

An Assessment of Risk Factors for Neonatal Brachial Plexus Palsy in the United States

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INTRODUCTION: Neonatal brachial plexus palsy (NBPP) occurs most commonly during birth when excessive force is applied to brachial plexus structures (C5-T1). The incidence of NBPP is 1.74 per 1000 live births. Previous studies have found that high birth weight, advanced maternal age, and shoulder dystocia can increase the risk of developing NBPP at birth. Patients that develop upper arm palsies, such as Erb's Palsy, can often recover spontaneously within a few weeks. However, some lower arm palsies, such as Klumpke's, can take as long as six months to recover and affect the child's quality of life. This study aims to identify potential risk factors that contribute to the likelihood of developing an NBPP.

METHODS: Neonates were identified using the United States 2016 Kids' Inpatient Database (KID) (ICD-10: Z38). Patient and hospital demographics, common comorbidities of mother and infant, and delivery methods were identified. Brachial plexus injuries were identified (ICD-10: P14.0 – 14.3). Univariate analyses with Chi-square and ANOVA were performed on patient and hospital demographics. Multivariate analyses were performed to determine statistical associations of risk factors with NBPP. All confidence intervals were determined at the 95% level. All analyses were conducted using IBM SPSS Version 25.

RESULTS: 1,325,476 neonates were identified in 2016 of which 701,466 were male (52.9%) and 623,272 (47.0%) were female. 2,557 neonates (0.2%) were diagnosed with a brachial plexus injury at birth. All patient demographics sampled varied with respect to plexus injury status, including sex, race, median income quartile, and primary payer status (Table 1). Hospital region and hospital control (i.e. government-owned vs. private) varied with respect to plexus injury status (Table 1). Teaching status of the hospital did not vary (Table 1). Upon multivariate analysis, after adjusting for all patient and hospital demographics, females were 1.22 [CI: 1.12 – 1.32] times more likely than males to develop NBPP ($p < 0.001$). Compared to White neonates, Black and Native American neonates were 1.31 [CI: 1.12 – 1.55] and 1.60 [CI: 1.23 – 2.07] times more likely to develop NBPP, respectively ($p < 0.01$ and $p < 0.01$). Patients birthed in a government-controlled hospital were 1.34 [CI: 1.15 – 1.56] times more likely to develop NBPP than private, non-profit hospitals ($p < 0.01$). A neonate born to a mother with gestational or pre-existing diabetes was 2.19 [CI: 1.93 – 2.48] times more likely to develop NBPP ($p < 0.001$, Table 2). A neonate classified as exceptionally large (>4500 g) or post-term was 5.26 times [CI: 4.83 – 5.75] times more likely to develop NBPP ($p < 0.001$, Table 2). A neonate that suffered a clavicular injury at birth was 17.24 [CI: 14.71 – 20.41] times more likely to develop NBPP ($p < 0.001$, Table 2). A neonate classified as underweight (<2500 g) was 4.27 [CI: 3.57 – 5.10] times less likely to develop an NBPP ($p < 0.001$, Table 2). A neonate affected by malpresentation or malposition, including persistent occiput posterior, transverse lie, or shoulder dystocia was 76.92 [CI: 71.43 – 83.33] times more likely to develop NBPP ($p = 0.012$, Table 2). NBPP patients were more likely to have undergone an instrument delivery (Table 1).

DISCUSSION AND CONCLUSION:

In this national cohort of neonates, NBPP occurred at an incidence of 1.93 per 1000 live births. Being female, Black, Native American, from a low-income household, born in a government-controlled hospital were all demographic predictors of NBPP occurrence. Pre-existing/gestational maternal diabetes, high gestational weight, clavicle fracture, and malpresentation of the fetus were all significant risk factors that contributed to the development of NBPP. After controlling for all covariates, the Black and Native American demographics demonstrated slightly increased injury probabilities. This difference could not be explained by other factors in this study. Previous literature has identified shoulder dystocia and high birth weight as significant contributors to brachial plexus injury. However, this study identified other potential risk factors, such as clavicular fracture, maternal diabetes, and malpresentation of the fetus in utero. Preventative strategies targeted at these risk factors can be developed by the healthcare team to improve perinatal outcomes.

		Newborn No Plexus Birth Injury	Newborn Plexus Birth Injury	p- value
		n = 1322866 (99.8%)	n = 2610 (0.2%)	
Sex	Male	53%	47.7%	<0.001
	Female	47%	52.3%	
Race	White	50.7%	40.8%	<0.001
	Black	16.1%	20.9%	
	Hispanic	19.4%	26.2%	
	Asian	6.1%	3.7%	
	Native American	0.8%	0.8%	
	Other	6.9%	7.7%	
Median Income Quartile	0 - 25%	28.8%	33.4%	<0.001
26 - 50%	24.1%	24.9%		
51 - 75%	24.8%	24.9%		
Patient Zip Code	76 - 100%	22.3%	16.8%	<0.001
Primary Payer Status	Medicare	0.4%	0.4%	
	Medicaid	47.3%	57.7%	
	Private Insurance	45.1%	35.5%	
	Self-Pay	4.4%	3.7%	
	No Charge	0.1%	0.2%	
Hospital Region	Other	2.8%	2.5%	<0.001
	Northeast	16.4%	17.8%	
	Midwest	21.8%	19.3%	
	South	38.1%	40.9%	
	West	23.8%	22.1%	
Hospital Teaching Status	Rural	7.9%	8.3%	0.25
	Urban nonteaching	23.2%	21.9%	
Hospital Control	Urban teaching	68.9%	69.9%	<0.001
	Government, non-federal	12.4%	15.6%	
	Private, not-for-profit	74.0%	72.4%	
Comorbidities	Private, investor-owned	13.6%	12.0%	<0.001
	Gestational/Pre-existing Diabetes	6.0%	12.5%	
	Malpresentation/Malposition During Delivery	0.7%	35.5%	
	Fracture of the Clavicle	0.4%	7.2%	
	Overweight/Long Gestation	10.0%	35.0%	
	Underweight/Short Gestation	19.4%	5.6%	
	Cesarean Delivery	0.1%	0.4%	
	Breech Delivery	1.0%	0.5%	
	Forcep Delivery	0.1%	0.7%	
	Vacuum Extraction	0.4%	1.8%	

Table 1. Patient Demographics, Hospital Characteristics, and Comorbidity Information

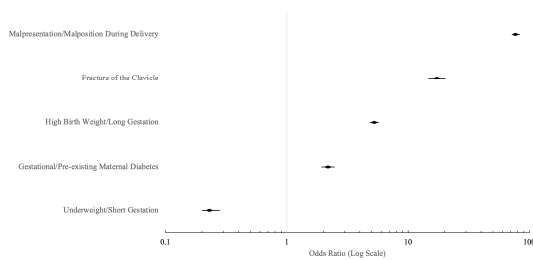


Table 2. Relative Risk of Various Comorbidities on the Development of Neonatal Brachial Plexus Injury