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PREVALÊNCIA DE FERIDAS EM NEONATOS INTERNADOS: UMA REVISÃO SISTEMÁTICA
PREVALENCE OF WOUNDS IN HOSPITALISED NEONATES: A SYSTEMATIC REVIEW
PREVALENCIA DE HERIDAS EN NEONATOS HOSPITALIZADOS: UNA REVISIÓN SISTEMÁTICA

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RESUMO

Introdução: A integridade da pele do recém-nascido é essencial para o seu bem-estar e sobrevivência, uma vez que atua como barreira protetora, promove a termorregulação e impede a absorção de agentes químicos.
Objetivo: Determinar a prevalência de feridas em neonatos internados em hospitais.
Métodos: Foi realizada uma revisão sistemática de prevalência com meta-análise que seguiu o método proposto pelo Instituto Joanna Briggs. A pesquisa foi realizada em nove bases de dados, e incluiu estudos em língua inglesa, portuguesa, francesa e espanhola, sem limite de data de publicação. A seleção, avaliação crítica e extração de dados foram realizadas por dois revisores independentes. Foram realizadas meta-análises binárias de efeito randomizado de prevalência através do método do inverso da variância com transformação Freeman-Tukey double arcsine.
Resultados: A estratégia de pesquisa identificou 1964 registos, dos quais apenas 26 artigos integraram o corpus da revisão. A meta-análise binária de prevalência foi realizada com 22 estudos e contou com uma amostra de 3768 neonatos. A prevalência combinada de lesões foi de 39% (IC 95% = 28-50%; p<0,01). Os estudos incluídos nesta revisão mostram a necessidade de intervenções direcionadas à prevenção e gestão das lesões cutâneas em recém-nascidos internados em hospitais.
Conclusão: Existe uma prevalência significativa de lesões cutâneas em recém-nascidos hospitalizados. É fundamental implementar intervenções, no âmbito da avaliação do risco e de práticas baseadas na evidência, para garantir a integridade da pele do neonato.

Palavras-chave: recém-nascido; ferimentos e lesões; prevalência; revisão sistemática

ABSTRACT

Introduction: The integrity of the newborn's skin is essential for its well-being and survival, as it acts as a protective barrier, promotes thermoregulation, and prevents the absorption of chemical agents.
Objective: To determine the prevalence of wounds in neonates admitted to the hospital.
Methods: A systematic prevalence review with meta-analysis was carried out following the method proposed by the Joanna Briggs Institute. The search was carried out in nine databases and included studies in English, Portuguese, French and Spanish, with no limit on the date of publication. The selection, critical evaluation, and extraction of data were carried out by two independent reviewers. Binary random-effect meta-analyses of prevalence were carried out using the inverse variance method with Freeman-Tukey double arcsine transformation.
Results: The search strategy identified 1964 records, of which only 26 articles formed part of the review corpus. The binary meta-analysis of prevalence was carried out with 22 studies and included a sample of 3768 neonates. The combined prevalence of injuries was 39% (95% CI= 28-50%; p<0.01). The studies included in this review show the need for interventions aimed at the prevention and management of skin lesions in newborns admitted to the hospital.
Conclusion: There is a significant prevalence of skin lesions in hospitalized newborns. It is essential to implement interventions within the framework of risk assessment and evidence-based practices to ensure the integrity of the neonate's skin.

Keywords: infant; newborn; wounds and injuries; prevalence; systematic review

RESUMEN

Introducción: La integridad de la piel del recién nacido es esencial para su bienestar y supervivencia, ya que actúa como barrera protectora, favorece la termorregulación e impide la absorción de agentes químicos.
Objetivo: Determinar la prevalencia de heridas en neonatos ingresados en el hospital.
Métodos: Se realizó una revisión sistemática de prevalencia con metaanálisis siguiendo el método propuesto por el Instituto Joanna Briggs. La búsqueda se realizó en nueve bases de datos e incluyó estudios en inglés, portugués, francés y español, sin límite de fecha de publicación. La selección, evaluación crítica y extracción de datos fue realizada por dos revisores independientes. Se realizaron metaanálisis binarios de efectos aleatorios de prevalencia mediante el método de la varianza inversa con transformación de doble arcoseno de Freeman-Tukey.
Resultados: La estrategia de búsqueda identificó 1964 registros, de los cuales sólo 26 artículos formaron parte del corpus de revisión. El metaanálisis binario de prevalencia se realizó con 22 estudios e incluyó una muestra de 3768 neonatos. La prevalencia combinada de lesiones fue del 39% (IC 95%= 28-50%; p<0,01). Los estudios incluidos en esta revisión muestran la necesidad de intervenciones dirigidas a la prevención y el tratamiento de las lesiones cutáneas en los neonatos ingresados en el hospital.
Conclusión: Existe una prevalencia significativa de lesiones cutáneas en los recién nacidos hospitalizados. Es fundamental implementar intervenciones, en el marco de la evaluación de riesgos y las prácticas basadas en la evidencia, para garantizar la integridad de la piel del neonato.

Palabras Clave: recién nacido; heridas y lesiones; prevalencia; revisión sistemática

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INTRODUCTION

The skin of the newborn has the main functions of acting as a protective barrier, promoting thermoregulation, minimizing transepidermal water loss, preventing the absorption of chemical agents, protecting against infectious agents, and acting in immunovigilance (Silva & Paiva, 2022).

As a result of technological advances, newborns currently have a higher survival rate, and infant mortality has fallen. However, in the hospital environment, newborns are often exposed to various procedures such as venipunctures, the use of medicinal products, disinfection, and devices, so skin care should be an effective concern for health professionals, including nurses (Silva & Paiva, 2022).

Newborns' skin is inherently fragile and delicate, compared to that of adults, as their organs and subsystems, including the skin, are immature. The use of medical devices, which are essential for the survival of this population, combined with these innate characteristics, increases the risk of skin damage (Machado et al., 2022).

Skin lesions in newborns are one of the factors that contribute to longer hospital stays, which calls for interventions by the nursing team to promote skin care and implement frequent skin assessments to identify and eliminate the risk factors that cause lesions. This is a constant challenge for care teams, which demonstrates the need for scientific knowledge with the application of evidence-based practice, to minimize possible complications during hospitalization (Silva & Paiva, 2022).

In view of these findings, the integrity of neonatal skin is essential for the well-being and survival of neonates, so understanding the prevalence of wounds in hospitalized neonates is fundamental to developing effective prevention and treatment strategies. Accurate data on the frequency and causes of these injuries is essential to improve clinical practices, enhance the quality of care, and minimize the negative impact on newborns' health. Thus, early identification and appropriate treatment of skin lesions can prevent serious complications and improve long-term health outcomes.

This article aims to present the prevalence of wounds in neonates admitted to hospitals, mainly in Neonatal Intensive Care Units, providing a comprehensive overview of the occurrence of these injuries. Through a detailed analysis of the available data and associated conditions, we aim to contribute to improving clinical practices and reducing the risks associated with skin lesions in neonates.

1. THEORETICAL FRAMEWORK / LITERATURE REVIEW

The World Health Organization (WHO) estimates that around 9.9% of babies are born prematurely in the world every year. In Europe, in 2019, there was an average preterm birth rate of 6.9 per cent. However, in Portugal, the rate is 8.0%. These figures are alarming, as complications related to premature birth are the leading cause of death among children under the age of five (Euro-Peristat Project, 2022; Ohuma et al., 2023; World Health Organization, 2023). It is known that in Portugal, between 2007 and 2016, there were 781,599 hospitalizations of newborns, with a hospitalization/birth rate of 1.035, of which 7.7% were diagnosed with prematurity or low birth weight (Magalhães, 2016).

The skin of newborn babies performs important functions, such as thermoregulation, protection against infections and fluid loss, as well as acting as a physical and sensory barrier. The skin, particularly of premature infants, has specific characteristics that increase the risk of trauma and loss of integrity (Gardner et al., 2016; Sociedade Portuguesa de Pediatria, 2014a).

Compared to adult skin, the skin of the full-term neonate is thinner, less mature, has less capacity for thermal regulation and immunological protection, and is still in the process of adapting from the aquatic environment of the womb to the air environment. On the other hand, the skin of premature neonates is even more delicate, as they have immature and more vulnerable skin. As the epidermis is thinner, the dermis has less collagen and elastic fibers, and the stratum corneum barrier is still maturing. The skin is therefore more permeable, prone to blisters and less elastic, which increases vulnerability to mechanical injuries, infections, and dehydration (Gardner et al., 2016; Sociedade Portuguesa de Pediatria, 2014b, 2014a).

Premature neonates are therefore particularly vulnerable to skin problems due to their physiological immaturity. Problems such as infections, difficulties in thermoregulation, and increased percutaneous absorption of chemicals are common among these babies. As the skin of these neonates is significantly thinner and more delicate, the risk of injuries from routine care practices such as skin disinfection and adhesive removal increases (Lund & Singh, 2022; Steen et al., 2020).

On the other hand, pressure injuries (PI) occur when there is a decrease in circulation, caused by external pressure constantly applied to the tissue, which results in the cell death of soft tissues. Possible causes include the compression of tissue over a bony prominence, the use of a medical device, or the pressure exerted by other devices (Machado et al., 2022).

It is estimated that more than 50% of PIs in newborns are associated with the use of or the contact with medical devices in the care environment, such as equipment, wires, tubes, positive airway pressure masks or prongs, oxygen, saturation sensors, electrocardiogram electrodes, and electroencephalogram electrodes (Machado et al., 2022).

Considering the above, the vulnerability of neonatal skin is exacerbated by various risk factors present in hospital environments, such as the use of sedative and vasopressor medication, the presence of multiple tubes and lines, constant monitoring, and surgical interventions. These factors, combined with the characteristics of the skin, require rigorous care and specific practices to prevent

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skin lesions (Fox, 2011; Gardner et al., 2016; Lund & Singh, 2022). These injuries can occur antenatally, during the labor process, or as a direct result of care (Irving, 2006).

2. METHODS

A systematic prevalence review with meta-analysis was carried out following the method proposed by the Joanna Briggs Institute (Munn et al., 2019). It was written in accordance with the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) (Moher et al., 2015; Page et al., 2021). The review protocol was carried out and followed by the authors, although it has not been published and/or registered.

The search was carried out on 23 February 2024 in the databases PubMed, CINAHL Complete, Nursing & Allied Health Collection: Comprehensive, MedicLatina, LILACS and the Cochrane Library (Cochrane Clinical Answers, Cochrane Methodology Register, Cochrane Database of Systematic Reviews and Cochrane Central Register of Controlled Trials).

Studies in English, Portuguese, French and Spanish were included, with no limit on the date of publication. The PubMed search strategy carried out on 23 February 2024 is shown in Table 1 and was subsequently adapted to the lexicons of the other databases.

Table 1 - Search strategy carried out on PubMed on 23 February 2024

ID	Search formula	Results
#5	("wound*"[Title/Abstract] OR "skin"[MeSH Terms] OR "wounds and injuries"[MeSH Terms]) AND ("intensive care units, neonatal"[MeSH Terms] OR "neonatal icu"[Title/Abstract] OR "neonatal intensive care unit*"[Title/Abstract] OR "newborn icu"[Title/Abstract] OR "newborn intensive care unit*"[Title/Abstract] OR "nicu"[Title/Abstract] OR "intensive care, neonatal"[MeSH Terms] OR "neonatal intensive care"[Title/Abstract]) AND ("infant, newborn"[MeSH Terms] OR "neonate*"[Title/Abstract] OR "newborn*"[Title/Abstract]) AND (english[Filter] OR french[Filter] OR portuguese[Filter] OR spanish[Filter])	873
#4	("wound*"[Title/Abstract] OR "skin"[MeSH Terms] OR "wounds and injuries"[MeSH Terms]) AND ("intensive care units, neonatal"[MeSH Terms] OR "neonatal icu"[Title/Abstract] OR "neonatal intensive care unit*"[Title/Abstract] OR "newborn icu"[Title/Abstract] OR "newborn intensive care unit*"[Title/Abstract] OR "nicu"[Title/Abstract] OR "intensive care, neonatal"[MeSH Terms] OR "neonatal intensive care"[Title/Abstract]) AND ("infant, newborn"[MeSH Terms] OR "neonate*"[Title/Abstract] OR "newborn*"[Title/Abstract])	932
#3	"infant, newborn"[MeSH Terms] OR "neonate*"[Title/Abstract] OR "newborn*"[Title/Abstract]	797,567
#2	"intensive care units, neonatal"[MeSH Terms] OR "neonatal icu"[Title/Abstract] OR "neonatal intensive care unit*"[Title/Abstract] OR "newborn icu"[Title/Abstract] OR "newborn intensive care unit*"[Title/Abstract] OR "nicu"[Title/Abstract] OR "intensive care, neonatal"[MeSH Terms] OR "neonatal intensive care"[Title/Abstract]	43,203
#1	"wound*"[Title/Abstract] OR "skin"[MeSH Terms] OR "wounds and injuries"[MeSH Terms]	1,470,156

After the search, all the citations identified were transferred to the Rayyan® platform and duplicates removed. To assess their eligibility, the titles and abstracts were analysed by two independent reviewers (DA and AR). In the absence of consensus, a third reviewer (ES) was included as a tiebreaker. The full articles were analysed based on the following inclusion criteria that follow the CoCoPop mnemonic (Condition, Context and Population):

- **Condition:** All studies presenting the prevalence of any aetiology of wound or skin lesion, which is defined as a disturbance in the normal structure and function of the skin and underlying soft tissues that may be related to a variety of aetiologies (e.g. trauma, surgery, sustained pressure, vascular disease, infection, among others) were considered (Beitz, 2022).
- **Context:** Only the hospital inpatient setting was considered, with an emphasis on neonates admitted to Neonatal Intensive Care Units, given the specificity of the population.
- **Population:** All studies referring to newborns were considered.

As for the types of studies included, in addition to meeting the inclusion criteria, they were quantitative studies, namely primary quantitative studies, and mixed studies, with the possibility of extracting quantitative data in isolation. As already mentioned, the study selection process was operationalised using the Rayyan® platform, which also served as a tool to register the blinding of reviewers.

The quality of the studies was assessed by two independent reviewers (DA and AR) using JBI's Critical Appraisal Tools, depending on the type of study. Thus, 13 studies were analysed using the 'Checklist for analytical cross-sectional studies', 1 study using the 'JBI Critical Appraisal Tool for Assessment of Risk of Bias for Randomized Controlled Trials', 5 studies using the 'Checklist for Cohort Studies', 6 studies using the 'Checklist for Prevalence studies' (Munn et al., 2020) and 1 study using the 'Checklist for Case Series'. After critical appraisal, all studies were included regardless of the results. However, the results of the critical appraisal were considered in the synthesis of the evidence and reported in narrative and tabular form.

The data was also extracted by two independent reviewers (DA and AR) and a data collection instrument specially constructed by the authors was used to minimise the risk of bias. Disagreements between reviewers were solved by including a third reviewer (ES).

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The results were grouped in a table and summarised. Finally, binary meta-analyses of the randomized effect of prevalence were carried out using the OpenMeta[analyst] program and the inverse variance method with Freeman-Tukey double arcsine transformation. Heterogeneity was assessed using the chi-square and I^2 tests. Random effects models were only considered in the presence of moderate to high heterogeneity (I^2>50%) (Santos et al., 2022). Given that the analysis is not based on primary data, it should be noted that the determination of prevalence is based on the available evidence.

3. RESULTS

After identifying the studies and applying the methods mentioned above, only 26 studies were selected for the review corpus. The process of selecting the studies is shown in the flowchart (Figure 1).

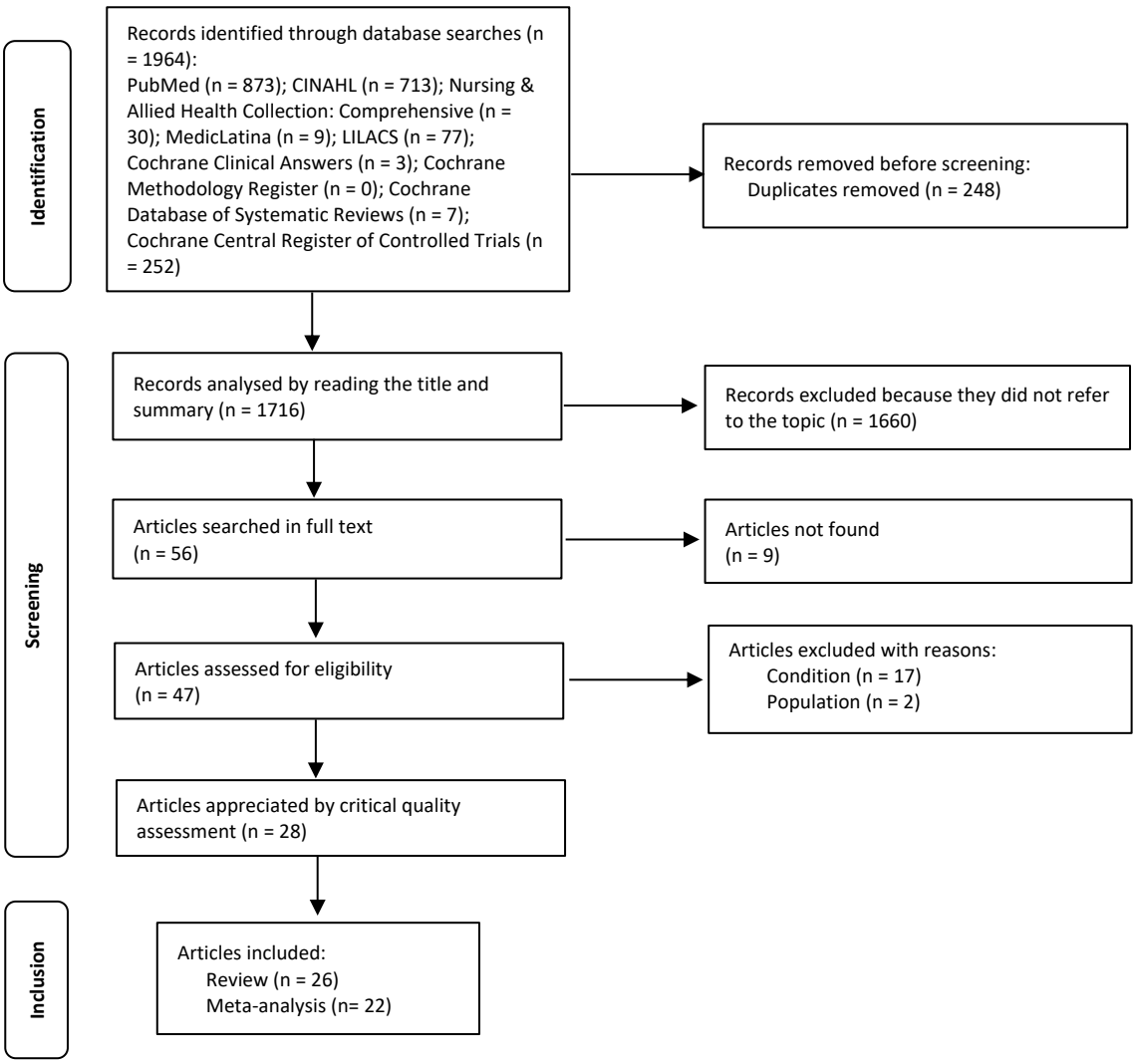

Figure 1 - PRISMA flowchart for identifying studies

Table 2 summarises the main characteristics of the included studies, such as the study, type of study, population, condition, context, number of participants with skin lesions/total number of participants, results and conclusion.

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Table 2 – Summary of the characteristics of the articles included in the review

Study/Country	Type of Study	Population (Neonates)	Participants with Injury/ Total	Results/Conclusions
Reza et al., 2018 (Mexico)	Cohort study	25 requiring CPAP	25/25 (100%)	Presence of CPAP nasal lesions: Mild lesions (60%); Moderate injuries (36%); Severe lesions (4%)
Faria et al., 2018 (Brazil)	Descriptive prospective study	104	42/104 (40.4%)	Diaper dermatitis (22.5%); Erythema (19.7%); Infiltration (18.3%); Ecchymosis (7%); Desquamation (5.6%)
Newman et al., 2015 (United States of America)	Prospective randomised experimental study	78	(24,2%)	CPAP injuries to the nasal septum (85.3%)
Broom et al., 2017 (Australia)	Longitudinal prospective study	Pre-study: 60 Post-study: 30	Without skin risk assessment tool: 37/60 (61.7%) With skin risk assessment tool: 12/30 (40%)	Excoriation (20%); Pressure (15%); Abrasions (15%); Extravasation (8.3%); Epidermal detachment (7%); Thermal injuries (6.6%)
Faria et al., 2019 (Brazil)	Observational, longitudinal and prospective study	85	62/85 (72.9%)	Escoriation (64.7%); Pressure injuries caused by medical devices (28.2%); Burns (2.4%); Flictenae (1.2%)
Marcatto et al., 2022 (Brazil)	Cohort study	46	8/46 (17.4%)	Skin lesions related to medical adhesives (17.4%); Erythema (10.9%); Skin breakage (4.4%); Dermatitis (2.2%)
Dai et al., 2020 (China)	Observational and prospective study	429	149/429 (34.7%)	Nasal pressure injuries due to CPAP use: Stage 1 (66.4%); Stage 2 (32.3%); Stage 3/4 (1.3%)
Grebinski et al., 2023 (Brazil)	Descriptive, exploratory, retrospective study	116 requiring CPAP	22/116 (19.0%)	Nasal pressure injuries due to CPAP: Stage 1 (45.5%); Stage 2 (31.8%); Stage 3 (18.2%); Stage 4 (4.5%)
Broom et al., 2019 (Australia)	Prospective study	63	93/248 evaluations (38%)	Bruises (47%); Excoriations (16%); Erythema (15%); Pressure injuries (14%); Abrasion (5%); Skin tears (1.5%)
Boyar, 2020 (United States of America)	Retrospective cohort study	Period 1: 80 Period 2: 27 Period 3: 128	Period 1: 6/80 (7%) Period 2: 13/27 (48%) Period 3: 2/128 (1.5%)	Period 1 and 3: with the use of foam Period 2: without use
August et al., 2014 (Australia)	Cohort study	247 neonates with gestational age between 22 and 41 weeks and weight between 445gr and 2678 gr	77/247 (31.2%)	Stage 1 (29.9%); Stage 2 (38.2%); Stage 3 (14%); Stage 4 (2.8%); Epidermal detachment (15%)
Sousa et al., 2013 (Brazil)	Cross-sectional study	47	32/47 (68.1%)	Nasal pressure injuries due to CPAP: Stage 1 (43.7%); Stage 2 (50.0%); Stage 3 (6.3%)
Habiballah et al., 2017 (Jordan)	Cross-sectional prevalence study	169	45/169 (26.6%)	Adhesive-related skin lesions (26.6%) - location: Face (42.2%); Arms and hands (22.2%); Chest (15.6%); Foot (4.4%); Back or buttocks (4.4%)
Azevedo et al., 2022 (Brazil)	Retrospective cross-sectional study	Preterm, mostly male (81.82%), with low or very low birth weight (89.47%)	2/22 (9.1%)	Nasal septum injury due to CPAP use (9.1%)
Ahmadizadeh et al., 2022 (Iran)	Cross-sectional study	On average, 33.92 (+/- 3.77) weeks gestation and 2307.13 (+/- 899.83) grams at birth, mostly male	191/265 (72.1%)	Adhesive removal injuries (47.2%); Pressure injuries (36.6%) Escoriation (9.1%); Extravasation and infiltration (4.2%); Thermal burn (1.9%); Chemical burn (1.5%)
Timbó et al., 2015 (Brazil)	Quantitative descriptive study	Preterm (24-29 sem - 33%, 30-34 sem - 45%, 35-36 sem - 22%), mostly male (52.0%), with adequate weight for gestational age (81%), and weighing less than 2500g (90%)	39/27 (more than one injury per neonate)	Injuries (31%); Diaper dermatitis (22%); Abrasion (10%)
Migoto et al., 2013 (Brazil)	Longitudinal study	Mostly preterm, male (52.5%), mostly under 1500g (55.0%)	58/100 (58%)	Diaper dermatitis (29%); Adhesive removal lesions (9.8%); Infiltration or extravasation (9.2%); Phlebitis (5.6%); Nasal pressure lesions (5.1%); Contact dermatitis (1%)
Maguire et al., 1999 (United States of America)	Cross-sectional prevalence study	Extreme underweight	21/100 (21%)	Skin lesions
Zanatta et al., 2023 (Brazil)	Cross-sectional study	Preterm (<32 weeks - 17.9%), average birth weight 2107.8g)	100/341 (29.3%)	Traumatic skin injuries, which includes lesions, contact dermatitis, adhesive removal injuries (24%). Contact dermatitis (5%)
Fontenele et al.,2011 (Brazil)	Prospective and descriptive study	Both preterm and term	6/137 (4.4%)	Skin abrasions (6.12%)

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Study/Country	Type of Study	Population (Neonates)	Participants with Injury/ Total	Results/Conclusions
Meszes et al., 2017 (Hungary)	Observational study	Both preterm and term, average gestational age of 34.5 weeks (+/- 4.3), mostly male (59.24%), 40% with adequate weight for gestational age	25/211 (11.8%)	Adhesive removal injury (20.0%); Extravasation (17.1%); Pressure ulcers (2.37%); Surgical (2.8%); Thermal burn (2.8%); Iatrogenic skin lesions (14.3%)
Jani et al., 2023 (Several countries)	Cross-sectional prevalence study	Extremely preterm	Diaper dermatitis - 331/840 (39.4%); Adhesive removal injury - 218/838 (26.0%); Injuries to the perineum - 218/840 (26.0%); Abrasion - 204/838 (24.3%); Pressure injuries - 183/843 (21.7%); Local infections 94/840 (11.2%)	Diaper dermatitis (39%); Adhesive removal lesions (38%); Perineal lesions (26%); Abrasion (24%); Pressure lesions (22%), most commonly nasal (46%); Local infections (11%)
Kostogloudis et al., 2015 (Greece)	Case series study	Mostly preterm (72.82%)	34/1409 (2.41%)	Grade III or IV extravasation (2.41%)
Csoma et al., 2015 (Hungary)	Prospective cohort study	On average, birth weight 2353.6g (+/- 981.6), gestational age 34.5 weeks (+/- 4.3), mostly male (59.24%), 40.6% with adequate weight for gestational age	89/211 (42.2%)	Iatrogenic injuries (39.3%), which includes adhesive removal injuries, extravasation, pressure injuries, thermal burns, surgical wound infection and contact dermatitis
Oudtshoorn et al., 2021 (Australia)	Retrospective study	Pre-term and term, mostly male (60%), average birth weight 2734g	30/27 (more than one injury per newborn)	56.7% occurred in hospital: chemical (35%), extravasation (35%), contact (18%), flame (6%), unknown cause (6%); 43.3% occurred at home or in the community: by liquids (31%); solar (31%); contact (15%); chemical (15%); unknown cause (8%)
Guimarães et al., 2020 (Portugal)	Retrospective study	Preterm, mean gestational age 28 weeks (+/-2), mean weight 1072g (+/- 239)	88/135 (65.2%)	Pressure injuries, nasal, from CPAP (65%): grade I (49%), grade II (16%) and grade III (1%)

The quality of the included studies is summarised in Table 3. There was agreement between the reviewers to include the twenty-six studies assessed, as they were of high quality.

Table 3 - Results of the critical appraisal of eligible studies

Studies	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13
Reza et al., 2018*	Y	Y	Y	Y	Y	Y	Y	Y	--	--	--	--	--
Faria et al., 2018*	Y	Y	Y	Y	Y	Y	Y	Y	--	--	--	--	--
Faria et al., 2019*	Y	Y	Y	Y	Y	Y	Y	Y	--	--	--	--	--
Dai et al., 2020*	Y	Y	Y	Y	Y	Y	Y	Y	--	--	--	--	--
Grebinski et al., 2023*	Y	Y	Y	Y	Y	Y	Y	Y	--	--	--	--	--
Broom et al., 2019*	Y	Y	Y	Y	NA	NA	Y	Y	--	--	--	--	--
Maguire et al., 1999*	Y	Y	Y	Y	Y	Y	NA	Y	--	--	--	--	--
Zanatta et al., 2023*	Y	Y	Y	Y	Y	NA	Y	Y	--	--	--	--	--
Fontenele et al.,2011*	Y	Y	Y	Y	Y	Y	Y	Y	--	--	--	--	--
Meszes et al., 2017*	Y	Y	Y	Y	Y	Y	Y	Y	--	--	--	--	--
Ahmadizadeh et al., 2022*	Y	Y	Y	Y	Y	Y	Y	Y	--	--	--	--	--
Sousa et al., 2013*	Y	Y	Y	Y	NA	Y	Y	Y	--	--	--	--	--
Timbó et al., 2015*	Y	Y	Y	Y	Y	Y	Y	Y	--	--	--	--	--
Newman et al., 2015**	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Broom et al., 2017***	Y	Y	Y	Y	Y	NA	Y	Y	Y	NA	Y	--	--
Marcatto et al., 2022***	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	--	--
Csoma et al., 2015***	NA	NA	Y	Y	Y	NA	Y	Y	NA	NA	Y	--	--
August et al., 2014***	Y	Y	Y	Y	Y	Y	Y	Y	Y	NA	Y	--	--
Boyar, 2020***	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	--	--
Habillah et al., 2017****	Y	Y	Y	Y	Y	Y	Y	Y	Y	--	--	--	--
Azevedo et al., 2022****	Y	Y	Y	Y	Y	Y	Y	Y	Y	--	--	--	--
Jani et al., 2023****	Y	Y	Y	NA	Y	Y	Y	Y	Y	--	--	--	--
Oudtshoorn et al., 2021****	Y	Y	Y	Y	Y	Y	Y	Y	Y	--	--	--	--
Guimarães et al., 2020****	Y	Y	Y	Y	Y	Y	Y	Y	Y	--	--	--	--
Migoto et al., 2013****	Y	Y	Y	Y	Y	Y	Y	Y	Y	--	--	--	--
Kostogloudis et al., 2015*****	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	--	--	--
% Yes	100	96	100	100	100	100	100	100	100	100	100	100	100

Note. Y = Yes; N = No; NA = Not applicable or uncertain. *Checklist for analytical cross-sectional studies, **JBI Critical Appraisal Tool for Assessment of Risk of Bias for Randomized Controlled Trials, ***Checklist for Cohort Studies, ****Checklist for Prevalence studies (Munn et al., 2020), *****Checklist for Case Series".

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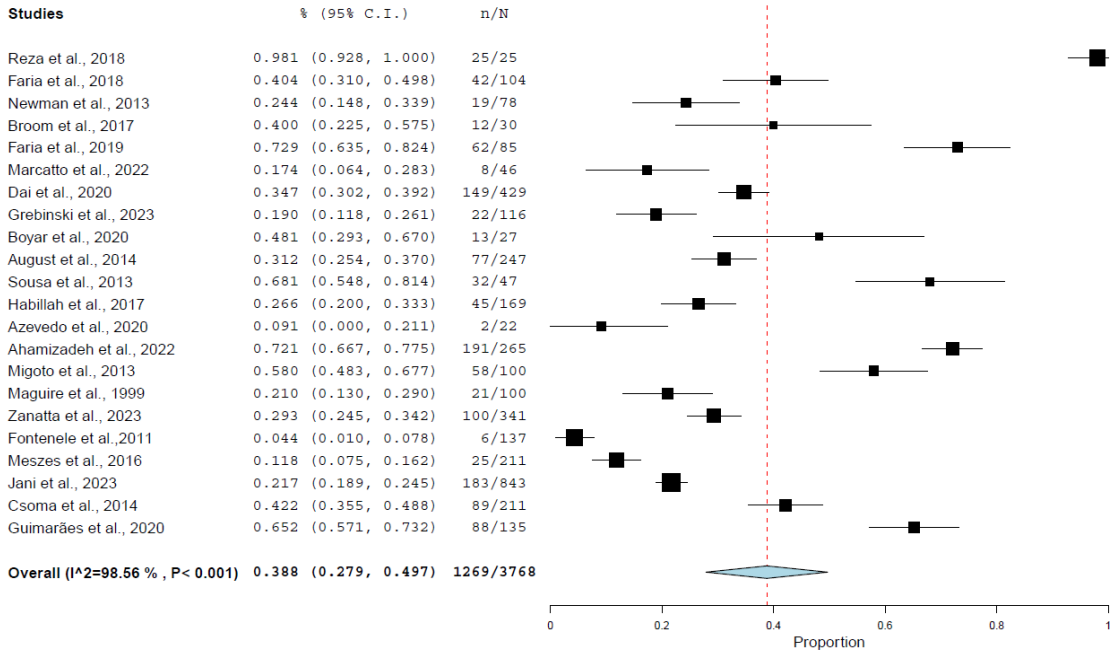
The binary meta-analysis of prevalence using the random effects model was carried out on 22 studies and included a sample of 3768 neonates. The combined prevalence of injuries was 39% (95% CI= 28-50%; p<0.01). The results of the meta-analysis are shown in Figure 2.

Figure 2 - Meta-analysis of the data



Considering that the studies included in the meta-analysis are of high quality, and there is no impact on the choice of models and/or assumptions of the meta-analysis. We found that there was high heterogeneity between the included studies (I^2= 98.56%), which attests to the use of random effects models in the analysis. The sensitivity analyses did not alter this result, so it is assumed to be sample heterogeneity (given the large sample size).

4. DISCUSSION

The prevalence of skin lesions in neonates admitted to the hospital is a significant concern, as the use of medical devices and the fragility of neonates' skin increase the risk of injury. The general prevalence of injuries in hospitalised neonates ranges from 1.5% to 100% (Ahmadizadeh et al., 2022; August et al., 2014; Azevedo et al., 2022; Boyar, 2020; Broom et al., 2017, 2019; Csoma et al., 2015; Dai et al., 2020; M. F. Faria et al., 2019; T. F. Faria & Kamada, 2018; Fontenele & Cardoso, 2011; Grebinski et al, 2023; Guimarães et al., 2020; Habiballah, 2017; Jani et al., 2023; Kostogloudis et al., 2015; Maguire, 1999; Marcatto et al., 2022; Meszes et al., 2017; Migoto et al., 2013; Newman et al., 2015; Oudtshoorn et al., 2021; Reza et al., 2018; Sousa et al., 2013b; Timbó et al., 2015; Zanatta et al., 2023).

The lowest prevalences were 1.5%, 2.4%, 4.4%, 9.1%, by Azevedo et al. (2022), Boyar (2020), Fontenele & Cardoso (2011), and Kostogloudis et al. (2015). These investigations involve studies on pressure injuries to the nasal septum due to the use of CPAP, serious injuries due to extravasation, and studies on different types of skin lesions in newborns.

The studies with the highest prevalence rates were 100%, 72.9%, 72.1% and 68.1%, by Reza et al. (2018), Faria et al. (2019), Ahmadizadeh et al. (2022), and Sousa et al. (2013b), respectively. These investigations correspond to studies on injuries caused by the use of CPAP and other medical devices. Thus, several studies included in this systematic review demonstrated the high frequency of skin lesions in neonates requiring hospitalization, such as the use of CPAP and adhesives. Injuries associated with the use of CPAP have been frequently observed in studies carried out in various countries, such as the study by Reza et al. (2018) in Mexico, which found 100% of neonates with nasal injuries, 60% of which were classified as mild injuries. Other studies, such as Newman et al. (2015) in the USA and Dai et al. (2020) in China, have also identified high rates of nasal pressure injuries associated with CPAP, with a predominance of Stage 1 injuries (66.4%). However, variations in CPAP injury rates may be related to the use of prevention methods, such as the use of foams (Boyar, 2020).

Differences between countries can also influence the rates of skin lesions observed. For example, the study by Grebinski et al. (2023) in Brazil reported a 19% prevalence of nasal CPAP injuries, while Guimarães et al. (2020) in Portugal found a prevalence of

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65.2%. These results suggest that factors such as the care protocol, the equipment used, and nursing practices may affect injury rates.

Injuries from medical devices have also been a significant concern, with studies such as that by Broom et al. (2017), which showed a reduction in the incidence of skin injuries from 61.7% to 40% after the introduction of a risk assessment tool. The introduction of prevention and management strategies seems to be an important factor in reducing the occurrence of injuries.

In terms of diaper dermatitis, studies such as Faria & Kamada, (2018) in Brazil and Jani et al. (2023) in several countries found prevalences of 22.5% and 39.4%, respectively. Diaper dermatitis is one of the most frequent skin lesions in hospitalized neonates, which suggests the importance of constant monitoring and preventive measures, such as frequent diaper changes and the use of protective skin barriers.

Adhesive injuries have been reported in several studies, such as the work by Ahmadizadeh et al. (2022), which found a prevalence of 47.2% of injuries related to adhesive removal. This injury is particularly common in preterm and low birth weight newborns, as their skin is thinner and more vulnerable. Thus, it is important to highlight that skin lesions in neonates are not only a consequence of the use of medical devices but can also be aggravated by environmental and iatrogenic factors, as mentioned in the study by Oudtshoorn et al. (2021), where chemical and extravasation burns occurred in both hospital and home environments.

CONCLUSION

Skin lesions in hospitalized newborns represent a significant issue, with the meta-analysis revealing a combined prevalence of 39%. This high rate, evidenced in 22 high-quality studies, demonstrates the need for a continuous and systematic approach to preventing and treating these injuries, especially in vulnerable neonates.

The high heterogeneity between the studies analyzed (I^2= 98.56%) reflects the diversity in clinical contexts and neonatal care practices around the world. This highlights the importance of contextualized interventions adapted to the particularities of each hospital environment. The implementation of risk assessment tools, together with the training of healthcare teams, can be key to reducing injuries associated with the use of medical devices, adhesives, and other interventions required in intensive care.

In light of these facts, it is crucial to promote hospital environments that prioritize the integrity of neonatal skin, using evidence-based preventive methods such as skin barriers, protective foams, and frequent alternation of medical devices.

Future studies should identify specific risk factors for skin lesions in different neonatal subpopulations and develop effective preventive interventions that can be implemented and evaluated longitudinally. These investigations should also be culturally sensitive and consider the differences between hospital practices in different countries.

We conclude that appropriate prevention and management of skin lesions in hospitalized newborns should be a priority in neonatal care, with evidence-based policies and interventions aimed at protecting this vulnerable population.

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AUTHORS´ CONTRIBUTION

Conceptualization, D.A. and A.R.; data curation, D.A., A.R. and E.S.; formal analysis, D.A., L.C. and E.S.; investigation, D.A., A.R. and E.S.; methodology, D.A., A.R. and E.S.; project administration, D.A., A.R. and E.S.; resources, D.A., A.R. and E.S.; software, E.S.; supervision, E.S.; validation, D.A., A.R. and E.S.; visualization, D.A., A.R. and E.S.; writing - original draft, D.A., A.R. and E.S. writing - review and editing, D.A., A.R. and E.S.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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