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Stress assessment instruments for hospitalized preterm newborns: scoping review

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Abstract

Background The highly technological environment existing in intensive care units, essential for the survival of the newborn, contributes with a potentially devastating and traumatic effect, especially in preterm newborns and in their future lives, due to the early and frequent exposure to multiple stressors. The preterm newborn must be observed in a systematic and structured way, before, during and after any intervention, aiming at the correct assessment and interpretation of his behaviour and signs of stress, and at the timely planning of interventions that minimize and prevent stress. The objective of this review is to identify and map the instruments for assessing stress in preterm newborns admitted to neonatal units in scientific evidence.

Methods A scoping review was carried out using the methodology presented by The Joanna Briggs Institute (JBI) and the PRISMA ScR model (Preferred Reporting Items for Systematic Reviews and Meta-Analyses extended for Scoping Reviews) for structuring the collected information. The research was carried out in three distinct phases supported by the Medline, CINALH databases through the EBSCO, Scielo and PubMed platform. Two reviewers screened all citations, abstract data and full-text articles, independently.

Results Ten articles were selected, all primary studies. Seven different scales were identified in the studies.

Discussion This review highlights the limited availability of instruments exclusively designed to assess neonatal stress in neonatology. While most tools, like the Newborn Comfort Behavior Scale and ALPS-Neo, focus on pain and stress together, the NISS and NSS provide valuable insights despite limitations in capturing individualized stress responses. Differentiating stress from pain is crucial for implementing targeted, neuroprotective interventions. Adapting neonatology environments and care practices to minimize stressors is essential for promoting newborns' well-being and long-term development.

Conclusion The findings underscore the critical need for stress-specific assessment tools in NICUs to differentiate between pain and stress. Existing instruments offer valuable insights but have notable limitations. Expanding validated tools and prioritizing individualized, neuroprotective care are essential for improving outcomes. Adapting neonatology practices to reduce stressors and implement family-centered care will support the holistic needs of newborns, fostering their development, physiological stability, and overall well-being.

System review registration Open Science Framework (https://osf.io/nsu95/).

Keywords Preterm newborn, Stress, Neonatology, Assessment tool

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Background

Approximately 13,4 million preterm newborns are born annually worldwide, a number that has progressively decreased over the years, but preterm birth complications continue to be the leading cause of death among children under 5 years of age [1]. In 2020, there was an estimated 3,4 million preterm birth, worldwide [1]. In Portugal, in 2023, the rate of premature live births, corresponding to births before 37 completed weeks of gestation and regardless of birth weight [2, 3], was 7,2%, corresponding to a total of 6190 births [4].

Prematurity assumes special relevance in the evaluation of perinatal health indicators and is associated with an increased risk of compromised neurodevelopment [5–7], a rate that in very premature infants, whose gestational age is less than 28 weeks, is between 15 and 25% [8, 9]. Preterm birth influences the healthy evolution of the child [10], increasing the probability of problems occurring in different areas and moments of child development [5–7, 11] and whose growth is contrary to what was expected and intended [12].

The main cause of neonatal mortality is still prematurity, but the survival of preterm newborns has been increasing, including that of very premature newborns [8, 9]. Despite the technological advances leading to improved survival of preterm newborns, namely newborns with very low birth weight [3, 13], the preterm newborn term is associated with a higher risk of mortality and morbidity [13, 14]. This fact is due to the increased tendency of excessive weight loss, food intolerance, hyperbilirubinemia, hypoglycaemia, hypothermia, respiratory stress, apnea and weak sucking, compared to the term newborn [14].

The highly technological environment existing in intensive care units, essential for survival, contributes with a potentially devastating and traumatic effect on newborns and their future lives, due to early and frequent exposure to multiple stressors, namely, hyperstimulating sensory stimuli, constant invasive procedures, lack of satisfaction of basic needs, especially the constant interruption of sleep and also by maternal and family deprivation that deprive them of affective relationships, protection and security [5, 15, 16].

By understanding that the hospitalization of preterm newborns is a traumatic event, professionals have a duty to increase their knowledge in order to incorporate the best practices based on evidence, minimizing and mitigating the associated toxic stress, contributing favourably to the reduction of long-term complications associated with language disorders, learning difficulties or emotional, mental and/or behavioural disorders [5–7, 15, 17–19].

The stress experienced in the perinatal period constitutes a pathogenic component that needs to be studied and deepened, to improve practices, since, due to their developmental phase, preterm newborns are not provided with effective strategies to deal with the various stimuli and, subsequently, reach a state of harmony and well-being.

Nurses must provide, in their care, a properly organized environment that promotes the harmonious development of the newborn, to minimize harmful stimuli and individualize stimulation based on the behavioural and physiological responses of the newborn, avoiding practices that are simply routine but unnecessary [6, 20–22]. Some author also suggest that nurses must create algorithms and practice standards to ensure the implementation of evidence-based practice [22] to manage stress exposure.

The newborn subject to constant sensory overload, has difficulties in managing energy in order to achieve regulation in all its subsystems [23], showing signs of exhaustion and stress. Faced with the nursing diagnosis, "stress" or "risk of stress" [24], which is always present in hospitalizations in neonatology, a careful assessment of the autonomic, motor, attention-interaction, self-regulation and general state of the subsystems is necessary [25, 26]. The preterm newborn must be observed in a systematic and structured way, before, during and after any intervention, aiming at the correct evaluation and interpretation of his behaviour. Therefore, it is important that the nurses perceive the neurobehavioral functioning of the preterm newborn, identifying the signs and symptoms of stress, aiming at the timely planning of interventions that minimize and prevent stress. The assessment is the first step of nursing process and nurses use several different instruments to provide safe and evidence-based care to patients. Systematic and structured assessment tools ensure the rigour of collected data and help nurses to evaluate the newborn stress correctly.

The aim of this scoping review (ScR) is to identify and map the instruments for assessing the stress of preterm newborns (NB) hospitalized in neonatology units in the scientific evidence. For this purpose, the following research intends to answer the question:

- What are the instruments for assessing the stress of preterm NB admitted to neonatology units?

Methods

In pursuit of the determined objective and question, a scoping review was developed on the instruments for assessing the stress of preterm newborns hospitalized in neonatology units, using the methodology presented by JBI (2020) and the PRISMA model ScR (Preferred

Reporting Items for Systematic Reviews and Meta-Analyses extended for Scoping Reviews) for structuring the collected information [27].

Eligibility criteria

Inclusion criteria

The inclusion criteria used, explained below, were constructed based on the mnemonic PCC – Population, Concept and Context, to which the typology of study, language and date of publication of the documents are added, with its inventory being justified in the previous chapter dedicated to the introduction and rationale for the proposed revision.

- ***Participants:*** Depending on the length of gestation, a newborn whose gestational age is less than 37 weeks of complete gestation is defined as preterm [1, 3, 28]. The preterm newborn can also be subdivided into three categories according to gestational age: extremely premature, aged less than 28 weeks, very premature, from 28 to 32 weeks, and late preterm, from 32 to 37 weeks [1]. Thus, the present study considered all studies that included preterm newborns admitted to the neonatology unit, regardless of their gestational age.
- ***Concept:*** Stress is considered a characteristic element of humanity that influences all biological systems. It is deemed as an environmental stimulus and tension producer that impels the person to readjust and adapt to new problems [29]. Preterm newborns, due to the immaturity of their neurodevelopment, do not have coping strategies to deal with stressors.
- ***Context:*** Hospitalization in neonatal intensive care unit (NICU) continues to constitute a paradigmatic example, in which the technical-scientific development essential to survival, can translate into a potentially devastating and traumatic effect on the child and on his/her future life, due to the early and frequent exposure to multiple stressors [5, 15, 16].
- ***Studies selection:*** All types of studies that assess the stress of preterm newborns admitted to the neonatology unit were considered, regardless of the gestational age. Aiming at the widest possible spectrum of the literature produced, no restrictions were established regarding the type of studies to be analysed, and all studies considered relevant to the topic in question may be included in this review, regardless of the research design adopted. There is also published and unpublished grey literature.
- ***Date:*** All types of studies published since January 1st of 2012.
- ***Language:*** All languages were included as long as the abstracts were in Portuguese, French, Italian, English and Spanish (Castilian) were considered eligible.

Exclusion criteria

All studies that had exclusively term newborns as participants were excluded, as also studies with the exclusive assessment of pain and did not include stress.

Search strategy

The research listed here had three distinct phases.

In the first one, the indexing terms in the CINAHL and Medline databases were identified, in order to identify the words and terms most suitable for building Boolean sentences.

The second phase of the research corresponded to the conventional search in electronic databases with previously delimited keywords. The databases used were Medline and CINALH through the EBSCO platform, as well as Scielo and PubMed. The search strategy will take place using different combinations of descriptors, through the Boolean operator "AND", and "OR" and the tool "*", to truncate words and contain multiple suffixes, being that the date of publication of 01/01/2012 to 09/1/2023 is the limiting filter. Aiming at accessing documents not included in the databases, a free search was also carried out in the so-called grey literature, academic Google, repositories, master's and doctoral theses, intending to include, in this way, information and studies that meet the criteria pre-delimited inclusion criteria, but which are not added to scientific publications, namely documents produced by professional associations and organizations.

In the third and last step, the list of references of the selected articles was analysed, proceeding to the reading of studies that may be considered relevant and, consequently, additional, aiming at increasing the sensitivity of the research. We present this list in Table 1.

Data extraction

Study selection, data extraction and coding were performed by two independent reviewers. In order to manage the research results, the Covidence® software was used, allowing easy collaboration in the study selection process. Duplicate studies were removed automatically. Initially, an analysis of the titles and abstracts of the selected studies was carried out, in accordance with the inclusion criteria described above.

After the first selection, the articles were read in full. Four studies were identified that did not obtain the agreement of both reviewers, so each one justified its choice and reached a consensus. Finally, after both reviewers having read the eligible studies in full, the relevant data

Table 1 Data sources and searches

CINHAL	MEDLINE	PUBMED	SCIELO
((Infant, Premature OR Premature OR Preterm OR Infant, low birthweight OR Neonat*) AND (Stress OR Stress Neonatal OR Neurobehavioral OR Disorganized Infant Behavior OR Signs of Disorganized State Behavior) AND (Scale OR Instrument OR Outcome evaluation OR Assessment OR Assessment tool OR Tool OR Outcome assessment) AND (Intensive Care Units, Neonatal OR Nurserie OR NICU OR Neonatal Intensive Care Unit OR Neonatology OR Hospitalization)) NOT (Oxidative stress OR Stress Disorders OR Mother stress))	((Infant, Premature OR Premature OR Preterm OR Infant, low birthweight OR Neonat*) AND (Stress OR Stress Neonatal OR Neurobehavioral OR Disorganized Infant Behavior OR Signs of Disorganized State Behavior) AND (Scale OR Instrument OR Outcome evaluation OR Assessment OR Assessment tool OR Tool OR Outcome assessment) AND (Intensive Care Units, Neonatal OR Nurserie OR NICU OR Neonatal Intensive Care Unit OR Neonatology OR Hospitalization)) NOT (Oxidative stress OR Stress Disorders OR Mother stress))	((Infant, Premature OR Premature OR Preterm OR Infant OR Neonat*) AND (Stress OR Stress Neonatal OR Neurobehavioral OR Disorganized Infant Behavior OR Signs of Disorganized State Behavior) AND (Scale OR Instrument OR Outcome evaluation OR Assessment OR Assessment tool OR Tool OR Outcome assessment) AND (Intensive Care Units, Neonatal OR Nurserie OR NICU OR Neonatal Intensive Care Unit OR Neonatology OR Hospitalization)) NOT (Oxidative stress OR Stress Disorders OR Mother stress OR Pain OR Father stress))	((Infant, Premature OR Premature OR Preterm OR Infant OR Neonat*) AND (Stress OR Stress Neonatal OR Neurobehavioral OR Disorganized Infant Behavior OR Signs of Disorganized State Behavior) AND (Scale OR Instrument OR Outcome evaluation OR Assessment OR Assessment tool OR Tool OR Outcome assessment) AND (Intensive Care Units, Neonatal OR Nurserie OR NICU OR Neonatal Intensive Care Unit OR Neonatology OR Hospitalization)) NOT (Oxidative stress OR Stress Disorders OR Mother stress OR Pain OR Father stress))

were extracted and subsequently analysed using the JBI Template Source of Evidence Details, Characteristics and Results Extraction Instrument, adapted to the question of this review, validated and accepted by both reviewers.

The result of the search and selection of studies is presented in full (Fig. 1) schematized through the Preferred Reporting Items for Systematic Reviews and Meta-analyses ScR (PRISMA—ScR).

Results

At the beginning of this path, 209 articles were identified for analysis in this review. Duplicate articles in the various databases were removed, leaving 109. An article obtained after analysing the references of the studies included in this review was also included. At the end of the process, 19 studies were obtained for full reading. 10 articles met the defined criteria, so they were included in this study. Of the total of excluded articles, 6 did not present the intended intervention (stress assessment), 1 was duplicated, 1 had no indication for stress and the last one was intended for another population, differently from the one defined in the inclusion criteria.

The 9 articles correspond to primary studies. The most frequent study design was experimental ($n=4$), followed by clinical trial ($n=2$), cross-sectional ($n=1$), observational ($n=1$) and methodological (1). Table 2 summarizes the main information extracted from the studies, namely the stress assessment tools used.

After analysing the studies, seven instruments were found in these studies, Neonatal Infant Stressor Scale (NISS) ($n=6$), Newborn Stress Scale (NSS) ($n=3$), ALPS – Neo pain and stress assessment scale ($n=1$), Neurobehavioral Assessment of Preterm Infant (NAPI) ($n=1$), NICU Network Neurobehavioral Scale ($n=1$),

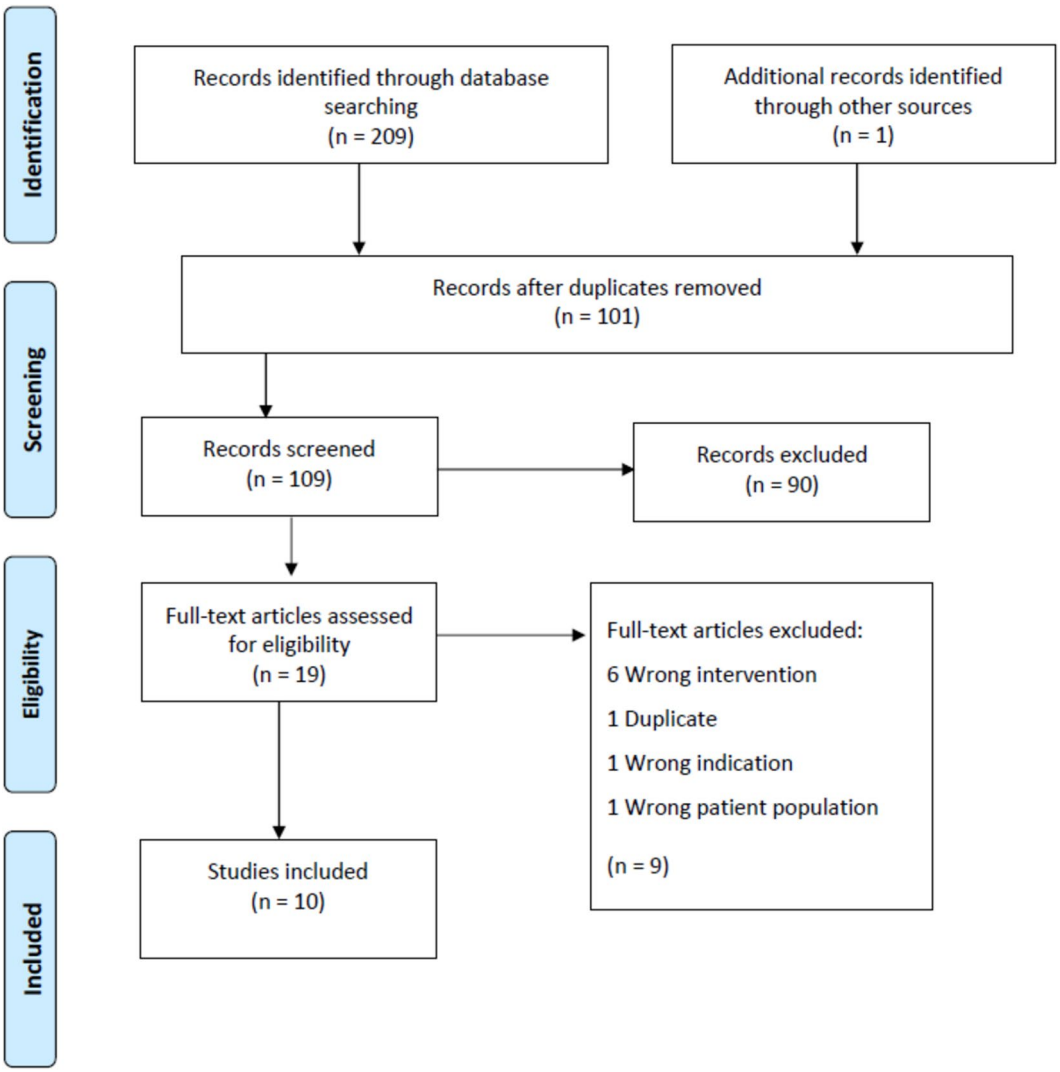

Fig. 1 PRISMA flowchart for presenting the research process, identification, and inclusion of studies

Table 2 Details of included studies

Reference	Article	Authors	Year	Country	Design	Study Sample and Level of NICU	Aims	Assessment Tool
[30]	Neurobehavioral development prior to term-age of preterm infants and acute stressful events during neonatal hospitalization	Gorzilio et al	2015	Brazil	Cross-sectional design	• 45 Preterm (PT) 23 to 36 weeks of gestational age • NICU level – without information	To compare early neurobehavioral development prior to term-age in preterm infants at 34–36 weeks of post-conceptional age in different gestational ages, and to examine the effects of prematurity level and acute stressful events during NICU hospitalization on neurobehavioral development	Neonatal Infant Stressor Scale (NISS) Neurobehavioral Assessment of Preterm Infant (NAPI)
[31]	The Impact of Cumulative Pain/Stress on Neurobehavioral Development of Preterm Infants in the NICU	Cong et al	2017	USA	Prospective Exploratory Study	• 50 PT 28 to 32 weeks of gestational age • NICU level – III e IV	To investigate the impact of early life painful/stressful experiences on neurobehavioral outcomes of preterm infants in the NICU	Neonatal Infant Stressor Scale (NISS) NICU Network Neurobehavioral Scale
[32]	Effects of Swaddled and Sponge Bathing Methods on Signs of Stress and Pain in Premature Newborns: Implications for Evidence-Based Practice	Ceylan & BolŁşŁk	2018	Turkey	Clinical trial with a crossover design	• 35 PT 33 to 37 weeks of gestational age • NICU level – II e III	Evaluate the pain and stress behaviors of infants	Newborn Stress Scale (NSS) ALPS – Neo pain and stress assessment scale
[20]	Novel Method of Measuring Chronic Stress for Preterm Infants: Skin Cortisol	D'Agata et al	2019	USA	Experimental study	• 82 PT 24 to 37 weeks of gestational age • NICU level III	To examine if skin cortisol may be a reliable biomarker of stress	Neonatal Infant Stressor Scale (NISS)
[33]	Clinical validation of the Neonatal Infant Stress Scale with preterm infant salivary cortisol	Pourkaviani el at	2020	USA	Longitudinal experimental study	• 125 PT 28 to 38 weeks of gestational age • NICU level IV	To test the association between NISS scores and salivary cortisol in preterm	Neonatal Infant Stressor Scale (NISS)
[34]	Effects of two different positions on stress, pain and feeding tolerance of preterm infants during tube feeding	Ceylan & Keskin	2021	Turkey	Randomized cross-over clinical trial	• 34 PT 30 to 34 weeks of gestational age • NICU level – without information	Explore the effect of semi-elevated supine and semi-elevated right lateral positions during tube feeding on preterm infants feeding tolerance, stress, and pain levels	Newborn Stress Scale (NSS)

Table 2 (continued)

Reference	Article	Authors	Year	Country	Design	Study Sample and Level of NICU	Aims	Assessment Tool
[35]	Measures of stress exposure for hospitalized preterm infants	Nist et al	2020	USA	Longitudinal study	• 71 PT • 28 to 31 weeks of gestational age • NICU level – without information	Compare measures of stress exposures commonly used by researchers and to determine the predictive validity of these measures for early neurobehavior	Neonatal Infant Stressor Scale (NISS)
[36]	Novel Methods Examining Stress, Rest and Growth in Nicu Vulnerable Infant Population	Purdy, I	2012	USA	Randomized controlled blinded multi-centre pilot study	• 19 PT • Without more information	To describe novel methods used to investigate stress reactivity, growth and rest in preterm infants randomized to a music intervention while quantifying noise levels in the neonatal intensive care unit	Neurobiologic Risk Score
[37]	Course of Stress during the Neonatal Intensive Care Unit Stay in Preterm Infants	van Dokkum et al	2021	Netherlands	Single centre prospective cohort study	• 45 PT 24 to 29 weeks of gestational age • NICU level III–IV	To describe the course of stress in preterm infants during the first 28 days of life, the influence of gestational age, and associations with clinical characteristics	Neonatal Infant Stressor Scale (NISS)
[17]	Examining psychometric properties of newborn stress scale	Ceylan & Bolışık	2017	Turkey	Methodological study	• 212 PT 28 to 37 weeks of gestational age • NICU level – without information	To develop a practical assessment tool that researchers and clinicians can use to evaluate the stress of a newborn	Newborn Stress Scale (NSS) Newborn Comfort Behavior Scale

Neurobiologic Risk Score ($n=1$) and Newborn Comfort Behavior Scale ($n=1$).

Aiming a greater understanding of the identified instruments, Table 3 shows their characterization, namely their aims and indicators.

After analysis, 3 of the scales refer to the assessment or prediction of the risk of alterations in the neurodevelopment of newborns (Neurobiologic Risk Score [36], NICU Network Neurobehavioral Scale [31] and NAPI [30]).

The Newborn Comfort Behavior Scale [17] and the ALPS—Neo pain and stress assessment scale [31] are instruments that aim to assess pain and stress.

The most mentioned scale in the included studies was the NISS [20, 30, 31, 33, 35, 37]. This scale aims to identify stress-generating experiences (stressors) in the daily routine of care for hospitalized newborns.

The NSS [17, 32, 34] is a scale that aims to assess the stress of newborns hospitalized in neonatology and includes 8 behavioural items, promoting a non-invasive assessment.

Discussion

The assessment of newborn' stress admitted to NICU is a crucial data of neuroprotective and humanized care, particularly because of the impact that environmental stimuli, invasive procedures, and clinical conditions can have on their well-being and development. However, during the research for instruments specifically designed to evaluate neonatal stress, it was observed that most available scales focus predominantly on pain assessment, with few tools dedicated exclusively to stress.

The Newborn Comfort Behavior Scale [17] and the ALPS—Neo pain and stress assessment scale [31] are good examples of that reality, because they are instruments that aim to assess pain and stress together, however they were accepted in this review because they were aimed at assessing also stress. Pain assessment was an exclusion element in the instruments that were intended to be found. This predominance of pain-focused scales partly reflects the heightened awareness of the adverse effects of untreated pain in newborns. Nevertheless, it is essential to recognize that stress and pain are distinct experiences, although they are often interrelated. Painful experiences are always stressful, but there are experiences that aren't recognized as painful, but they are very stressful, like mother separation or hyperstimulant environment in NICU. Both involve similar physiological and behavioral responses, but the use of pain-assessment scales may underestimate or fail to capture the full extent of stress experienced by newborns.

Identifying and monitoring neonatal stress is equally important, as it can have long-term repercussions, including an increased risk of emotional, behavioral, and cognitive developmental issues [5–7, 15, 16]. Neuroprotective care aims to provide care based on the newborn's behavioral response, individualizing care to their rhythm and focusing on their need [5–7].

Neurobiologic Risk Score [36], NICU Network Neurobehavioral Scale [31] and NAPI [30]), aim to assess the progression of early neurobehavioral and to predict neurodevelopmental problems, so they do not correspond to what was intended with this review.

The NISS was introduced as a practical and non-invasive method for assessing the cumulative stress experienced by preterm infants in the NICU [20, 30, 31, 33, 35, 37]. With this instrument researchers can concluded that neonatal stress varies significantly between infants and over time, with the highest average scores occurring in the first week after birth. NISS scores are closely linked to various clinical factors, potentially indicating the severity of illness during the NICU stay [37]. The researchers also studied the role of stress in the NICU, and they concluded that NISS can be used as a reasonable indicator of a newborn's acute stress [33]. However, the limitation of this instrument is the fact that it evaluates the number of interventions, and not the newborn's response to them. NISS provides a practical way to estimate cumulative stress in preterm infants, but it does not assist nurses in recognizing specific signs of stress in these newborns, so important to individualize the nursing care according to newborn's tolerance.

NSS promotes a non-invasive stress assessment, using only observation [17, 34]. It was developed by Ceylan & Bolışık in 2017 in Turkey and is only available in this language. As it is a behavioural scale, it cannot be applied to newborns under analgesic, sedative, or muscle relaxant medication, or with neurological disease, congenital anomalies, hyperbilirubinemia, or undergoing surgery [17]. It is an easy-to-use instrument and does not involve associated costs, as it does not require specific equipment. According to the authors, this instrument will contribute to the planning of individualized care based on the stress of newborns hospitalized in NICU and can also be used in studies that aim to assess neonatal stress [17].

Furthermore, distinguishing between pain and stress is essential for implementing targeted and effective interventions, preventing future development problems.

It is crucial for nurses to differentiate between pain and stress in preterm infants admitted to the NICU. While both can have negatively impact on the infant's development and well-being, they require different management approaches. Acute pain is typically a response to a specific stimulus and often necessitates immediate intervention, such as analgesics or non-pharmacological strategies. Stress, on the other hand, may result from cumulative stressors like noise,

Table 3 Characterization of instruments

Instrument	Aims	Indicators
Neonatal Infant Stressor Scale (NISS) [20, 30, 31, 33, 35, 37]	Describe the breadth of stressors to which preterm infants are exposed Used to collect information concerning daily stress experiences of NICU infants during care	Daily stressors are assessed for a daily stress score. The interventions are ranked on a 4-point scale as extremely stressful, very stressful, moderately stressful and a little stressful. Each procedure attempt is counted as one stress event
Newborn Stress Scale (NSS) [17, 32, 34]	Assess stress in premature infants	8 items: face expression, colour, respiration, activity level, consolation, muscle tone, extremities and posture Each item scored on the scale 0–2. The minimum score is 0 and the maximum is 16. As the scores increases, so the stress levels on infants
ALPS – Neo pain and stress assessment scale [32]	Assess pain and stress in premature and term neonates	5 items: facial expression, breathing pattern, tone of extremities, hand and foot activity, and level of activity The minimum score is 0 and the maximum is 10. As the scores increases, so the pain and stress levels on infants
Neurobehavioral Assessment of Preterm Infant (NAPI) [30]	Assess the progression of early neurobehavioral performance in preterm infants from 32 weeks of post-conceptional age to term age (38–40 weeks post-conceptional age, gestational age plus chronological age)	Seven clusters: motor development and vigour, scarf sign, popliteal angle, alertness and orientation, irritability, cry quality, and percent asleep ratings The score in each cluster range is from 0 to 100. When cluster scores fall more than one standard deviation below the mean, there is early risk of abnormal neurodevelopment
NICU Network Neurobehavioral Scale [31]	Measure the infant's bio-behavioral organizations as a valid biomarker for detecting at-risk infants, with the ability to predict neurodevelopment	3 main sections – Neurological, items for tone and reflexes; Behavioral, items of state, sensory, and interactive processes; stress/abstinence responses Total of 115 items which generates 13 summary subscales (measuring – habituation, attention, need for handling, quality of movement, self-regulation, non-optimal reflexes, asymmetric reflexes, arousal, hypertonicity, hypotonicity, excitability, lethargy, and stress/abstinence)
Neurobiologic Risk Score [36]	Neurological prediction in very-low birth weight newborns	Originally worked on 11 variables of conceptual model, but a revised scoring system indicates that using only 7 of these items has similar effects Those items are ventilation, pH, seizures, intraventricular haemorrhage (IVH), periventricular leukomalacia, infection, and hypoglycaemia The minimum score of each variable is 0 and the maximum is 4
Newborn Comfort Behavior Scale [17]	Nonintrusive method of assessing distress and pain To be used in the assessment of sedation and comfort needs, pain and anguish in newborns monitored in the intensive care unit	7 dimensions—Respiratory response, Alertness, calmness/agitation, crying, facial tension, muscle tone, body movement. The responses are assessed in a 1 to 5 Likert scale, and total scores range from 6 to 30—with higher scores indicating more pain and less comfort

handling, mother separation or even pain, and it's managed through strategies to minimize the negative impact of that stressors or to extinguish the stressors. Recognizing and addressing these distinct concepts, although the responses of newborn could be similar, ensures that preterm infants receive appropriate and individualized care to support their recovery and development. Researchers found that infants' total stress scores during and after tube feeding were higher in the semi-elevated supine position compared to the semi-elevated right lateral position, and this difference was larger [34]. These findings were possible because a stress assessment scale was used, allowing for the precise detection of differences in stress levels between the two feeding positions.

NICU must adapt their routines, care practices and environment to minimize preterm newborn stress. This includes implementing strategies to reduce noise and light exposure, minimizing unnecessary handling, and ensuring a supportive environment. Adjusting daily care routines to prioritize the infant's comfort and incorporating family-centered practices, such as kangaroo care, can significantly reduce stress levels. These adaptations are essential to minimize stress and consequently to promote the infant's neurological development, physiological stability, and overall well-being during their stay in the NICU. There is, therefore, a clear need to expand the range of available tools to include validated and specific instruments for neonatal stress, fostering a more holistic approach to the care of hospitalized newborns. This would enable more precise interventions and contribute to neonatal practices that fully respect the emotional and physical needs of this vulnerable population.

Study limitations

Limitations of our findings are anticipated due to limited access to information sources and language, because of the Turkish language of some articles. Another limitation was because there are few instruments who really assess the newborn 's stress. The studies included varied significantly in their focus, with some addressing pain and stress assessment, others emphasizing neurobehavioral development, and only a few directly targeting neonatal stress. This heterogeneity complicates the synthesis of findings and the development of a comprehensive understanding of stress-specific assessment tools. The lack of specific tools limits the ability to evaluate stress independently from related constructs, such as pain or neurobehavioral outcomes. Neonatal stress assessment is an emerging field, and this scoping review may not have captured the most recent developments or unpublished tools under validation.

Conclusion

The findings of this review highlight the critical importance of identifying and assessing neonatal stress in the NICU setting as part of neuroprotective and humanized care. While significant progress has been made in understanding the impact of environmental and procedural stressors on newborns, the limited availability of specific tools to assess neonatal stress remains a key challenge.

Most existing instruments, such as the Newborn Comfort Behavior Scale and the ALPS-Neo, focus predominantly on pain and stress combined, reflecting a historical emphasis on pain management. However, stress and pain, though interconnected, are distinct phenomena that require differentiated approaches to assessment and management. The lack of tools specifically designed to evaluate stress independently from pain underscores the need for further research and development in this area.

The review also underscored the potential of tools like the NISS and NSS for stress assessment. While the NISS provides valuable insights into cumulative stress through a non-invasive approach, its limitation lies in its inability to capture individual newborn responses. On the other hand, the NSS offers a behavioral-based assessment that aligns with neuroprotective care principles, though its applicability is constrained by factors such as language availability and exclusion of certain populations.

Given the implications of neonatal stress on long-term development, there is a pressing need for NICUs to adapt their practices to minimize stressors. This includes creating a supportive environment, prioritizing individualized care, and integrating family-centered practices. Moreover, fostering the development and validation of new tools focused exclusively on stress assessment would enable nurses to implement more precise interventions tailored to the unique needs of each newborn.

Implication for nursing and research

This study identifies a stress assessment instrument that can be used in NICU just with nursing observation, without no need for monitoring or medical devices, so it can be used like a non-invasive instrument. Using a dedicate scale to identify signs of neonatal stress allows nurses to carry out a more precise and systematic assessment of newborns. By recognizing stress early on, the nursing team can act proactively, preventing potential adverse consequences such as problems in neurobehavioral development or increased length of hospital stay. Also, the continued use of stress assessment's instruments promotes nurses' knowledge about recognition of neonatal stress signs, and can be used in training and classes, promoting competences based on scientific evidence.

The findings of this review highlight the need for further studies to validate and adapt the scale to

different cultural and clinical contexts, ensuring its global applicability.

Future research could explore the relationship between neonatal stress, identified through the scale, and long-term clinical outcomes such as cognitive and emotional development.

There are also opportunities to investigate how interventions based on the early identification of stress, can impact on the quality of neonatal care and the experience of families.

The findings of this review underline the critical thinking of nursing in the assessment and management of neonatal stress, highlighting the importance of standardized tools and promoting advances both in clinical care, in the training and production of knowledge.

Dissemination

The results of this review will be disseminated through publication in a peer-reviewed journal, presentation in scientific conferences and through interaction with potential knowledge users as NICU professionals.

Abbreviations

JBI	Joanna Brigs Institute
WHO	World Health Organization
NICU	Neonatal intensive care units
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-analyses
ScR	Scoping Review
NISS	Neonatal Infant Stressor Scale
NSS	Newborn Stress Scale
ALPS	Neo pain and stress assessment scale
NAPI	Neurobehavioral Assessment of Preterm Infant
IVH	Intraventricular haemorrhage

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MC and AB worken on this review and drafted the protocol under the supervision of MASC, MFG. All authors of the manuscript have read and agreed to its content and the final version.

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Declarations

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Consent for publication

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Competing interests

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