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Causes of Late Preterm Infant Hospital Readmission Rates in Relation to Feeding

An honors thesis/project in partial fulfillment
of the requirements for the degree of
Honors Baccalaureate in Nursing

By

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This honors undergraduate thesis/project is approved for recommendation to the
College of Education and Health Professions Honors Council.

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Abstract

Background:

In the U.S., late preterm (LP) births, which occur at 34^{0/7}-36^{6/7} weeks gestation, make up the largest and fastest-growing group of preterm births. Although there is a trend of increased rates of LP infant readmissions compared to term infant readmissions, the relationship between LP infant morbidities and method of feeding has not been extensively studied.

Objective:

The purposes of this study were to 1) identify the primary causes of LP infant hospital readmissions and, 2) correlate the primary causes of LP infant hospital readmissions with the method of feeding.

Methods:

The design of this nonexperimental study was a retrospective chart review identifying the primary diagnosis, and method of feeding, of term and LP infants readmitted to the medical or pediatric unit of a Northwest Arkansas hospital between the dates of May 1, 2015 and July 31, 2017. A total of 114 charts were reviewed, of which 17 LP infants met the study inclusion criteria. All infants were breastfed or formula-fed as their only source of nutrition. Term infants served as the control sample. Those infants transported from another level III tertiary neonatal unit were excluded, as well as infants aged 6 months or older at the time of readmission. The outcome measure was a comparison of nutritive and non-nutritive readmission diagnoses, with the focus of the nutritive readmission diagnoses placed on whether the infant was formula-fed or breastfed. A Cochran-

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Mantel-Haenszel was calculated to determine whether there was a relationship between the infants' readmission diagnoses and feeding methods when controlling for gestational age.

Results:

A Breslow-Day Test for Homogeneity of the Odds Ratios demonstrated statistically significant differences between primary cause of readmission and the method of feeding, $\chi^2(1) = 5.7453, p = .0165$. The Cochran-Mantel-Haenszel was significant, CMH (1) = 13.9886, $p = .002$, indicating there was a relationship between the readmission diagnosis and feeding method when controlling for gestational age. While only 11.1% of breastfed LP infants were readmitted for non-nutritive reasons, 88.89% of breastfed LP infants were readmitted for nutritive reasons. One hundred-percent of formula-fed LP infants were readmitted for non-nutritive reasons.

Conclusion:

This study revealed breastfeeding LP infants were more likely to be readmitted with nutritive diagnoses, with hyperbilirubinemia accounting for 75% of those readmissions. Formula-fed LP infants were more frequently readmitted with non-nutritive diagnoses, with 62.5% of those diagnoses being bronchiolitis caused by respiratory syncytial virus (RSV). Although breastfeeding is linked to increased incidences of hyperbilirubinemia, inadequate breastfeeding may play a significant role in further increasing bilirubin levels in LP infants. From this study, an intervention aimed at improving breastfeeding outcomes and preventing hyperbilirubinemia from a nursing and lactation standpoint, such as with the

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implementation of a discharge readiness assessment checklist, may prove beneficial in reducing readmission rates of LP infants related to breastfeeding.

Background and Significance

Late preterm (LP) infants are defined as those infants that are born between 34^{0/7} -36^{6/7} weeks. In the U.S. alone, LP births make up the largest and fastest-growing group of preterm births, accounting for 70% of those infants born earlier than 37 weeks (Forsythe & Allen, 2013). LP infants have considerably higher morbidity rates than their older or younger counterparts, with varying percentages of morbidity within the LP group itself. A higher incidence of morbidity therein leads to higher rates of hospital readmissions in relation to various admitting diagnoses. LP infants have higher rates of respiratory distress, apnea, temperature instability, hyperbilirubinemia, feeding problems, hypoglycemia, and seizures, with 59.7% of all LP infants born at 34 weeks suffering from at least one of these morbidities (Dimitriou et al., 2010). Although studies in recent years have identified this trend of increased hospital readmissions of LP infants in comparison to term infants, the magnitude of these morbidities related to method of feeding, whether that be breastfeeding or formula-feeding, has not yet been extensively studied. What begins as poor feeding can quickly turn into hospital readmissions due to dehydration, weight loss and/or poor weight gain, and hyperbilirubinemia.

In 2005, the term “late preterm” was introduced by the National Institute of Child Health and Human Development, a phrase meant to accurately categorize this particular group of infants who require more individualized care in order to

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meet their unique needs (McDonald et al., 2013). As a population that is steadily increasing, and a population that has a mortality rate three times higher than term infants, it is critical that the gaps in the research surrounding their readmissions be narrowed. Current studies show the relationship between LP infant outcomes and the post-partum physiological and mental status of the mother, as well as the mother's ethnicity, socioeconomic status, education level, and method of delivery. However, there lacks corresponding links to what directly causes LP infants' readmissions. By implementing potential prevention measures for these direct causes, LP infant readmission rates may decline, leading to decreases in healthcare demands as well as those demands often placed on the infant's family, mother, and caregivers (McDonald et al., 2013).

Goyal, Attanasio, and Kozhimannil (2014) stated that it may be even more critical that LP infants are able to breastfeed, and thereby reap the benefits, than their term counterparts. Multiple medical conditions that require hospitalization, whether they be dehydration, hyperbilirubinemia, low weight, food intolerance, or hypoglycemia, could result from problems directly related to feeding, such as ineffective latching or immature sucking. Unfortunately, LP infants are the ones with the poorest breastfeeding outcomes, most commonly due to feeding issues. Strikingly, Goyal et al. (2014) argued that LP infants are actually less likely than term infants to experience those hospital practices that encourage breastfeeding. These practices include withholding of a pacifier, being held by their mother during the first hour of life, and experiencing rooming-in, in which the infant's crib is kept near the mother's bed.

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Aside from the aforementioned external forces, LP infants are metabolically and physiologically immature. This includes immature sucking during breastfeeding. According to Nagulesapillai, McDonald, Fenton, Mercader, and Tough (2013), a cycle begins to emerge between delayed lactogenesis and immature sucking of the LP infant. Milk production, which is already reduced by the delayed lactogenesis, is further decreased as a result of the immature sucking, which then severely limits the amount of milk available to the newborn. As the coordinated sucking ability begins to develop at 34 weeks, LP infants are more likely to suffer from poor intake necessary for growth. Although infants born at 35 and 36 weeks would be expected to have more mature sucking and swallowing mechanisms, Gianni et al. (2015) suggests that fetal maturation is not linear, but that it is instead a non-linear and continuous process, which indicates that different organs mature at their own trajectories. Due to LP infants' uncoordinated suck-swallow-breathe mechanisms, combined with their simultaneous high energy demands and low energy stores, they are prone to suffering from feeding fatigue, which is often mistaken for feeding satisfaction (Nagulesapillai et al., 2013). When feeding fatigue is mistaken for feeding satisfaction, there is a further decreased intake of milk and thereby lower rates of breastfeeding success, a factor frequently reported by LP infant mothers. Nagulesapillai et al. (2013) suggests that LP infants experience higher rates of hospitalization related to poor feeding in comparison to term infants. Goyal, Attanasio, and Kozhimannil (2014) investigated further, proposing that early term infants with an estimated gestational age of 37 to 38 weeks have higher readmission rates than their term

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counterparts born at 39 to 42 weeks. Similar to studies previously mentioned, of these early term infants, jaundice and feeding issues were the top two causes of readmission, accounting for 83% of readmissions (Young, Korgenski, & Buchi, 2013).

With feeding difficulties and thereby a potential decreased intake of milk, LP infants are more likely than their counterparts to be readmitted to the hospital with diagnoses including hypoglycemia, hyperbilirubinemia, low birth weight, dehydration, food intolerance, and delay in successful breastfeeding. During an 11-year study conducted by Young et al. (2013) 5,308 of 296,114 infants were readmitted to Enterprise Data Warehouse of Intermountain Healthcare hospitals, with LP newborns accounting for 34.6% of readmissions, early term newborns making up 20.6%, and term infants coming in at 14.8%. Of those that were readmitted, 41% suffered from feeding problems, 35% were diagnosed with jaundice, and 33% were admitted with respiratory distress (Young et al., 2013). Though studies such as this have analyzed those morbidities that affect LP infants, there still remains a gap in the research. A study looking specifically at those morbidities related to feeding, and thereby resulting in hospital readmissions, is necessary in order to obtain a better grasp of what leads to those morbidities and ways in which to prevent and/or catch them earlier, improving health outcomes and decreasing healthcare costs. After conducting a retrospective cohort study, Bérard, Le Tiec, and De Vera (2012) noted that the cost of healthcare for LP infants in the first two years of life was double the healthcare costs of their term counterparts. LP infants require long-term follow-up, as well

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as diligent monitoring, early return appointments, monitoring, and evaluation. The 5,300 readmitted infants included in the 11-year study conducted by Young et al. (2013) culminated in a total healthcare cost of almost \$24 million, averaging \$4500 each. Obstetricians face the challenge of weighing the risks and benefits of delivering an infant at the late-preterm stage, which so often is decided in relation to the welfare of the mother. Pediatricians are then left to walk a very thin line, caring for these LP infants who at first appear healthy, but in actuality have higher risks of hospital readmission than term infants in relation to their morbidities. And thereby, the fact remains that many of these morbidities might be traced back to feeding problems, but the lack of current research in this focused area leaves much to speculation. It is understood that a delay in successful breastfeeding and food intolerance can lead to low weight and dehydration, again much of which is due to the immaturity with which LP infants enter the world. With a lower state of arousal, less physiologic stability, a decreased suck and swallowing mechanism, and limited muscle tone, 36% of LP infants are readmitted due to feeding problems in comparison to just 5% of term infants according to a retrospective analysis conducted by Nagulesapillai et al. (2013). Forsythe and Allen (2013) reported in an integrative literature review that 76% of LP infants readmitted for feeding problems had to endure a prolonged hospitalization, compared to only 28.6% of term infants readmitted for similar problems with feeding. Within the same group of infants, LP infants were three times more likely to be treated for hypoglycemia and low blood sugar compared to their term counterparts (Forsythe & Allen, 2013). LP infants have also been found to have a higher incidence of

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hyperbilirubinemia, which can manifest as breastfeeding failure jaundice. The LP infants' immature hepatic system, combined with poor breastfeeding practices and thereby decreased fluid intake, results in limited excretion of bilirubin and instead, extremely high levels of bilirubin in hepatic circulation (Forsythe & Allen, 2013). Nagulesapillai et al. (2013) identified in a recent review that LP infants that are breastfeeding when discharged from their birth hospitalizations are more likely to be readmitted with breastfeeding-associated diagnoses of jaundice, failure to thrive, and dehydration than term infants or other LP infants that are not breastfeeding.

With such astounding increases in the birth rates of LP infants and their associated morbidities, it is imperative that the relationship between these morbidities and what causes them, in relation to feeding, be investigated. The eventual aim is to educate those most influential in the treatment and care of LP infants. The purposes of this study are to 1) identify the primary causes of LP infant hospital readmissions and, 2) correlate the primary causes of LP infant hospital readmissions with the infant's method of feeding, whether that be breastfeeding or formula-feeding.

Methods

Overview

This study was conducted following the approval of the University of Arkansas Institutional Review Board and the target hospital's quality improvement department. At the time of this study, the target hospital did not

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have Baby Friendly designation, but did have full-time lactation consultants available.

Design

The design of this nonexperimental study was a retrospective chart review identifying the primary diagnosis, and method of feeding, of LP and term infants readmitted to a hospital in Northwest Arkansas.

Study Population

The study population included those LP and term infants that were readmitted to the target hospital's medical or pediatric units between the dates of May 1, 2015 and July 31, 2017. Those LP and term infants that were transported to the target hospital from another level III tertiary neonatal unit were excluded. Those infants aged 6 months or older at the time of readmission were also excluded from the study, as once the infants reach this age, diet supplementation with solid foods may be initiated, and the focus of this study is meant to remain on the causes of LP infant hospital readmission rates in relation to breastfeeding and formula-feeding.

Study Procedures

All patient information was de-identified in accordance with the Health Insurance Portability and Accountability Act (HIPAA). All medical record chart reviews were conducted within the target hospital. Demographic data collected included the infants' gestational age, age at readmission, ethnicity, primary cause of readmission, and method of feeding. The outcome measure was a comparison of nutritive and non-nutritive readmission diagnoses, with the focus of the

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nutritive readmission diagnoses placed on whether the infant was formula-fed or breastfed. Nutritive causes of readmissions include those diagnoses in which the infant's method of feeding may have served a role, including hyperbilirubinemia, failure to thrive, dehydration, poor feeding, neonatal weight loss, and lethargy. In a recent review, Nagulesapillai et al. (2013) similarly cites that jaundice, dehydration, and failure to thrive can be classified as breastfeeding-associated diagnoses. Non-nutritive causes of readmissions include those diagnoses that were deemed independent of the infant's method of feeding, including bronchiolitis resulting from RSV, pneumonia, urinary tract infections, gastroenteritis, and fever.

Timeline

Data collection was conducted between August 2017 and December 2017.

Data analysis began in January 2018 and was completed in March 2018.

Statistical Analysis

The medical charts of those infants readmitted to the target hospital's medical or pediatric units between the dates of May 1, 2015 and July 31, 2017 were reviewed. A total of 114 charts were reviewed between August and December 2017, of which 17 LP infants met the study inclusion criteria. All infants were breastfed or formula-fed as their only source of nutrition. For the purpose of this study, term infants served as the control sample.

Results

A Breslow-Day Test for Homogeneity of the Odds Ratios was performed in order to determine whether the odds ratio was similar between the two groups,

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LP infants and term infants. The Breslow-Day Test showed that the differences between primary cause of readmission, nutritive versus non-nutritive, and the method of feeding, formula versus breast, were statistically significant, $\chi^2(1) = 5.7453$, $p = .0165$. The Cochran-Mantel-Haenszel was also significant, CMH (1) = 13.9886, $p = .002$, indicating that there was a relationship between the readmission diagnosis and feeding method even when controlling by gestational age.

Because of the smaller sample size, a 2x2x2 Cochran-Mantel-Haenszel was used, which resembles a 2x2x2 chi square analysis. While 0% of LP infants who were formula-fed were readmitted for nutritive reasons, 88.89% of LP infants who were breastfed were readmitted for nutritive reasons. Only 11.1% of LP infants who were breastfed were readmitted for non-nutritive reasons. When analyzing term infants, 20% of term infants who were formula-fed were readmitted for nutritive reasons, while 80% of term infants who were formula-fed were readmitted for non-nutritive reasons. For term infants that were breastfed, 46.27% were admitted for nutritive reasons, while 53.73% were admitted for non-nutritive reasons. Appendix A provides a summary of these results.

Discussion

Of those LP infants that were readmitted for nutritive reasons related to breastfeeding, 75% had a primary diagnosis of hyperbilirubinemia and 25% were diagnosed with failure to thrive. Although there were no LP infants that were formula-fed and readmitted for nutritive reasons, of those LP infants that were formula-fed and admitted for non-nutritive reasons, 62.5% had primary

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diagnoses of RSV bronchiolitis. Those remaining LP infants were readmitted with gastrointestinal (GI) diagnoses or urinary tract infections. Those readmitted with GI diagnoses were classified as being readmitted for a non-nutritive reason, as it was not definitively evident whether the GI issue was related to method of feeding, a viral or bacterial infection, or a physiologic malformation. Young et al. (2013) found that those LP infants that were readmitted averaged a little more than half a day shorter nursery length of stay than those that were not readmitted, suggesting that increasing the nursery length of stay of LP infants may allow for more appropriate evaluation of the newborn's readiness for discharge and thereby lead to fewer hospital readmissions related to feeding issues and jaundice.

Prolonged birth hospital stays of four days or longer may also allow for more adequate time to monitor infants for hyperbilirubinemia and prevent readmissions related to complications, as Shapiro-Mendoza et al. (2006) found that a birth hospital stay of less than four days was a risk factor for LP readmissions.

Prolonged birth hospital stays would also allow for additional instruction in proper breastfeeding practices, an intervention that may allow for fewer readmissions related to feeding issues and jaundice later on. On the other hand, in a retrospective cohort study of LP infants, McLaurin, Hall, Jackson, Owens, and Mahadevia (2009) found that those LP infants that were not initially discharged in less than four days had the highest rates of re-hospitalization, but with primary diagnoses of respiratory disease rather than those diagnoses related to nutrition. Further studies may analyze causes of readmission in regards to method of feeding of both LP and term infants, while paying particular attention to

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corresponding length of birth hospitalization stay and gestational age, so as to distinguish and compare more specifically early term, late preterm, and term infants.

Limitations

The primary limitation in this study stemmed from the small sample size. The target hospital's neonatal deliveries doubled with the opening of a new women and infant's center in late 2016 after previously averaging two LP infant births per month. However, despite seeing an increase in the number of term infants readmitted during the latter end of the study's designated timeline, there was no similar increase seen in the number of LP infants readmitted. Despite the results showing statistical significance, due to the limited sample size, the results are not generalizable.

Another limitation included evidence of incomplete diet data on a small number of medical charts, making it impossible to determine the infant's method of feeding at readmission. This resulted in the dismissal of a small number of patient charts from the study, due to inability to determine inclusion criteria.

Conclusion

With the number of LP births on the rise, in addition to the unique physiologic needs and challenges with which this gestational group presents, it is essential that breastfeeding support is made a top priority during both the hospital stay and after discharge. This study revealed that breastfeeding LP infants are most likely to be readmitted with nutritive diagnoses, primarily hyperbilirubinemia at 75% of nutritive readmissions. Those LP infants that are

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formula-fed are most likely to be readmitted with non-nutritive diagnoses, with 62.5% of those diagnoses being RSV bronchiolitis. These findings support the claim that hyperbilirubinemia is the most common readmitting diagnosis of LP infants (Alkalay, Bresee, & Simmons, 2010) when comparing both nutritive and non-nutritive diagnoses, suggesting that additional interventions should be put in place for this population of infants that is known to be susceptible to feeding difficulties. Although breastfeeding is linked to increased incidences of hyperbilirubinemia, studies have shown that inadequate breastfeeding may play a significant role in further increasing bilirubin levels in infants. Interventions should be aimed at improving breastfeeding outcomes and reducing LP infant readmissions, including pursuance of longer birth length of stays for LP infants. Waldrop, Anderson, and Brandon (2013) found that through the utilization of educational interventions centered around hyperbilirubinemia risk assessments, timely follow-up appointments, and breastfeeding education, infant readmissions due to hyperbilirubinemia can be reduced by 50%. Peer counselors have also been found to have a positive impact on not only breastfeeding initiation, but duration and exclusivity as well (Chapman, Morel, Anderson, Damio, & Perez-Escamilla, 2010).

Adapting a discharge readiness assessment checklist for LP infants, similar to the checklist developed for term infants at Henrico Doctors' Hospital in Richmond, Virginia, may further serve to decrease the readmission rates of LP infants (Flaster, 2017). The discharge checklist, which can serve as backup documentation, aids nursery staff in ensuring that all necessary protocols are met

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before discharging a newborn early, but after 24 hours (Flaster, 2017). According to Flaster (2017), in 2016, Henrico's 30-day readmission rate of term newborns dropped to 0.08% from 0.25% in 2015. In addition to implementing a mandatory discharge readiness checklist, Flaster (2017) recommends using newborn nursery protocols that follow the American Academy of Pediatrics policy statement guidelines, getting the input of key stakeholders prior to checklist implementation, and building quality relationships with pediatricians in the area to help facilitate an effective and smooth continuum of care.

Future research that includes the length of birth hospitalizations may allow for tighter comparisons to be drawn when analyzing readmission rates of those breastfeeding LP infants. Through studies aimed at investigating the incidence of RSV bronchiolitis readmission diagnoses in LP formula-fed infants, the readmission rates of formula-feeding LP infants may be reduced. It may also prove interesting to make comparisons specifically between LP and early term infants, as early term infants have been shown to have similarly high rates of readmissions with diagnoses similar to those of readmitted LP infants. From this study, an intervention aimed at improving breastfeeding outcomes and preventing hyperbilirubinemia from a nursing and lactation standpoint, such as with the implementation of a discharge readiness assessment checklist, may prove beneficial in reducing readmission rates of LP infants related to breastfeeding.

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Appendix A

Determination of outcomes of the impact of breastfeeding and formula-feeding on nutritive and non-nutritive readmitting diagnosis rates of late-preterm and term infants.

Readmission Diagnosis	Gestation	Breastfeeding	Formula- feeding
		%	%
Nutritive	Late Preterm (34 ^{0/7} - 36 ^{6/7})	88.89	0
	Term (37 ^{0/7} - 41 ^{6/7})	46.27	20
Non-Nutritive	Late Preterm (34 ^{0/7} -36 ^{6/7})	11.1	100
	Term (37 ^{0/7} - 41 ^{6/7})	53.73	80

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