Food & Nutrition Journal
Tonucci LB, et al. Food Nutr J. 8: 276.
https://www.doi.org/ 10.29011/2575-7091.100176
www.gavinpublishers.com

Research Article

Nutritional Risk Screening in Newborns in the Neonatal Intensive Care Unit

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Citation: Tonucci LB, Silva SED, Albuquerque RADS, Izabel Moreira CM (2024) Nutritional Risk Screening in Newborns in the Neonatal Intensive Care Unit. Food Nutr J 9: 276. DOI: 10.29011/2575-7091.100176

Received Date: 21 November 2023; **Accepted Date:** 23 January 2024; **Published Date:** 29 January 2024

Abstract

Objectives: neonatal nutritional diagnostic tools is essential to early detection of babies at nutritional risk, included newborns hospitalized in Neonatal Intensive Care Unit (NICU), to avoid the general assumption that all newborns in the NICU have the same nutritional risk to assess the nutritional risk of newborns admitted to the NICU.

Methods: this is a cross-sectional, retrospective study, carried out by collecting data from medical and nutritional records of newborns admitted to the NICU in Ceará (Brazil). FARNNeo nutritional screening questionnaire was collected at first week in NICU and used to classify newborns as low (0 points), medium (1-3 points) or high nutritional risk (≥ 4 points). The association between gender, gestational age, and birth weight with nutritional risk, was analyzed by the Chi-square test.

Results: a number of 56 newborns were evaluated with a mean gestational age of 33.0 ± 4.1 weeks and birth weight of 1.859 ± 868 g. There was a high prevalence of the preterm newborns (71.4%) and high nutritional risk (78.6%). At birth, 37.5% were underweight, and 26.8% with very low weight. The variable disease and/or clinical condition was the one that most contributed to increased neonatal nutritional risk, with 96.42 (18.72), followed by nutritional therapy 54.16 (32.13%).

Conclusions: newborns in the neonatal intensive care unit had a high nutritional risk. The nutritional risk showed an important correlation with gestational age and birth weight classification.

Keywords: Nutritional Risk; Nutritional Assessment; Neonatal Screening; Infant Malnutrition; Nutritional Therapy

Introduction

Nutritional screening is essential for the clinical evolution of hospitalized children as birth weight is an important health indicator in the first years of life [1]. Low birth weight is associated with higher rates of neonatal and postnatal morbidity and mortality and plays an important role in the admission of newborns to neonatal intensive care units (NICU) [2], prematurity, and respiratory complications [3,4].

An important strategy to provide adequate nutritional support for newborns is the implementation of effective protocols for nutritional assessment and intervention, using tools for monitoring nutritional risk, such as nutritional screening questionnaires [5]. The European Society for Pediatric Gastroenterology, Hepatology and Nutrition (ESPGHAN), the European Society for Parenteral and Enteral Nutrition (ESPEN) and American Society for Parenteral and Enteral Nutrition (ASPEN) recommended the use of nutritional screening to identify nutritional risk in hospitalized children [6,7]. Furthermore, studies about medical cost related to nutritional care have shown that a nutrition-focused quality

improvement program reduced the healthcare cost [8,9].

Currently, the main nutritional screening questionnaires used for children are StrongKids, PEDSGNA, SCAN and the Neonatal Nutritional Risk. However, such questionnaires cannot be used in newborns admitted to the NICU because they were designed for infants older than one month [10-12]. Recently, a screening questionnaire was validated to assess nutritional risk in newborns, even those admitted to NICU. The FARNNeo is a neonatal nutritional screening questionnaire that includes important questions related to the nutritional status, such as gestational age, birth weight, diseases and/or clinical complications, and nutritional therapy [13]. However, the questionnaire is still little used in NICUs, and few studies have evaluated newborns nutritional risks [14].

Identifying the nutritional risk classification in high-risk babies is an important starting point for the establishment of more effective nutritional practices to reduce nutritional risk, morbidity and mortality. Thus, the development of this new tool validated for the Brazilian population and the need to implement nutritional assessment protocols in high-risk newborns, were the main relevant factors for carrying out this research, which had the objective of to assess the nutritional risk of children admitted to the NICU.

Methods

Study Population

This is a cross-sectional study with records of infants admitted to the neonatal care unit of a public hospital in Sobral (Ceará, Brazil), between April and September 2021. The study started after the approval of the National Bioethics Committee (CAAE: 57372222.5.0000.8109; #5,337,608). Informed consent was waived because data were extracted from nutritional records retrospectively (non-invasive observational study).

The sample size was calculated according to Miot (2011) and based on primary outcome of birth weight obtained from Cardoso and Falcao (2007), considering a alpha level of 0.05 and a power of 80% [15,16]. The minimal number of subjects calculated was 54. We excluded records of babies with more than 28 days older and congenital malformation which made the anthropometric measurements difficult.

Nutritional Risk

Early nutritional risk screening questionnaire (FARNNeo) were filled out by a nutritionist at first week in the NICU. The FARNNeo was recently validation to care of Brazilian newborns admitted to an intensive care unit [13]. This questionnaire consists of four itens: gestational age, birth weight, diseases and/or clinical condition, and nutritional therapy, each scoring from 0 to 4 points (Figure 1). The clinical conditions evaluated by the questionnaire were: congenital anomalies or gastrointestinal tract malformation and pathologies that affected the nutritional status (respiratory, renal and/or hepatic diseases). Furthermore, the nutritional therapy (oral, enteral anr/or parenteral) was analyzed. Adding information on gender, gestational age and exact birth weight was also collected.

Weight was measured according standard procedures by a trained investigator with a calibrated electronic anthropometric scale (Balmak 25BB® 0.1 kg) [17]. The classifications of birth weight and gestational age at birth follow the World Health Organization [18].

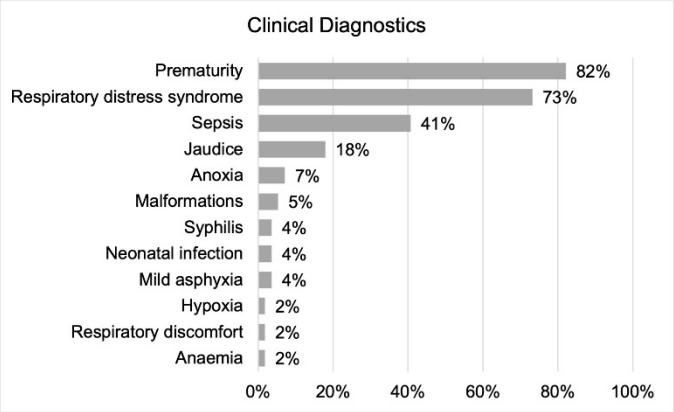

Figure 1: Main diagnoses and causes of admission to the NICU.

Statistical Analysis

The data was tabulated in Excel and the statistical analysis was carried out in the STATA program version 14.2 (Stata Corp., College Station, Texas, USA). Quantitative variables were presented as means and standard deviation and qualitative variables as percentages.

The association between gender, gestational age, and birth weight with nutritional risk, was analyzed by the Chi-square test. The significance level was set at 5%.

To analysis the impact of each nutritional variables on total nutritional risk score, the variables was process to a standardized scale ranging from 0 to 100. Afterwards, central tendency (mean) and their respective standard deviations were measured.

Results

Data from 56 newborns admitted to the NICU were collected and analyzed, of which 53.6% were male, a mean gestational age of 33.0 ± 4.0 weeks and birth weight of 1.859 ± 868 g. The nutritional risk assessment was analyzed based on the variables proposed by the FARNNeo screening tool, which are: gestational age, birth weight, diseases and/or clinical conditions, and nutritional therapy. Prevalence of high nutritional risk was 78.6% and low nutritional risk was 1.8%. Table 1 presents the general results and the nutritional risk classification, according to the score in the screening tool.

Characteristics	N (%)
Gender	
Males	30 (53.6%)
Female	26 (46.4%)
Gestacional age	
Preterm (< 37 and > 28 weeks)	40 (71.4%)
Full term (> 37 weeks)	10 (17.9%)
Extremely preterm (< 28 weeks)	6 (10.7%)
Birth weight	
Low weight (< 3.000)	21 (37.50%)
Very low weight	15 (26.80%)
Normal weight	12 (21.40%)
Extreme low weight	8 (14.30%)
Nutritional risks level (Farneo)	
Low	1 (1.8%)
Medium	11 (19.6%)
High	44 (78.6%)
Results express in percentage.	

Table 1: Characteristics of the newborns under intensive care.

The association analysis of nutritional risk with the other variables, a correlation was observed between the nutritional risk classification of newborns with gestational age and with birth weight. There were higher percentages of preterm and extremely preterm infants with high nutritional risk (87.50% and 100%, P = 0.001). As for the classification of birth weight, higher percentages of low weight, very low weight and extremely low weight with high nutritional risk were identified (76.19%, 100% and 100%; P= 0.008) and a higher percentage of newborns with adequate weight and average nutritional risk (50%) (Table 2).

Characteristics	Low Risc	Medium Risc	High Risc	X^2
Sex				
Male	1 (3.85%)	3 (11.54%)	22 (84.62%)	0.223
Female	0 (0%)	8 (26.27%)	22 (73.33%)	
Gestacional age				
Term	1 (10%)	6 (60%)	3 (30%)	0.001*
Pré-term	0 (0%)	5 (12.50%)	35 (87.50%)	
Extremely preterm	0 (0%)	0 (0%)	6 (100%)	
Birth weight				0.008*
Normal weight	1 (8.33%)	6 (50%)	5 (41.67%)	
Low weight	0 (0%)	5 (23.81%)	16 (76.19%)	
Very low weight	0 (0%)	0 (0%)	15 (100%)	
Extreme low weight	0 (0%)	0 (0%)	8 (100%)	
Total	1 (1.8%)	11 (19.6%)	44 (78.6 %)	
* Chi- square p < 0.05.				

Table 2: Association of the General Characteristics and Nutritional Risk Screening.

The most frequent admission was premature (82.4%), followed by 73.2% of respiratory distress syndrome and 40.7% of sepsis (Figure 1). In the present study, the same NB may have been diagnosed with one or more pathologies, especially preterm infants, who have other clinical complications due to prematurity.

In addition to clinical diagnoses, we evaluated the main complications reported in the medical records in the first 48 hours after birth, which could influence nutritional therapy. There were no gastric complications in the first 48 hours after birth in 57.1% (n = 32) of the newborns. Gastric residue was the main complication reported (28.5%; n = 16), followed by abdominal distention and presence of gastric residue in 9% (n=5).

For the nutritional therapy and form of feeding, 50% of newborns received enteral nutrition (exclusive or mixed), 16.1% received parenteral nutrition, and only 7.1% received oral feeding with breast milk or infant formula. However, 26.8% were without nutritional therapy following 48 hours after birth or hospitalization in the sector. Finally, the variable with the greatest influence on nutritional risk. For this analysis, we considered the amplitude of the scores of each item in percentage, where the maximum value in the screening (2 or 3) represented 100%. Disease and/or clinical condition was the most variable that contributed to the increase in neonatal nutritional risk (Figure 2).

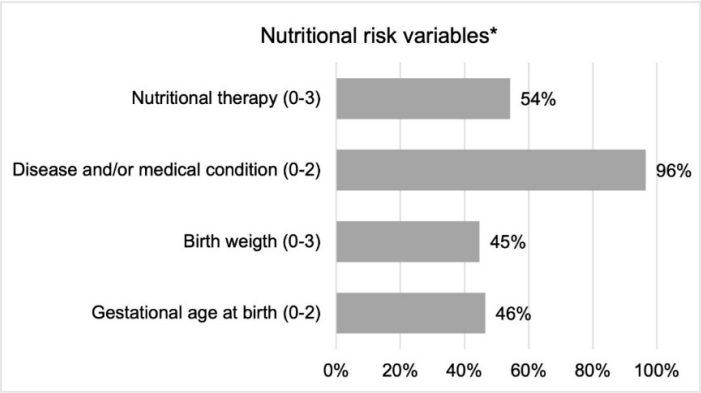

Figure 2: Analysis of the impact of nutritional risk variables on final nutritional risk

*standardized scale ranging from 0 to 100. Central tendency (mean) and their respective standard deviations.

Discussion

In the present study, we observed a high prevalence of high nutritional risk in newborns under intensive care. However, studies with nutritional risk assessment results in hospitalized newborns are scarce. As far as we know, this is the first study with this focus, involving newborns Brazilian patients under intensive care. Nutritional screening is a simple, fast, noninvasive method that identifies patients at risk of malnutrition. Some neonatal nutritional screening questionnaires have been recently validated, such as: OHIO Neonatal Nutritional Screeng [19], Neonatal Nutritional Screening [13], FARNNeo [13], and the Neonatal Nutritional Risk Screening Tool [14]. However, these screening methods are still little used in clinical practice. Strong Kids tool is one of the most used nutritional screening tools, but it is recommended only from 30 days of birth [20].

In Brazil and China, numerous births occur each year, but there is a shortage of nutritional support teams for newborns. Generally, medical staff evaluate the nutritional status of infants with a specific growth curve during hospitalization, and there is no practical or professional tool with which to screen for nutritional risk among babies [14]. The great advantage of nutritional screening questionnaires is that they combine anthropometric assessment with clinical and dietary assessments, enabling a more complete nutritional risk assessment. Nutritional risk assessment is important for a good prognosis and to enable prior and effective clinical and nutritional interventions, especially for high-risk babies [21]**.** Regarding the gestational week of birth, there was a high prevalence of preterm births (71.4%; n = 40) and only 17.9% classified as term. Damian et al., in their cross-sectional study on the profile of newborns admitted to NICU, also observed a high prevalence of preterm infants in their sample (69.6%) [4], as well as Bernadino, et al. [22], and Costa, et al. [23], with prevalence of 74.81% and 79.8%, respectively. In the present study, the hospital where the data were collected is a reference in the northern region of Ceará state as an open-door maternity hospital, receiving a high flow of high-risk pregnant women from 55 associated municipalities, which also contributes to a higher prevalence of preterm infants.

In the analysis of birth weight, a higher prevalence of low weight infants (37.50%) was observed, followed by 26.8% of very low weight. Only 21.40% were born with adequate weight. The birth weight of hospitalized patients ranged from 678g to 4,130g, with a mean of 1.859g ± 868.31g, which represents an average low birth weight. Rodrigues and Belham studied the profile of infants admitted to a NICU in Santa Catarina/Brazil and reported a higher prevalence of low birth weight (36.6%) [24]. Low weight in babies is considered a risk factor, especially when associated with prematurity. Low weight is correlated with greater chances of complications, neonatal morbidity and mortality, and prolonged hospitalization. Continuous care is necessary, especially after discharge and during the first year after birth, so as to correct possible nutritional deficits [25]. Premature birth abruptly interrupts the physiological growth and development that occurs more rapidly in the last three months of pregnancy. After birth, the NB cannot maintain the same growth rate due to several factors, especially to the immaturity of the organs and systems, with increased energy expenditure for the maintenance of thermal and metabolic homeostasis, hence the necessity to ensure a caloric and

adequate protein intake [26]. However, many premature baibes do not tolerate the evolution of nutritional therapy well, exhibiting complications such as necrotizing enterocolitis, respiratory disorders, and sepsis [27]. This fact makes it even more difficult for the infants to gain weight and to be granted discharge from the NICU.

Furthermore, the risk of malnutrition is also associated with low nutrient intake, low absorption and/or delay in early initiation of enteral or parenteral nutritional therapy in the NICU, due to the presence of clinical conditions associated with prematurity. Low weight growth is one of the indicators of the presence of malnutrition, a consequence of low caloric and protein intake [28].

The great disadvantage of prematurity is its correlation with multiple factors, triggering several metabolic complications, especially respiratory ones, thereby contributing to increased caloric expenditure and impairing the feeding process [29]. Respiratory Distress Syndrome (RDS) is one of the most frequent causes among newborns, especially in low birth weight and extremely premature infants. This occurs due to the decrease in surfactant levels due to lung immaturity because the lung is one of the last organs to fully develop at the end of pregnancy [30]. In addition, studies point out that RDS is the most prevalent causes of morbidity and mortality in high-risk children, requiring intensive care [31].

Early and late sepsis are also considered important findings among newborns admitted to the NICU. According to a study carried out by Damian et al., the incidence of sepsis ranges from one to eight cases per 1,000 births, and may be influenced by weight, invasive procedures, hospital stay, among other factors. Also, sepsis is difficult to diagnose in the first days after birth and can be confused with other pathologies, in addition to being more frequent in premature babies [4].

Regarding complications associated with the gastrointestinal tract, we can observe the presence of abdominal distension and gastric residue**,** data similar to that reported by Holzbach et al., who observed that 19.5% had gastric residue and 15.6% had abdominal distension [32]. Such symptoms indicate a malabsorption of nutrients, contributing to bronchoaspiration and consequent interruption of enteral nutrition [33]. Furthermore, the presence of gastric residue may be an indication of necrotizing enterocolitis when it is accompanied by other symptoms, such as: abdominal distension, vomiting, bloody stools, among others [32]. It is believed that one of the main causes of enterocolitis is gastrointestinal immaturity, which affects mainly prematurely born babies, interfering with nutritional therapy [34].

It is recommended to start the diet in the first 24 hours after birth, regardless of the gestational age at birth, except for those with intestinal pathologies, congenital digestive malformations, or hemodynamic instability [35]. However, when dealing with a premature baby or in the presence of any clinical condition that the diet may pose risks, the recommendation is to start with minimal/ trophic nutrition, that is, early administration of small volumes of diet, preferably breast milk. or pasteurized human milk [36]. In some cases, enteral and parenteral therapy should be associated, known as mixed nutritional therapy [27].

The objective of trophic enteral nutrition is to reduce the risks of necrotizing enterocolitis, especially for children born at less than 32 weeks and weighing less than 1.500 g, in addition to contributing to intestinal development, preventing atrophy from occurring and favoring the maturation of motor activity and weight gain [36]. A prolonged period of fasting results in impaired nutritional status and favors the risk of infections and complications due to the prolonged use of parenteral nutrition associated with central accesses, thus prolonging the days of hospital stay and increasing costs [37].

In the present study, enteral therapy data are similar to those reported by Santos et al., who observed that 50.8% of newborns in the NICU used enteral therapy via orogastric tube [20]. In fact, enteral nutritional therapy is the most recommended for infants in NICU. ESPGHAN recommends that the energy requirement of preterm newborns with healthy growth should reach the range of 115 to 140 kcal/kg/day. For a full-term baby, a caloric intake of 115 kcal/kg/day is recommended, which is often not possible due to the previously mentioned complications [37,38].

Preterm-born children have greater difficulty receiving oral feeding, due to immaturity, clinical conditions, low sucking reflex, hypotonia and respiratory problems that require great efforts such as breastfeeding [39]. In the present study, the newborns who were receiving an oral diet were late preterm infants with stable clinical conditions, in NICU care only for the treatment of jaundice, without respiratory problems or contraindications for oral feeding. The importance of implementing nutritional screening protocols in the NICU is fundamental to identify the nutritional risk even in the first 48 hours after birth, ensuring a faster and more effective, and accurate intervention. Thus, is possible to reduce the days of hospital stay, costs and better recovery of nutritional and general status. Moreover, nutritional risk screening aims to predict the probability of a better or worse outcome due to nutritional factors and whether nutritional treatment is likely to influence this outcome [4].

It is often assumed that every newborn in the NICU is at nutritional risk. However, nutritional screening tools are rarely used in practice. It is necessary to point out that the importance the routinely and standardized nutritional screening in all NICU patients.

Although this is a pioneering study with a neonatal

nutritional risk screening tool, we evaluated a small sample size. The literature has presented some studies of the validation the nutritional screening tools, however, there are still few studies with results from the use of such tools in clinical practice. So, we hope to encourage the development of new studies in these settings which include a large population and analyze the association the nutritional risk scores with other clinical outcomes.

Conclusions

This study demonstrated an elevated presence of the high nutritional risk in neonates in the NICU, as well as the variables with the greatest influence on nutritional risk. We propose that all infants admitted in the NICU be screening by a nutritional risk questionnaire in the routine care. Since nutritional risk is a potentially modifiable factor, nutrition could be an important element for improving the clinical outcomes of these patients.

Acknowledgments: the authors thank teachers, hospital school and children's family.

Conflict of interest: the authors declare no conflict of interest.

Author contributions: LBT and SES conceived the idea. LBT, SES and ICMM designed the study. SES and ICMM conducted data collection. LBT, SES, RASA and ICMM performed the data analysis. LBT and SES wrote the first draft of the manuscript. RASA and ICMM reviewed the first draft and critically reviewed the manuscript. LBT contributed to the writing, drafting and schematization of the article. All authors contributed to writing and approved the final version of the paper.

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