Pediatric Oncall Journal
DOI: https://doi.org/10.7199/ped.oncall.2027.60

ORIGINAL ARTICLE

MATERNAL KNOWLEDGE OF NEONATAL WARNING SIGNS: A CROSS-SECTIONAL STUDY

Beatriz Martins[1], Beatriz Andrade[1], Mónica Marçal[2], Anabela Salazar[2], Madalena Tuna[2].

[1]Pediatrics Department, Hospital Santa Maria, Unidade Local de Saúde de Santa Maria, Lisbon, Portugal; [2]Neonatology Service, Hospital de São Francisco Xavier, Unidade Local de Saúde Lisboa Ocidental, Lisbon, Portugal.

ABSTRACT

Background: The neonatal period is a vulnerable stage of infancy. Early recognition of warning signs is essential to prevent potentially fatal outcomes. Maternal knowledge of these signs is an important marker of health literacy and can guide interventions to improve neonatal care.

Objective: To evaluate maternal knowledge of neonatal warning signs and to identify sociodemographic factors associated with knowledge levels.

Methods: Observational, cross-sectional, descriptive-analytical study at a level II hospital. Mothers of newborns hospitalized in the nursery completed an electronic questionnaire assessing sociodemographic characteristics and knowledge of neonatal warning signs. Descriptive and comparative statistics were performed.

Results: A total of 150 mothers participated. Maternal age ranged 18 - 42 years, with 57.3% Portuguese and 42.7% of other nationalities. Most mothers were employed (78%) and 38.7% had prior experience with children or healthcare. Knowledge scores ranged from 1 to 17 (mean ± SD: 9.89 ± 3.24), with 66% correctly identifying more than half of the warning signs. Commonly recognized signs included fever (>38ºC), bloody stools, central cyanosis, and periumbilical infection signs (>75%). Less recognized signs included moaning and reduced urine output (<25%). No statistically significant associations were found between knowledge scores and maternal age, education, employment status, parity, nationality, or prior experience with children/healthcare.

Conclusion: Maternal knowledge of neonatal warning signs is variable, with a good recognition of obvious signs but limited awareness of subtle indicators of serious illness. Health literacy interventions are essential to improve parental recognition of warning signs, promote timely healthcare seeking, and prevent neonatal morbidity and mortality.

ARTICLE HISTORY

Received 09 July 2026

Accepted 03 August 2026

KEYWORDS

Neonatal warning signs, Maternal knowledge, Health literacy, Newborn care, Cross-sectional study.

ABBREVIATIONS

SD — Standard deviation

SNS — Serviço Nacional de Saúde (Portuguese National Health Service)

IBM SPSS — Statistical Package for the Social Sciences

ULS — Unidades Locais de Saúde (Local Health Units)

WHO — World Health Organization

Introduction

The neonatal period corresponds to the first 28 days of life and is the most vulnerable period of infancy.[1] Newborns are at higher risk of severe disease, and the clinical signs and symptoms of serious illness are often subtle and nonspecific, making them difficult to assess.[2] Warning signs of severe disease during the neonatal period include fever, poor feeding, altered consciousness, signs of respiratory distress, jaundice, central cyanosis, and inflammatory signs of the umbilical cord stump, among others.[1–3] Early recognition of these signs and timely assessment of newborns can prevent potentially fatal outcomes. The World Health Organization (WHO) defines health literacy as the cognitive and social abilities of individuals to understand and use available information to promote and maintain good health.[4] Therefore, supporting parents and caregivers in recognizing neonatal warning signs may contribute to improved health outcomes.[5]

In this study we aim to determine mothers' knowledge about clinical warning signs in newborns that warrant urgent medical attention and to promote public awareness, with a potential positive impact on health promotion and disease prevention.

Observational, cross-sectional, descriptive-analytical study, conducted in 2024 at a tertiary hospital in the Lisbon region, through the application of a questionnaire to mothers of newborns in the nursery during joint hospitalization in the first days of life between December 2024 and December 2025. Prior to the study, approval was obtained from the hospital Ethics Committee (Decision No: 2024-127). Inclusion criteria were: voluntary participation, age ≥ 18 years, and having a newborn hospitalized in the nursery during the first days of life. No predefined exclusion criteria were established. The first part of the questionnaire consists of a total of 13 open-ended and multiple-choice questions collecting maternal, paternal, and family characteristics, including maternal age, nationality, marital status, educational level, current employment, previous experience working

Address for Correspondance: Beatriz Martins, Avenida Prof. Egas Moniz MB, 1649-028 Lisbon, Portugal.
Email: beatrizcm1994@hotmail.com

with children or in healthcare, paternal age and nationality, first child status, total number of children, number of other children living in the household, and planned follow-up of the newborn. The second part of the questionnaire assessed maternal knowledge of neonatal warning signs. Mothers were asked to identify which of the 29 presented complaints and symptoms they considered to be warning signs requiring urgent medical evaluation. The list of warning signs used in the questionnaire was based on the World Health Organization (WHO) definition of newborn danger signs.[3] Informed consent was obtained electronically via Google Forms®, accessible through a QR code displayed in the hospitalization rooms. All responses were collected anonymously and treated as confidential.

A knowledge score was calculated based on the number of neonatal warning signs correctly identified by the mothers. A misidentification score was also calculated based on the number of non-warning signs incorrectly identified as warning signs. Continuous variables were summarized as means and standard deviations, and categorical variables as frequencies and percentages. Associations between continuous variables were evaluated using Pearson's correlation coefficient and Spearman's correlation coefficient. Comparisons of mean knowledge scores between two groups were performed using Student's t-test. Comparisons of mean misidentification scores between two groups were performed using Mann-Whitney U test. Maternal education was originally categorized into six levels and subsequently grouped into three categories to ensure adequate group sizes and improve statistical robustness. Kruskal-Wallis test was used to compare maternal education with knowledge and misidentification scores. Statistical significance was set at $p < 0.05$. Analyses were conducted using IBM SPSS Statistics version 30.0.0.0 (172).

RESULTS AND DISCUSSION

A total of 150 participants were included in the study, and their sociodemographic characteristics are summarized in Table 1. The mean maternal age was 30.5 ± 6.2 years (range: 18–42 years). Most mothers were Portuguese (57.3%, n=86), while 42.7% (n=64) had other nationalities (12% Brazil, 8% Cape Verde, 8% Guinea-Bissau, 4.7% Angola, 2.7% São Tomé, 1.3% Nepal, 1.3% United Kingdom, 0.7% Afghanistan, 0.7% India, 0.7% Bangladesh, 0.7% Italy, 0.7% France and 0.7% United States of America). Regarding marital status, 54.0% (n=81) were married or cohabiting, 45.3% (n=68) were single, and 0.7% (n=1) were widowed. In terms of educational level, nearly half of the mothers had completed secondary education (10th–12th grade: 49.3%, n=74). Higher education was also frequent, with 23.3% (n=35) holding a bachelor's degree, 15.3% (n=23) a master's degree, and 1.3% (n=2) a doctoral degree. A small proportion had lower educational attainment (≤9th grade: 5.3%). Most mothers were currently employed (78.0%, n=117), while 22.0% (n=33) were unemployed; 38.7% (n=58) reported previous professional experience working with children or in healthcare. The mean paternal age was 34.4 ± 7.7 years (range: 20–55 years), and slightly more than half of the fathers were Portuguese (54.0%, n=81), with the remaining 46.0% (n=69) sharing a similar nationality distribution to the mothers. Regarding family context, 45.3% (n=68) of the newborns were first children. Most families had one or two children (46% and 30%, respectively), with 8.7% having three children and 7.3% four or more. Overall, 62.0% (n=93) of families had other children in the household in addition to the newborn, the majority (54%) having one to two additional children. Concerning planned follow-up, 82.0% (n=123) of newborns were expected to be followed at a primary healthcare center within the Portuguese National Health Service (SNS), 4.7% (n=7) in hospital care within the SNS, and 15.8% (n=19) by a private physician or institution.

The sociodemographic profile of our population reflects a broad maternal age range and considerable cultural diversity. The substantial proportion of non-Portuguese mothers aligns with national demographic trends indicating that approximately 15% of the population in Portugal consists of foreign residents,[6] highlighting the growing relevance of migrant families within the healthcare system and reinforcing the importance of culturally sensitive health education strategies.[7] Overall, the sample demonstrated relatively high educational attainment and employment rates, suggesting a predominantly middle socioeconomic profile — factors generally associated with improved access to healthcare and greater exposure to health information.[8] Nevertheless, as discussed below, important knowledge gaps were identified despite this favourable context.

In Portugal, the neonatal mortality rate is approximately 2.6 per 1,000 live births, largely associated with prematurity, congenital malformations, and neonatal asphyxia.[9-11]

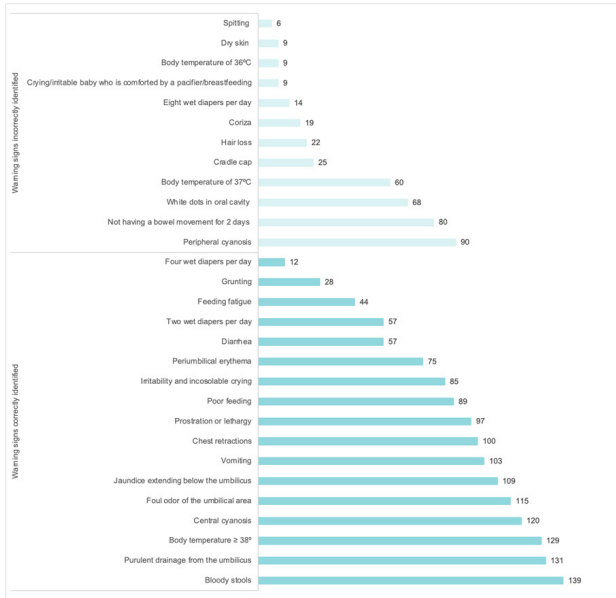
The neonatal warning signs and the number of mothers who correctly identified each are presented in figure 1. A knowledge score was calculated based on the number of correctly identified neonatal warning signs. Of the 29 signs presented, 17 were true warning signs, each corresponding to one point. Scores ranged from 1 to 17, with a mean of 9.89 ± 3.24. Overall, 66% (n=99) of mothers correctly identified more than 50% of the warning signs. Warning signs such as fever (body temperature >38°C), bloody stools, central cyanosis, and periumbilical signs of infection (purulent drainage and foul odour) were the most correctly identified, with more than 75% of mothers recognizing them. Conversely, moaning and reduced urine output (fewer than four urinations per day) were identified by less than 25% of mothers, indicating a lack of awareness regarding subtle signs of potentially serious illness. Warning signs associated with common infectious conditions — such as diarrhea (38%), fewer than two urinations per day (38%), and feeding fatigue (29.3%) — were recognized by less than half of the mothers, while chest retractions were reported by two-thirds of the sample (66.7%). These findings are concerning, as these signs may be present in multiple common conditions but are associated with significant morbidity and mortality if diagnosed and treated late.[3] Therefore, raising parental awareness of the need for urgent healthcare consultation whenever these signs are observed in the newborn is essential.

Table 1. Maternal, paternal and family characteristics of the study population

Variable	% (n) or Mean ± SD
Maternal characteristics	
Maternal age (years)	30,5 ±6,2
Nationality	
Portuguese	57,3% (n = 86)
Other	42,7% (n = 64)
Marital status	
Single	45,3% (n = 68)
Married / Cohabiting	54% (n = 81)
Divorced / Separated	0% (n = 0)
Widowed	0,7% (n = 1)
Educational level	
No formal education	1,3% (n = 2)
1st–4th grade	0,7% (n = 1)
5th–9th grade	3,3% (n = 5)
10th–12th grade	49,3% (n = 74)
Bachelor's degree	23,3% (n = 35)
Master's degree	15,3% (n = 23)
Doctoral degree	1,3% (n = 2)
Currently employed	78% (n = 117)
Unemployed	22% (n = 33)
Previous worked with children/ healthcare	38,7% (n = 58)
Paternal characteristics	
Paternal age (years)	34,4 ±7,7
Nationality	
Portuguese	54% (n = 81)
Other	46% (n = 69)
Family context	
First child	45,3% (n = 68)
Total number of children	1,69 (SD 1,3)
Number of other children living in the household	0,95 (SD1,1)
Follow-up of the newborn	
Primary healthcare center (SNS)	82% (n = 123)
Hospital care (SNS)	4,7% (n = 7)
Private physician/institution	15,83% (n = 19)
Not yet defined	0,7% (n = 1)

Abbreviations: SD, standard deviation

Figure 1. Neonatal warning signs correctly and incorrectly identified by mothers



Footnote: Neonatal warning signs correctly and incorrectly identified by mothers. Bars represent the number of mothers (out of the total sample) who correctly identified each item as a neonatal warning sign (bottom panel) or who incorrectly classified a non-warning-sign finding as a warning sign (top panel). Items are ordered by frequency within each panel, from lowest to highest.

A separate misidentification score was calculated based on the number of incorrectly identified signs. Of the 29 signs presented, 12 were not true warning signs. This score ranged from 0 to 9, with a mean of 2.54 ± 1.72. Notably, 89.3% of mothers incorrectly identified more than 50% of the non-warning signs as requiring urgent medical evaluation. Among these, acrocyanosis and absence of bowel movements for two days were the most frequently indicated (60% and 53.3%, respectively), and body temperature of 37°C was erroneously flagged by 40% of mothers. These are common and benign findings that generate unnecessary concern and anxiety among caregivers, particularly first-time parents. Such misconceptions frequently lead to repeated healthcare visits, overburdening healthcare resources and increasing the risk of exposure to infectious diseases in emergency settings.[12] They could, however, be readily addressed through targeted education during both the prenatal period and the maternity ward stay and reinforced during early follow-up visits.

The associations between family characteristics and the knowledge score and misidentification scores and family characteristics of the study population are presented in Table 2, and for maternal education and both scores in Table 3. Maternal age was not significantly correlated with the knowledge score ($r = -0.06$, $p = 0.42$), nor was the total number of children ($r = -0.03$, $p = 0.73$). No significant differences in knowledge scores were observed between first-time mothers (mean ± SD: 9.69 ± 3.16) and mothers with

previous children (10.13 ± 3.30; p = 0.404), between Portuguese mothers (9.80 ± 2.99) and non-Portuguese mothers (10.11 ± 3.56; p = 0.58), between mothers with previous professional experience in childcare or healthcare (10.33 ± 3.30) and those without (9.69 ± 3.18; p = 0.24), or between employed (9.78 ± 3.19) and unemployed mothers (10.63 ± 3.40; p = 0.24). When comparing knowledge scores across maternal educational levels, no statistically significant differences were observed (Kruskal-Wallis H(2) = 2.74, p = 0.255).

Regarding the misidentification score, maternal age was not significantly correlated (ρ = −0.14, p = 0.096), but the total number of children showed a statistically significant correlation (ρ = −0.17, p = 0.032). Misidentification scores did not differ significantly between first-time mothers (mean rank = 82.70) and mothers with previous children (mean rank = 69.53; Mann-Whitney U = 2298.5, Z = −1.89, p = 0.058), between employed (mean rank = 75.88) and unemployed mothers (mean rank = 74.17; Mann-Whitney U = 1886.5, Z = −0.20, p = 0.838), or between mothers with and without professional experience in childcare or healthcare (mean rank = 68.96 vs. 79.63; Mann-Whitney U = 2288.5, Z = −1.50, p = 0.134), although a tendency toward higher misidentification scores was observed among those without such experience. A significant difference in misidentification scores was found between Portuguese (mean rank = 68.84) and non-Portuguese mothers (mean rank = 84.45; Mann-Whitney U = 2179.5, Z = −2.23, p = 0.026). When comparing misidentification scores across maternal educational levels, statistically significant differences were observed (Kruskal-Wallis H(2) = 8.53, p = 0.014).

Individual analysis of warning signs by maternal educational level revealed no statistically significant associations in most cases; exceptions were observed for prostration and lethargy, grunting, feeding fatigue, and jaundice extending below the umbilical level. For non-warning signs, maternal education was significantly associated with the recognition of approximately half of the signs analysed, namely body temperatures of 36°C and 37°C, easily consolable irritability, cradle cap, rhinorrhea, and hair loss (Table 4).

These findings are noteworthy in light of previous literature. Although higher educational levels have been associated with improved health literacy by Brandstetter et al.[13] and other European studies, and lower health literacy has been reported among individuals with lower educational attainment or migrant backgrounds in Germany and the United States,[13, 14] such associations were not observed for the overall knowledge score in our population. A similar pattern was reported in a Turkish study evaluating maternal knowledge of warning signs in infants under 12 months, which also found no significant association with maternal age, education, or parity.[15] While parenting experience is often assumed to enhance recognition of neonatal illness,[16] this hypothesis was not supported by our data. Previous professional experience in childcare or healthcare also did not correlate with improved knowledge, likely because most participants with such experience were technical assistants, dental practitioners, and pharmacists, with only a few physicians and nurses included. Taken together, these findings indicate that knowledge gaps are widespread across demographic subgroups and reinforce the need for universal educational interventions rather than strategies targeting only specific risk groups.

Although maternal education was not significantly associated with the overall knowledge score, it is widely recognized as a key determinant of child health[17,18] and was significantly associated with the correct identification of both specific warning signs and non-warning signs — including those most likely to prompt unnecessary emergency visits. A similar pattern was observed when comparing Portuguese and non-Portuguese mothers, suggesting a possible influence of nationally rooted health literacy, though further improvement is needed across all groups.

Comparing our findings with two published studies that evaluated maternal recognition of neonatal warning signs, jaundice was among the most consistently recognized signs across all settings.[19, 20] Vomiting and chest retractions were identified by at least two-thirds of mothers in both our study and the Turkish study (66.7% and 78%, respectively), while Abu-Shaheen et al. reported chest retractions identified in only 9.6%. Fever was recognized by 86% of mothers in our study and 80.4% in Kemer et al., but only by 31.2% in the Saudi Arabian study. Periumbilical inflammatory signs were frequently identified in our study (purulent drainage 87.3%, foul odour 76.7%, erythema 50%), while the other studies evaluated similar signs within broader categories (77% and 37.1%, respectively). In contrast, diarrhea was identified as a danger sign by only 38% of mothers in our study versus 81.8% in Kemer et al. Overall, these findings emphasize considerable variability in maternal recognition of warning signs across different settings, likely influenced by sociocultural factors, health literacy levels, and methodological differences between studies.

This study included a substantial number of participants and reflects demographic variability consistent with contemporary Portuguese society. Previous studies have evaluated maternal knowledge of neonatal danger signs in developing countries,[15, 19] and other European research has focused more broadly on health literacy.[13] To our knowledge, this is the first study conducted in Portugal, and one of the few in developed European settings, to assess maternal knowledge of neonatal warning signs. However, its cross-sectional design limits causal inference and does not allow evaluation of the impact of educational interventions.

Most newborns in this study were expected to be followed in primary healthcare centers within the SNS, reflecting the central role of primary care in neonatal surveillance and representing a critical opportunity for structured parental education. Educational reinforcement during prenatal care, maternity ward discharge, and early follow-up visits may improve both sensitivity (recognition of true warning signs) and specificity (avoidance of unnecessary concern regarding benign symptoms). Digital platforms and social media, widely used in contemporary society, can be strategically explored by healthcare professionals as effective channels for disseminating reliable, evidence-based information in accessible language, while also

Table 2. Statistical analysis of knowledge scores, misidentification scores and family characteristics of the study population

Variable	Category	Knowledge score			Misidentification score		
		Mean ±SD	r	p-value	Median (IQR)	ρ	p-value
Maternal age	-	-	-0.06	0.42	-	-0.14	0.096
Total number of children	-	-	-0.03	0.73	-	-0.17	0.032
Parity	First-time mothers	9.69 ± 3.16	-	0.404	2 (4-2)	-	0.058
	Previous children	-	-		2 (3-1)	-	
Nationality	Portuguese	9.80 ± 2.99	-	0.58	2 (3-1)	-	**0.026**
	Other	10.11 ± 3.56	-		3 (4-2)	-	
Previous experience (children/ healthcare)	Yes	10.33 ± 3.30	-	0.24	2 (3-1)	-	0.134
	No	9.69 ± 3.18	-		2 (3-2)	-	
Employment status	Employed	9.78 ± 3.19	-	0.24	2 (3-2)	-	0.838
	Unemployed	10.63 ± 3.40	-		2 (3-1)	-	

Abbreviations: SD, standard deviation; r, Pearson correlation coefficient; ρ, Spearman correlation cofficient

Table 3. Statistical analysis of knowledge and misidentification scores and maternal educational level

Maternal educational level	n	Knowledge score		Misidentification score	
		Median (IQR)	Mean rank	Median (IQR)	Mean rank
Low (≤ 9th grade)	16	11 (13-9)	90.09	2 (4-2)	84.50
Medium (high school)	74	10 (13-7)	76.56	3 (4-2)	83.59
Higher (university level)	60	10 (12-7)	70.30	2 (3-1)	63.12
Kruskal-Wallis		H = 2.74, df = 2, p = 0.255		H = 8.528, df = 2, p = 0.014	

Abbreviations: IQR, Interquartile range

Table 4. Statistical analysis of identification and misidentification of neonatal warning signs and maternal educational level

Signs	Maternal Educational Level			x^2	p
	Low	Medium	Higher		
Identified warning signs(n,%)					
Irritability and inconsolable crying	12 (75%)	38 (51,4%)	35 (58,3%)	3.109	0.211
Periumbilical erythema	11 (68%)	36 (48,7%)	28 (46,7%)	2.571	0.277
Prostration or lethargy	6 (37,5%)	45 (60,8%)	46 (76,7%)	9.431	0.009
Two wet diapers per day	6 (37,5%)	24 (32,4%)	27 (45%)	2.223	0.329
Purulent drainage from the umbilicus	3 (18,8%)	11 (14,9%)	5 (8,3%)	1.877	0.391
Central cyanosis	14 (87,5%)	58 (78,4%)	48 (80%)	0.684	0.710
Body temperature ≥ 38ºC	14 (87,5%)	64 (86,5%)	51 (85%)	0.094	0.954
Grunting	7 (43,8%)	10 (13,5%)	11 (18.3%)	7.929	0.019
Chest retractions	10 (62,5%)	45 (60,8%)	45 (75%)	3.142	0.208
Feeding fatigue	8 (50%)	25 (33,8%)	11 (18,3%)	7.506	0.023

Poor feeding	12 (75%)	45 (60,8%)	32 (53,3%)	2.590	0.274
Bloody stools	15 (93,8%)	72 (97,3%)	52 (86,7%)	5.541	0.063
Vomiting	12 (75%)	57 (77,0%)	34 (56,7%)	6.718	0.035
Four wet diapers per day	3 (18,8%)	5 (6,8%)	4 (6,7%)	2.813	0.245
Jaundice extending below the umbilicus	15 (93,8%)	59 (79,7%)	35 (58,3%)	11.645	0.003
Diarrhea	7 (43,8%)	34 (45,9%)	16 (26,7%)	5.479	0.065
Foul odor of the periumbical area	11 (68,8%)	58 (78,4%)	46 (76,7%)	0.682	0.711
Misidentified warning signs (n,%)					
Body temperature of 36ºC	2 (12,5%)	7 (9,5%)	0 (0%)	6.599	0.037
Body temperature of 37ºC	2 (12,5%)	22 (29,8%)	6 (10%)	8.691	0.013
Eight wet diapers per day	3 (18,8%)	7 (9,5%)	4 (6,7%)	2.182	0.336
Crying/irritable baby who is comforted by pacifier/breastfeeding	1 (6,2%)	8 (10,8%)	0 (0%)	6.970	0.031
White dots in oral cavity	6 (37,5%)	34 (46,0%)	28 (46,7%)	0.450	0.798
Cradle cap	2 (12,5%)	20 (27,0%)	3 (5%)	11.799	0.003
Peripheral cyanosis	10 (62,5%)	39 (52,7%)	41 (68,3%)	3.420	0.181
Not having a bowel movement for 2 days	11 (68,8%)	39 (52,7%)	30 (50%)	1.808	0.405
Coriza	5 (31,3%)	11 (14,9%)	3 (5%)	8.506	0.014
Hair loss	4 (25%)	15 (20,3%)	3 (5%)	7.701	0.021
Dry skin	1 (6,2%)	6 (8%)	2 (3.3%)	1.341	0.511
Spitting	0 (0%)	5 (6,8%)	1 (1,7%)	2.982	0.225

contributing to the demystification of common health-related myths. At an organizational level, the current integration of primary and hospital care into Local Health Units (ULS) within the Portuguese NHS has the potential to optimize patient referral pathways, reduce pressure on emergency settings, and facilitate interprofessional communication across levels of care. Future longitudinal studies assessing the effectiveness of structured educational programs would provide valuable insight into strategies for improving neonatal health literacy.

CONCLUSION

Our findings demonstrate that knowledge gaps regarding neonatal warning signs are present across sociodemographic groups, reinforcing the need for universal educational strategies rather than targeted interventions. Structured and consistent education on neonatal warning signs and appropriate care-seeking behaviours should be systematically provided during prenatal care, reinforced during maternity hospitalization, and revisited at early postnatal follow-up appointments. Public health initiatives, including campaigns in healthcare settings and community environments, may further support parental awareness. Improving parental recognition of neonatal danger signs has the potential to promote timely healthcare utilization, reduce unnecessary emergency visits, and ultimately contribute to improved neonatal outcomes and prevention of avoidable morbidity and mortality.

Compliance with Ethical Standards

Funding: None

Conflict of Interest: None

References:

1. Lawn JE, Blencowe H, Oza S, et al. Every Newborn: progress, priorities, and potential beyond survival. Lancet. 2014 Jul 12;384(9938):189–205. doi:10.1016/S0140-6736(14)60496-7. Epub 2014 May 19. Erratum in: Lancet. 2014 Jul 12;384(9938):132.
2. Young Infants Clinical Signs Study Group. Clinical signs that predict severe illness in children under age 2 months: a multicentre study. Lancet. 2008 Jan 12;371(9607):135–142. doi:10.1016/S0140-6736(08)60106-3.
3. World Health Organization. Pocket book of hospital care for children: guidelines for the management of common childhood illnesses. 2nd ed. Geneva: World Health Organization; 2013. Chapter 3.6, Danger signs in newborns and young infants.
4. World Health Organization. Health promotion glossary of terms 2021. Geneva: World Health Organization; 2021.
5. Zaidman EA, Scott KM, Hahn D, Bennett P, Caldwell PH. Impact of parental health literacy on the health outcomes of children with chronic disease globally: a systematic review. J Paediatr Child Health. 2023 Jan;59(1):12–31. doi:10.1111/jpc.16297. Epub 2022 Dec 19.
6. Movingto.com. Portugal Migration Statistics | Insights on Migration Trends. Movingto.com; 2025. Accessed 2026 Feb 21.
7. Machado AS, Godinho C, Marques MJ, Dias S. Barriers and facilitators in accessing health information among migrants residing in Portugal. Eur J Public Health. 2025;35(Suppl_6):ckaf180.229. doi:10.1093/eurpub/ckaf180.229.
8. Touzani R, Protopopescu C, Rouquette A, et al. Does health literacy mediate the relationship between socioeconomic status and navigation in the healthcare system? Patient

Educ Couns. 2025;138:109204.

9. La Cour EE, Malange VNE, Mohaissen T, et al. Causes of neonatal mortality in the European Economic Area and Switzerland: a WHO-based analysis and systematic review. Eur J Pediatr. 2025;184:628. doi:10.1007/s00431-025-06467-0.
10. Doetsch JN, Almendra R, Severo M, et al. Neonatal outcomes and parental health literacy. Lancet Reg Health Eur. 2023;34:100735. doi:10.1016/j.lanepe.2023.100735.
11. World Health Organization. Newborn mortality. Geneva: World Health Organization; 2024. Available from: https://www.who.int/news-room/fact-sheets/detail/newborn-mortality. Accessed 2026 Feb 21.
12. Santos C, Gandham S, Liu A, Bhurawala H. Characteristics of non-urgent neonatal presentations to an Australian metropolitan emergency department. J Paediatr Child Health. 2023 Jun;59(6):802–807. doi:10.1111/jpc.16392. Epub 2023 Apr 3.
13. Brandstetter S, Atzendorf J, Seelbach-Göbel B, Melter M, Kabesch M, Apfelbacher C; KUNO-Kids study group. Sociodemographic factors associated with health literacy in a large sample of mothers of newborn children: cross-sectional findings from the KUNO-Kids birth cohort study. Eur J Pediatr. 2020 Jan;179(1):165-169. doi:10.1007/s00431-019-03483-9. Epub 2019 Oct 29.
14. Fong HF, Rothman EF, Garner A, et al. Association between health literacy and parental self-efficacy among parents of newborn children. J Pediatr. 2018 Nov;202:265-271.e3. doi:10.1016/j.jpeds.2018.06.021.
15. Kemer D, Karataş H. Mothers' Knowledge of Neonatal Danger Signs: A Cross-Sectional Study. Pediatr Pract Res [Internet]. 2024 Mar 1;12(1):1-8. Available from: https://izlik.org/JA93XM47EW
16. Sørensen K, Pelikan JM, Rothlin F, et al. Health literacy in Europe: comparative results of the European health literacy survey (HLS-EU). Eur J Public Health. 2015;25:1053–1058.
17. Abu-Shaheen A, AlFayyad I, Riaz M, et al. Mothers' and Caregivers' Knowledge and Experience of Neonatal Danger Signs: A Cross-Sectional Survey in Saudi Arabia. Biomed Res Int. 2019 Mar 28;2019:1750240. doi:10.1155/2019/1750240.
18. Balaj M, York HW, Sripada K, et al. Parental education and inequalities in child mortality: a global systematic review and meta-analysis. Lancet. 2021;398(10300):608–620.
19. Mose A, Abebe H, Shitu S, Shimels H. Determinants of maternal knowledge of neonatal danger signs among postpartum mothers: an institutional-based cross-sectional study. BMJ Open. 2021;11(9):e048888.
20. Demis A, Gedefaw G, Wondmieneh A, Getie A, Alemnew B. Women's knowledge towards neonatal danger signs and its associated factors in Ethiopia: a systematic review and meta-analysis. BMC Pediatr. 2020;20:217. doi:10.1186/s12887-020-02098-6.