

Newborn physiological immaturity. A concept analysis.

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Abstract

Both *Immaturity* alone and *Physiological immaturity* are terms commonly used in the neonatal scientific literature mainly related to preterm and very-low birth weight infants. *Newborn physiological immaturity* is a concept contained in the ATIC Nursing Terminology, and related to well, full term neonates. But literature in this sense is scarce. The aim of this paper is to identify the essential attributes of the concept and provide its conceptual and operational definition, using wilsonian approach.

Keywords: Neonatal nursing, Physiological immaturity, Nursing diagnosis, Healthy newborn, Well baby, ATIC terminology, Concept analysis.

Introduction

During the last decades, nurses have used concept analyses to examine fundamental components of disciplinary phenomena, to guide concept clarification by proposing operational definitions and to reduce ambiguity in order to ease theory development, research and clinical practice.¹

The neonatal period is featured by “*the most dramatic and rapid physiological changes seen in humans*”.² During the first weeks of extrauterine life, infants experience transitions and changes as part of the developmental and adaptive-to-environment processes. The newborn confronts myriad unique adaptation challenges to support life and the ongoing maturation process will extend beyond the neonatal period.²⁻³

The authors hypothesized that healthy, full-term neonates exhibit an appropriate “normal” functioning and development that may be explained using the concept of *Newborn physiological immaturity* (NPI). But, in the scientific literature, *immaturity* is a concept mainly used to illustrate preterm and very low-birth-weight infants’ status.⁴⁻⁶

NPI was initially proposed as a nursing phenomenon within the diagnosis axis of the ATIC terminology, a nursing controlled vocabulary, in which concepts are based on the natural language that nurses use in their daily practice and then, they are revised for theoretical refinement. Several methodological and practical issues related to the ATIC terminology have been recently published.⁷⁻¹⁴

This paper focuses on the evaluation of the concept *Newborn physiological immaturity* (NIP) by using the wilsonian concept analysis approach.

Background

Significant improvements in maternal-child health were achieved during the last century in many countries in the world, including better survival rates during the neonatal

period.¹⁵ But paradoxically, whilst improving health outcomes, the nursing process representation for well, full term newborns in the nursing documentation or the electronic health records, has turned to contain many *non-healthy* concept labels. Scientific literature on the use of nursing diagnoses in healthy newborns is scarce, but most of the standardized nursing care plans for healthy neonates, published during the last 20 years, include nursing diagnoses to reflect nurses' judgments on the infant' status such as: Risk for infection¹⁶⁻¹⁹, Ineffective airway cleaning^{16, 19-22}, Risk for ineffective airway cleaning¹⁸, Risk for aspiration^{17,22}, Ineffective breathing pattern¹⁶, Hypothermia¹⁶, Risk for hypothermia¹⁸, Ineffective thermoregulation^{17, 19-22}, Risk for ineffective tissue perfusion¹⁸, Risk for fluid volume deficit²¹, Risk for hemorrhage¹⁷, Risk for unstable blood glucose²¹, Risk for injury²², Neonatal jaundice²¹, Impaired urinary pattern¹⁹, Nutritional deficit: less than body requirements^{16-19, 21}, Risk for impaired skin integrity²² and Pain²⁰⁻²¹.

These diagnostic labels are based on the North American Nursing Diagnosis Association International (NANDA-I) Nursing Diagnosis Classification²², which is a world-wide recognized nursing vocabulary. Whilst NANDA-I include some specific diagnoses for the neonatal period, with regard to direct care, there is increasing evidence showing that, this and other nursing classification systems are not able to completely cover care problems identified by nurses in the clinical settings and also that, these standardized nursing languages lack alignment of terms being used by nurses in practice.²⁴⁻²⁵ Similarly, these classifications may be failing in representing the "normal" status of maturation for human babies during this early period of life. Fragmenting the neonate' status into many nursing diagnoses, does not match with the idea of a holistic, comprehensive approach to the neonatal nursing care process representation. Therefore,

the identification of a concept that could clearly inform of this phenomenon, with a universal definition based on research findings, may result helpful for researchers, managers and clinicians, and may contribute to better represent neonatal nurses' judgments on healthy, full term newborns' status, while assuring the provision of safe and comprehensive nursing care to this vulnerable group.

The main purpose of this study was to clarify the phenomenon of *Newborn physiological immaturity* and to provide a conceptual and operational definition for neonatal nurses and other health care professionals to use in practice, management, education and research.

Methods

The study applied a concept analysis design, using the Wilsonian technique as described by Avant ¹. This technique is designed in a stepwise format and explicated in eleven steps: (S1) Isolating questions of concept, (S2) Finding right answers, (S3 to S7) Case examples, (S8) Social context, (S9) Underlying anxiety, (S10) Practical results and (S11) Results in language.

The Wilsonian concept analysis procedure was chosen for this study because this technique is particularly valuable when a concept has or may have more than one meaning ¹, as in the case of *Newborn physiological immaturity*.

Results

Step 1. Isolating the questions of concept

Given the lack of evidence on this concept in the literature, several questions arose: (1) What is the nature of the *Newborn physiological immaturity* (NPI)? (2) Does *Newborn physiological immaturity* differ from *prematurity*? (3) What are the features of *Newborn*

physiological immaturity? and (4) Does *Newborn physiological immaturity* require nursing interventions?.

According to the Wilsonian technique, these questions have to be classified into three categories: questions of concept, fact and value. Questions of concept are about meaning; the way they are answered depends on the angle from which they are explored. Questions of fact can be answered with already available knowledge and scientific evidence.¹ Question of value should be answered based on moral principles.

In this study, the first question is a question of concept. The second is a question of concept and a question of fact, as it implies explanations on the differences and similarities among concepts. The third is a question of fact. The last is a question of fact and of value.

Step 2. Finding the right answers

The definition of *Newborn physiological immaturity*, as one word was not found in any dictionary, so each term required initial separated definitions.

The concepts *Newborn* and *Neonate* were searched at the Online Merriam-Webster's Collegiate Dictionary (O-MWCD)²⁶, displaying the following definitions: (1) *Recently born*, (2) *Born anew* and (3) *A newborn child, especially a child less than one month*.

For the purposes of this analysis, this last definition was considered.

In this same dictionary, the term *Physiological* is defined as: (1) *Of or related to physiology*, (2) *Characteristic of or appropriate to an organism's healthy or normal functioning* and (3) *Differing in, involving or affecting physiological factors*.

The second definition was considered optimal to illustrate the concept of *Newborn physiological immaturity*.

At examining the ontology of *Immaturity* two main uses were revealed: the first, clearly referred immaturity as a concept very close to prematurity. The second use, referred to a state of incomplete growth or development. According to the O-MWCD too, *Immature* has two related definitions in this sense: (1) *Lacking complete growth, differentiation or development* and (2) *Having the potential capacity to attain a definitive form or state*.

Both, these two definitions were found useful to inform the concept of interest, because they involve associated ideas of potentiality for growth and development and maturation- dependent vulnerability.

The use of immaturity to describe the *exhibition of less than expected degree of maturity* for extrauterine survival, better match the idea of prematurity. The concept premature is defined as: *happening, arriving existing, or performed before the proper, unusual or intended time; especially, born after a gestation period of less than 37 weeks.*²⁶ Then, *Immaturity* (“incomplete maturity”) involves having the potential capacity to attain or being ready to complete neonatal growth and development, while *Prematurity* (“previous to maturity”) indicates a stage of significant or extreme degree of immaturity, which is “less than expected” to survive the extrauterine life, that is, out of the standard time and maturation range or non-physiological²⁶.

Steps 3 to 7. Case examples

Case examples are used to identify the essential elements of the concept of interest. According to the Wilsonian technique, four cases are presented: a model case, a contrary case, a related case and a borderline case.

Model case must contain all the attributes of the concept. The contrary case includes opposite clues. As concepts are not studied in isolation but they are connected to other concepts, the related case promotes a better understanding of the similarities and

differences of the concept under study from others in the same conceptual network. The borderline case reflects unsureness whether a case fits an example of the concept; this case contains only some of the essential elements of the concept and some features indicating the need for differential diagnosis.¹

Model case – *Albert H. is a two-day healthy, at term baby sharing room with his mum in the maternal-child ward. Born via vaginal delivery, his vital signs and anthropometry at birth were within normal range and APGAR test scored 10. Now, his respiratory rate is 40; BP 60/35 mmHg; heart rate, 130 and temperature, 36.9 °C. He shows a periodic breathing pattern of apnea of less than 5 seconds, followed by tachypnea. His skin is warm, not wet and slightly icteric. He is now eunuric after several previous hours of oliguria. His mother Clare, talks to him calmly while changing the napkin and the romper suit. He keeps his eyes open at his mum's voice. He strongly cries when the nurse obtains capillary blood sampling for metabolic screening, glucose monitoring and lab tests, by right plantar side heel stick without exerting pressure. Then, soft pressure is applied to the site with a gauze wrap, comfort measures continued and bleeding of the site ruled out. All test results are within normal limits. Her mother caresses him, sings him a song while holding and breastfeeding him. Suction is functional with proper sucking-swallowing-breathing coordination. Later, he falls slept in his mother's arms.*

In this case, vital signs are within the “expected” range for a well newborn, reflecting physiologic neonatal breathing and circulation mechanisms to adapt the extrauterine environment.^{2,27} Blood pressure levels also reflect cerebral autoregulation, perfusion and parasympathetic predominance to protect the neonate against hyper and hypotension²; although neonatal hypotension is considered a “subprime physiological

state of low systemic blood flow”.²⁸ Neonates are at high risk for heat loss; protecting clothes and warming environment of the room contribute to maintain his body temperature and minimize thermal stress.^{2,29-31} His diuresis is within normal limits; some degree of oliguria is expected during the first hours of life due to poor renal perfusion, which improves with circulatory adaptation. Neonate limited ability to concentrate urine and reduced glomerular filtration rate make the infant susceptible to both dehydration and fluid overload.^{2,31-32} Glucose is at normal range; cerebral metabolism and functioning depends upon an adequate blood glucose supply which provides for most of the brain's energy requirement.³³⁻³⁵ His “slightly icteric” skin reveals the normal rise of unconjugated bilirubin levels during the first 48-72 hours of life, because of the rapid breakdown of fetal hemoglobin and poor conjugating ability of the immature liver. Bilirubin levels will gradually fall during the next 15 days, with jaundice being rare beyond this period.^{2,36} Neonates’ platelet counts are in the adult range, but platelet function is diminished and vitamin K-dependent clotting factors are initially low due to transition to bone marrow hematopoiesis and immature hepatocyte function. Vitamin K prophylaxis is administered to protect the infant against hemorrhage.³⁷⁻³⁹ While breastfeeding protects the infant against gastrointestinal and respiratory infections, immature hematopoiesis and humoral system exposes the infant to extrauterine environment microorganisms, increasing the risk for infection.⁴⁰⁻⁴²

Effective sucking enhances breast-milk production and proper infant nutrition and hydration. An adequate coordination of sucking, swallowing and breathing is crucial to avoid respiratory complications such as desaturation, apnea or pulmonary aspiration.⁴³⁻

⁵⁰ The infant in the model case is able to respond to noxious stimuli. He also initiates a need and receives loving attention from his mother. He responds to stimuli, with states

of consciousness and within a dynamic reciprocal interaction with a caretaking environment. Mother holding, cuddling, visual contact and touch stimulate immunological maturation, strengthen attachment and enhance neurobehavioural organization, including habituation to environment, consolability, orientation and motor performance. Sleep is essential to brain development, general maturation and physical growth in infants.⁵¹⁻⁵⁷

Contrary case – *Martin J., a 55 years old, self-perceived healthy, active gardener has been experiencing hip pain for the lasts months. He explained: I thought I'd been working too much, strengthening too much. For the last weeks pain became extremely limitant so he decided to seek for his practitioner's help. After several days of extensive medical exams and proper pain control, he has been diagnosed of hip arthrosis, probably related to developmental dysplasia of the hip. Mr. J asked the nurse whether she could further explain him what his diagnosis means and what could he do to avoid pain and complications".*

At birth, the femur head and the acetabulum are mainly cartilaginous. Position of fetus at birth predisposes to developmental dysplasia of the hip (DDH), because of the immaturity of these structures. Nowadays 60 to 80% of DDH are detected through routine screening, most of them resulting in a spontaneous and favorable clinical resolution. But, 50% of hip arthrosis in adults elder than 50, are related to DDH. Routine screening for this condition was not a standard when Mr. J was born.⁵⁸⁻⁶⁰

Whilst he suffered this condition, he has never perceived it, until the pain episodes. A component of his body did not completely achieve the expected development, but this did not prevent him to become a completely autonomous and active adult individual.

Related case: Prematurity – Sarah P. is a beautiful, fragile, very-low birth weight preterm infant (29 weeks gestational age). She was admitted to the NICU and received intensive ...

Prematurity and premature birth, frequently used as a synonym of preterm birth, refers to an insufficient degree of maturity of organs to allow normal postnatal physiological adaptation and survival.⁶¹⁻⁶⁵ The premature infant is immature in the sense that developing organs are not mature enough for extrauterine life. Neonatal intensive care is needed both to create an intrauterine-like environment and promote development,⁶⁶ and also to prevent, promptly detect and manage life-threatening potential complications such as hypoxic-ischemic encephalopathy,^{65,67-68} cerebral palsy,^{65,67} intraventricular hemorrhages,⁶⁹⁻⁷⁰ shock,²⁸ hyperammonemia of the premature,⁷¹ necrotizing enterocolitis,⁷²⁻⁷³ retinopathy,⁷⁴ or developmental disabilities⁶⁴⁻⁶⁵. At the same time, this non-physiological environment may add stressors to the premature infant, because of the lack of neurological and sensory maturity to modulate external environmental factors.⁷⁵⁻⁷⁸ Immature intergumentary and immune systems do not provide competent defense against microorganisms.⁷⁹⁻⁸² Lung immaturity and inadequate production of surfactant limits the capacity for gas exchange.² Supplemental oxygen to prevent hypoxemia places the premature infant at risk for bronchopulmonary dysplasia.⁸³⁻⁸⁴ Structural immaturity of the digestive system challenges absorption of nutrients.⁸⁵⁻⁸⁶

Borderline case: Neonatal neurobehavioural organization – Hillary K. is a cute, 27 days, full-term infant. Her mother Martha, carefully places her into the stroller to go to the neonatal and pediatric nursing ambulatory clinics for immunization and routine

consultation. Martha explains the nurse that her baby “is so good, she sleeps almost five hours without interruption, only wakes up to eat and suckles properly while breastfed. She enjoys the bath time; she seems to hear me, to look at me, somehow to understand what I tell her”.

Neonatal behavioural organization is featured by reciprocal, evolving process of information exchange between the infant and the environment. This interaction has been described as selective and purposeful.⁵² Somehow, the neonate seeks stimuli and influences the caregiver by communicating different cues. The infant is able to coordinate sensory, motor and behavioural functions and social interaction systems, to develop consolability and resiliency, and to encourage and discourage interaction, while maintaining stability to enhance developmental maturation.⁵²

Step 8. Social context

The concept of NPI is nurtured by the advances in neonatology and basic sciences research. Scientific evidence has expanded our understanding of the physiological maturation of the newborn: from the first breath to lung mechanics and ventilation control; cardiac and circulatory adaption changes, thermogenesis, thermoregulation and the influence of a thermoneutral environment, the hepatic and renal adaption, fluid hemostasis and requirements, immunocompetency development, as well as nutritional and metabolic processes.²⁷⁻⁵¹ Evidence from multiple disciplines has also been produced to explain nervous system maturation and neurobehavioural organization in reciprocal interaction with a caring environment. Environment is a key aspect to support life and promote newborn healthy growth and development.⁵²⁻⁵⁷

Further support for the notion of *Newborn physiological immaturity* as a “healthy syndrome nursing diagnosis” concept has been gained from the literature examining the

outcomes of healthy neonates and mothers receiving episodic nursing care during the whole neonatal period.⁸⁷⁻⁹²

Step 9. Underlying anxiety

There are multiple issues that may cause “underlying anxiety” to the newborn, the mother, the parents, the family and the healthcare providers.

Besides of those factors presented in the previous sections, the neonate is challenged by continuous new stimuli, adaptation to home and social environment, adaption to ongoing immunological challenges, etc.

Underlying anxiety for the parents is related to properly protecting the infant from perils. The family as a whole faces an adaptation process to “adopt” the new member and promote growth and development.

For the healthcare professionals, underlying anxiety is mainly associated with the social context and a perceived need to intervene. Across the globe nurses provide care interventions to well babies and parental health education on caring the infants. But with the growing nursing shortage and the shrinking public money for preventive health care programs, these essential health care services are threatened.⁹² Health care interventions should be evidence-based, but also wisdom-based,⁹³ mainly oriented to prevention and education, in order not to medicalize the natural maturation process of the newborn. This may be the main reason why so many neonate nursing care plans contain so many nursing diagnoses: an underlying anxiety that lead some nurses to think they have to demonstrate through the charts they are thinking of and doing everything for the infant. But probably, the same can be formally represented in a neonate’s chart, using one-single nursing concept: *Newborn physiological immaturity*.

Step 10. Practical results

This analysis has shown that the concept Newborn physiological immaturity embeds a natural syndrome of vulnerability, involving several vital processes of progressive adaptation, habituation and organization, an a ready-to-adapt organic, functional and maturational development, that enhance neonate' survival, internal homeostasis and environmental interaction.

The analysis results in a clarified concept that should enable healthcare professionals to recognize it as a healthy maturation-dependent vulnerability condition and to determine when to intervene and when to withhold unnecessary interventions.

Step 11. Results in language

This concept analysis was aimed to the identification of the essential structure of the concept *Newborn physiological immaturity*, which results as follows:

1. NPI is an expected, natural, status of vulnerability of the full term healthy neonate, from intrauterine environment to the adaption for life in the extrauterine environment, during the first month of life.
2. As a syndrome-like nursing diagnosis, it includes all the physiological maturation-dependent potential problems including risk for: respiratory fatigue, impaired gas exchange (hypoxemia and hypoxia), aspiration, decreased cardiac output, impaired cardiac rhythm (propensity to bradycardia), hyper and hypotension, dehydration, fluid overload, hemorrhage, infection, hypothermia and dysthermia, hyperbilirubinemia, hypoglycaemia, constipation, impaired metabolic homeostasis, delayed growth and development and neurological and behavioural disorganization.
3. The caretaking environment plays a vital role to enhance a positive, evolving maturation process, protecting the infant from risks and promoting healthy interactions between the neonate and the macroenvironments.

4. Whilst some essential maturation is achieved within the first month of life, some of the maturation processes will extend beyond this period.
5. Newborn physiological immaturity differs from prematurity. Vulnerability is a shared feature although it is much marked in the preterm neonate. The healthy full term neonate is equipped with ready-to-adapt extrauterine environment mechanisms, while the premature infant is not.

Implications for practice, education and research

In the clinical settings, the use of a single concept label, *Newborn physiological immaturity*, to represent the well infant' status, may contribute to simplify the process of charting the nursing care plans. If used as a syndrome-like main nursing diagnosis, preventive and health promoting interventions may be prescribed, as well as interventions to support the caretaking environment.

This analysis may contribute to consistent usage of the concept in healthcare research, education and practice, but it would be interesting to explore the opinion of healthcare providers, including neonatal and pediatric nurses, physicians and midwives. To further inform this concept, it would also be useful to conduct studies on its use in the neonates' health records.

Practice may be better achieved if we are able to clarify our language. Translating nursing theory and research into clinical practice is essential to advance the scientific base of the discipline, but scholars and researchers should also actively listen to the voices of nurses in practice, the words and meanings of their professional natural language.

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