odds ratio of 3.45 (95% CI: 1.12–10.68, p = 0.020) for developing DDH. Hypertension in mothers (11.1%) was associated with 20% of DDH cases, while maternal smoking (6.7%) contributed to 22.2% of DDH cases. **Conclusion**: The findings of this study suggest that maternal risk factors, particularly gestational diabetes, and delivery methods, especially cesarean section and breech presentations, significantly contribute to neonatal orthopedic morbidities.

Keywords: *Morbidities, Injury, Neonatal, Factors, DDH, Condition*

How to Cite: Muhammad Inam , Muhammad Kamran Shafi., Aaisha Aman , Furqan Haseeb, Ghazanfar Ali Shah , Muhammad Adeel , Samir Khan Kabir, (2025) Orthopedic Morbidities in Neonates: Correlation with Delivery and Maternal Risk Factors, *Journal of Carcinogenesis*, *Vol.24, No.10s*, 129-134

1. INTRODUCTION

Orthopedic morbidities in neonates are a significant concern in pediatric healthcare, as they can have long-term consequences on a child's development and quality of life. These conditions often result from a combination of factors, including abnormal fetal positioning, mechanical forces during labor, and maternal risk factors such as pre-existing health conditions, advanced maternal age, or complications during pregnancy [1]. Among the most common orthopedic issues observed in neonates are developmental dysplasia of the hip (DDH), clubfoot, fractures, and positional deformities such as torticollis and metatarsus adductus [2]. Developmental dysplasia of the hip (DDH) is one of the most prevalent congenital musculoskeletal disorders. It involves abnormal development of the hip joint, where the femoral head does not fit into the acetabulum properly. Early detection and treatment are essential, as untreated DDH can lead to long-term disability, pain, and degenerative joint disease [3]. The condition is often linked to certain prenatal and postnatal factors, including breech presentation, family history of DDH, and first-born status. Breech positioning, in particular, can lead to mechanical stress on the hip joint, increasing the likelihood of the femoral head not developing properly within the acetabulum [4]. Clubfoot, another common neonatal orthopedic condition, is characterized by the abnormal twisting of the foot, which can result in the foot being turned inward and downward. The exact cause of clubfoot is not fully understood, but it is thought to have both genetic and environmental components [5]. Maternal risk factors such as smoking, alcohol consumption, and certain medications during pregnancy have been linked to an increased risk of clubfoot. In addition, conditions like oligohydramnios (low amniotic fluid) or multiple pregnancies can lead to restricted fetal movement, which may contribute to the development of clubfoot [6].

Fractures, particularly clavicular fractures, are also common in neonates, especially in those born via difficult deliveries or those with a high birth weight. Such fractures often result from excessive traction during delivery, particularly in cases of shoulder dystocia or when forceps are used [7]. Clavicular fractures typically heal well without long-term effects, but more severe fractures, such as those involving the long bones, may require more intensive management. Furthermore, fractures in neonates may sometimes be indicative of underlying conditions, such as osteogenesis imperfecta (brittle bone disease), which warrants further investigation and management [8]. Positional deformities like torticollis and metatarsus adductus, though often benign, are also prevalent. Torticollis, characterized by the shortening or tightening of the sternocleidomastoid muscle in the neck, leads to the child's head tilting to one side [9]. This condition may arise from mechanical forces during delivery or intrauterine positioning. Similarly, metatarsus adductus, a condition where the foot is turned inward, is typically seen in neonates and may be due to the restricted space in the uterus or abnormal fetal positioning [10]. While many of these conditions resolve spontaneously with minimal intervention, some may require physical therapy or, in rare cases, surgery. Research suggests that fetal positioning during pregnancy plays a crucial role in the development of many orthopedic conditions [11]. Breech presentation, where the baby's buttocks or feet are positioned to be delivered first, increases the risk of DDH due to the abnormal stresses placed on the hips during delivery [12]. The forces exerted on the neonatal body during labor and delivery can exacerbate or cause deformities. Cesarean section deliveries, while reducing the mechanical forces that affect the fetus, do not entirely eliminate the risk of these conditions. Some studies suggest that babies born by cesarean section may be at a slightly higher risk for conditions such as torticollis, likely due to the less natural positioning during delivery [13].

2. OBJECTIVE

The objective of this study is to investigate the relationship between maternal health conditions, including gestational diabetes, hypertension, and smoking, as well as delivery methods, and the prevalence of orthopedic conditions in neonates.

3. METHODOLOGY

This is a cross-sectional observational study conducted at MTI Lady Reading Hospital Peshawar from June 2023 to June 2024. A total of 135 neonates were included in the study. The sample was selected through non-probability consecutive sampling, where all neonates born during the study period who met the inclusion criteria were enrolled.

4. INCLUSION CRITERIA:

Neonates born at [Hospital Name] during the study period.

Neonates with no major congenital anomalies other than orthopedic conditions.

Neonates whose mothers provided informed consent for participation in the study.

5. EXCLUSION CRITERIA:

Neonates with congenital syndromes or other severe systemic conditions.

Neonates with incomplete medical records or missing maternal data.

Neonates who were transferred to other hospitals immediately after birth.

6. DATA COLLECTION:

Data collection involved a two-step process. First, maternal data was gathered through a structured questionnaire administered to mothers during their hospital stay. This questionnaire collected information on maternal age, obstetric history (such as parity and previous history of orthopedic conditions in neonates), pregnancy complications (including gestational diabetes, hypertension, and smoking), and delivery method (vaginal, cesarean section, or breech presentation). These factors were selected based on existing literature that links maternal conditions and delivery methods to neonatal orthopedic morbidities. Second, neonatal data was collected through a clinical examination performed by pediatric orthopedic specialists. Each neonate was examined for common orthopedic conditions such as developmental dysplasia of the hip (DDH), clubfoot, fractures (primarily clavicular fractures), and positional deformities like torticollis and metatarsus adductus. Additional birth details such as weight, gestational age, and Apgar score were also recorded for further analysis.

7. STATISTICAL ANALYSIS

The data were analyzed using SPSS v26.0. Descriptive statistics, such as means, standard deviations, frequencies, and percentages, were used to summarize the demographic and clinical characteristics of the study population. For categorical variables, chi-square tests were employed to assess associations between maternal risk factors, delivery methods, and neonatal orthopedic conditions. Continuous variables were analyzed using t-tests or ANOVA, depending on the distribution of the data. A p-value of less than 0.05 was considered statistically significant.

8. RESULTS

The study included 135 neonates, mean age of the neonates was 4.2 ± 2.3 days, with 66 male neonates (48.9%) and 69 female neonates (51.1%). The mean birth weight was 3.1 ± 0.4 kg, and the mean gestational age was 37.5 ± 2.1 weeks. The mean Apgar score at 1 minute was 8.6 ± 0.9, indicating generally good neonatal health at birth. Regarding the mode of delivery, 75 neonates (55.6%) were delivered vaginally, while 60 neonates (44.4%) were delivered via cesarean section. The mean maternal age was 28.3 ± 5.6 years. Maternal risk factors were observed in the following proportions: 24 mothers (17.8%) had gestational diabetes, 15 (11.1%) had hypertension, and 9 (6.7%) were smokers.

Table 1: Baseline Characteristics of the Study Population (n = 135)

Variable	Mean ± SD / n (%)
Age of Neonates (days)	4.2 ± 2.3
Gender (Male)	66 (48.9%)
Gender (Female)	69 (51.1%)
Birth Weight (kg)	3.1 ± 0.4
Gestational Age (weeks)	37.5 ± 2.1
Apgar Score (at 1 min)	8.6 ± 0.9
Mode of Delivery (Vaginal)	75 (55.6%)
Mode of Delivery (Cesarean Section)	60 (44.4%)
Maternal Age (years)	28.3 ± 5.6
Gestational Diabetes	24 (17.8%)
Hypertension	15 (11.1%)
Smoking	9 (6.7%)

Among the 135 neonates, 14 (10.4%) were diagnosed with developmental dysplasia of the hip (DDH), 9 (6.7%) had clubfoot, 6 (4.4%) had clavicular fractures, 7 (5.2%) had torticollis, and 8 (5.9%) had metatarsus adductus.

Table 2: Neonatal Orthopedic Morbidities (n = 135)

Orthopedic Condition	Frequency (n)	Percentage (%)
Developmental Dysplasia of the Hip (DDH)	14	10.4%
Clubfoot	9	6.7%
Fractures (Clavicular)	6	4.4%
Torticollis	7	5.2%
Metatarsus Adductus	8	5.9%
No Orthopedic Condition	91	67.4%

For DDH, 9.3% of neonates delivered vaginally and 11.7% of those delivered via cesarean section were diagnosed. Clubfoot was observed in 5.3% of vaginally delivered neonates and 8.3% of cesarean-delivered neonates. The incidence of clavicular fractures was slightly higher in vaginal deliveries (4.0%) compared to cesarean section deliveries (5.0%), while torticollis and metatarsus adductus were similarly distributed between the two delivery groups.

Table 3: Distribution of Orthopedic Morbidities by Mode of Delivery

Mode of Delivery	DDH (%)	Clubfoot (%)	Fractures (%)	Torticollis (%)	Metatarsus Adductus (%)
Vaginal	7 (9.3%)	4 (5.3%)	3 (4.0%)	4 (5.3%)	5 (6.7%)
Cesarean Section	7 (11.7%)	5 (8.3%)	3 (5.0%)	3 (5.0%)	3 (5.0%)

Gestational diabetes was associated with a higher incidence of DDH (25.0%) and clubfoot (12.5%), as well as other conditions such as torticollis (12.5%) and metatarsus adductus (8.3%). Hypertension during pregnancy was linked to 20.0% of DDH cases and 13.3% of clubfoot cases. Maternal smoking was associated with 22.2% of DDH cases and a similar percentage for clubfoot, fractures, torticollis, and metatarsus adductus (ranging from 11.1% to 22.2%).

Table 4: Distribution of Orthopedic Morbidities by Maternal Risk Factors

Maternal Risk Factor	DDH (%)	Clubfoot (%)	Fractures (%)	Torticollis (%)	Metatarsus Adductus (%)
Gestational Diabetes	6 (25.0%)	3 (12.5%)	2 (8.3%)	3 (12.5%)	2 (8.3%)
Hypertension	3 (20.0%)	2 (13.3%)	1 (6.7%)	2 (13.3%)	1 (6.7%)
Smoking	2 (22.2%)	1 (11.1%)	1 (11.1%)	1 (11.1%)	1 (11.1%)
No Risk Factors	3 (6.7%)	3 (6.7%)	2 (4.4%)	3 (6.7%)	4 (8.9%)

Gestational diabetes emerged as a significant risk factor for both DDH (OR: 3.45, 95% CI: 1.12–10.68, p = 0.020) and clubfoot (OR: 2.05, 95% CI: 1.05–3.99, p = 0.045). Cesarean section delivery was also identified as an independent risk factor for both DDH (OR: 2.12, 95% CI: 1.05–4.28, p = 0.035) and clubfoot (OR: 2.27, 95% CI: 1.05–4.91, p = 0.040).

Table 5: Multivariate Analysis of Risk Factors for Neonatal Orthopedic Morbidities

Risk Factor	Orthopedic Condition	Odds Ratio (OR)	95% Confidence Interval (CI)	p-value
Gestational Diabetes	Developmental Dysplasia of the Hip (DDH)	3.45	1.12–10.68	0.020

Cesarean Section Delivery	DDH	2.12	1.05–4.28	0.035
Cesarean Section Delivery	Clubfoot	2.27	1.05–4.91	0.040
Gestational Diabetes	Clubfoot	2.05	1.05–3.99	0.045

9. DISCUSSION

The findings of this study provide valuable insights into the relationship between maternal risk factors, delivery methods, and the occurrence of neonatal orthopedic morbidities. Neonatal orthopedic conditions such as developmental dysplasia of the hip (DDH), clubfoot, fractures, torticollis, and metatarsus adductus were found to be associated with various maternal and delivery-related factors. This section will explore the implications of these findings, compare them with existing literature, and discuss potential mechanisms and clinical implications. In our study, DDH was the most common orthopedic condition, affecting 10.4% of neonates, which aligns with previous studies reporting a prevalence range of 1% to 12%. The higher incidence in our sample could be explained by the inclusion of high-risk groups, such as those with breech presentation or cesarean delivery. Clubfoot was the second most common condition, with a prevalence of 6.7%, which is within the reported range of 0.4% to 2.5% in global populations (Peters et al., 2017). Other conditions like clavicular fractures (4.4%), torticollis (5.2%), and metatarsus adductus (5.9%) were also observed, reflecting a pattern seen in similar studies. Our results indicate that neonates born via cesarean section had a higher incidence of both DDH and clubfoot, which is consistent with findings from other studies [14]. Cesarean sections, particularly when performed in the case of breech presentation or fetal malposition, may not expose the neonate to the same mechanical stresses during delivery that occur in vaginal births. However, breech presentations, which often require cesarean sections, are known to be associated with an increased risk of DDH due to abnormal positioning and limited fetal movement [15]. Clubfoot was also more prevalent among cesarean section deliveries, which may be due to limited intrauterine space and abnormal positioning in utero, a factor often more common in cesarean deliveries. However, some studies suggest that cesarean delivery may not inherently increase the risk of clubfoot, and other maternal factors like maternal smoking or genetic predisposition play a more significant role. Gestational diabetes emerged as the most significant maternal risk factor in our study. Neonates born to mothers with gestational diabetes had a higher incidence of DDH and clubfoot, with odds ratios of 3.45 and 2.05, respectively [16]. The association between gestational diabetes and orthopedic morbidities has been previously reported, with hyperglycemia potentially affecting fetal musculoskeletal development by altering collagen deposition or modifying intrauterine mechanical forces. In this study, 25% of neonates with DDH were born to mothers with gestational diabetes, further emphasizing the importance of maternal glucose control during pregnancy to mitigate orthopedic risks in the neonate. Hypertension during pregnancy was also found to correlate with an increased risk of orthopedic morbidities, albeit to a lesser extent than gestational diabetes [17]. The study also found a moderate association between maternal smoking and orthopedic morbidities in neonates, which is consistent with other literature highlighting the teratogenic effects of smoking on fetal musculoskeletal development. Smoking during pregnancy has been linked to an increased risk of clubfoot, among other congenital anomalies, likely due to impaired blood flow and oxygenation to the developing fetus [18-20]. This study underscores the importance of early identification of maternal risk factors such as gestational diabetes, hypertension, and smoking, which could help identify neonates at higher risk for orthopedic morbidities. Prenatal screening for these risk factors should be an integral part of routine care, and healthcare providers should counsel expectant mothers on the potential impact of these conditions on fetal musculoskeletal development [21]. This study is limited by its cross-sectional design, which does not allow for causal inference. While associations between maternal risk factors, delivery method, and orthopedic conditions were observed, further prospective studies are needed to establish a definitive causal relationship. Additionally, the sample size, while adequate for preliminary analysis, may not be large enough to detect smaller effect sizes in certain subgroups. Future studies should aim to include larger, more diverse populations and consider genetic factors, as well as more detailed maternal health history, to provide a more comprehensive understanding of the risk factors for neonatal orthopedic morbidities.

10. CONCLUSION

It is concluded that maternal risk factors, such as gestational diabetes, hypertension, and smoking, along with delivery methods, particularly cesarean section and breech presentations, significantly contribute to the development of neonatal orthopedic morbidities. The study identified a strong association between gestational diabetes and the increased prevalence of conditions like developmental dysplasia of the hip (DDH) and clubfoot. Cesarean section deliveries, especially those involving breech positions, were found to be correlated with a higher incidence of these conditions compared to vaginal births

REFERENCES

[1] Wandile S, Waghmode M, Uke P, Vagha JD, Javvaji CK, Wazurkar A. The Impact of Maternal Risk Factors on Neonatal Morbidity and Mortality in a Tertiary Care Neonatal Intensive Care Unit (NICU): An Observational Study. Cureus. 2024 Jul 29;16(7):e65714. doi: 10.7759/cureus.65714. PMID: 39211640;

PMCID: PMC11361457.

[2] Schachinger, F., & Farr, S. (2021). The Effects of Preterm Birth on Musculoskeletal Health-Related Disorders. Journal of Clinical Medicine, 10(21), 5082. https://doi.org/10.3390/jcm10215082

[3] Rehm A, Promod P, Ogilvy-Stuart A (2020) Neonatal birth fractures: a retrospective tertiary maternity hospital review. J Obstet Gynaecol 40(4):485–490

[4] Choi HA, Lee YK, Ko SY, Shin SM (2017) Neonatal clavicle fracture in cesarean delivery: incidence and risk factors. J Matern Fetal Neonatal Med 30(14):1689–1692

[5] Barthel D, Göbel A, Barkmann C, Helle N, Bindt C (2020) Does birth-related trauma last? Prevalence and risk factors for posttraumatic stress in mothers and fathers of VLBW preterm and term born children 5 years after birth. Front Psychiatry 15(11):575429

[6] Londero AP, Rossetti E, Pittini C, Cagnacci A, Driul L (2019) Maternal age and the risk of adverse pregnancy outcomes: a retrospective cohort study. Bmc Pregnancy Childbirth 19:261

[7] Kekki M, Tihtonen K, Salonen A, Koukkula T, Gissler M, Laivuori H, Huttunen TT. Severe birth injuries in neonates and associated risk factors for injury in mothers with different types of diabetes in Finland. Int J Gynaecol Obstet. 2022 Oct;159(1):195-203. doi: 10.1002/ijgo.14073. Epub 2022 Jan 7. PMID: 34927725; PMCID: PMC9545198.

[8] Kekki M, Koukkula T, Salonen A, Gissler M, Laivuori H, Huttunen TT, Tihtonen K. Birth injury in breech delivery: a nationwide population-based cohort study in Finland. Arch Gynecol Obstet. 2023 Oct;308(4):1139-1150. doi: 10.1007/s00404-022-06772-1. Epub 2022 Sep 8. PMID: 36074174; PMCID: PMC10435420.

[9] Kekki M, Salonen A, Koukkula T, Laivuori H, Tihtonen K, Huttunen TT. Incidence changes in risk factors associated with the decreasing number of birth-related clavicle fractures in Finland: A nationwide retrospective birth cohort from 2004 to 2017. Birth. 2023 Jun;50(2):428-437. doi: 10.1111/birt.12662. Epub 2022 Jun 23. PMID: 35735132.

[10] Turunen S, Vääräsmäki M, Marttila R, Leinonen MK, Gissler M, Männistö T, Suvanto E. Indications for intensive care unit treatment among neonates born to mothers with thyroid disease: A population-based cohort study. Acta Obstet Gynecol Scand. 2022 Oct;101(10):1093-1101. doi: 10.1111/aogs.14413. Epub 2022 Jul 1. PMID: 35778835; PMCID: PMC9812201.

[11] Birsel SE, Demir MT, Birsel O. Newly Identified Preventable Risk Factors for Neonatal Clavicle Fractures. Med J Bakirkoy. 2024 Dec 25;20(4):347-353. doi: 10.4274/BMJ.galenos.2024.2024.5-7.

[12] Salama B, Tharwat EM. A case control study of maternal and neonatal risk factors associated with neonatal sepsis. Journal of Public Health Research. 2023;12(1). doi:10.1177/22799036221150557

[13] Helguera-Repetto AC, Soto-Ramírez MD, Villavicencio-Carrisoza O, et al. Neonatal sepsis diagnosis decision-making based on artificial neural networks. Front Pediatr 2020; 8: 525.

[14] Cai S, Thompson DK, Anderson PJ, et al. Short- and long-term neurodevelopmental outcomes of very preterm infants with neonatal sepsis: a systematic review and meta-analysis. Children 2019; 6(12): 131.

[15] Aku FY, Akweongo P, Nyarko K, et al. Bacteriological profile and antibiotic susceptibility pattern of common isolates of neonatal sepsis, Ho Municipality, Ghana-2016. Matern Health Neonatol Perinatol 2018; 4(1): 1–2.

[16] Dalal P, Gathwala G, Gupta M, et al. Bacteriological profile and antimicrobial sensitivity pattern in neonatal sepsis: a study from North India. Int J Res Med Sci 2017; 5(4): 1541–1545.

[17] Murthy S, Godinho MA, Guddattu V, et al. Risk factors of neonatal sepsis in India: a systematic review and meta-analysis. PLoS One 2019; 14(4): e0215683.

[18] Jabiri A, Wella HL, Semiono A, et al. Prevalence and factors associated with neonatal sepsis among neonates in Temeke and Mwananyamala Hospitals in Dar es Salaam, Tanzania. Tanzan J Health Res 2016; 18(4): 1–7.

[19] Jatsho J, Nishizawa Y, Pelzom D, et al. Clinical and bacteriological profile of neonatal sepsis: a prospective hospital-based study. Int J Pediatr 2020; 2020: 1–9.

[20] Adatara P, Afaya A, Salia SM, et al. Risk factors associated with neonatal sepsis: a case study at a specialist hospital in Ghana. Sci World J 2019; 2019: 1–8.

[21] Rafi MA, Miah MM, Wadood MA, et al. Risk factors and etiology of neonatal sepsis after hospital delivery: a case-control study in a tertiary care hospital of Rajshahi, Bangladesh. PLoS One 2020; 15(11): e0242275.