ORIGINAL ARTICLE

Factors Influencing Neonatal Pain Management Practices Among Healthcare Providers at Nyangabgwe Referral Hospital and Princess Marina Hospital, Botswana: A Cross-Sectional Study

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ABSTRACT

Background: Neonatal pain management is a global challenge, particularly in low- and middle-income countries like Botswana, due to inadequate resources, training, and evidence-based practice. This study therefore sought to assess neonatal pain management practices by Health Care Professionals at Nyangabgwe Referral Hospital and Princess Marina Hospital Neonatal Intensive Care Units, Francistown and Gaborone, Botswana.

Methods: This descriptive cross-sectional study involved 110 Health Care Professionals selected by census method. Data was collected through a validated online questionnaire and analysed using Stata version 18 with descriptive and inferential statistics, including Chi-square, Fisher's exact, and logistic regression tests. A 95% confidence interval and 5% significance level were applied.

Results: Results revealed that 79% of respondents had good neonatal pain management practices, while 21% had poor practices. Knowledgeable respondents were over six times more likely to have good practices than not knowledgeable ones (AOR = 6.34; 95% CI: 2.10-19.10, p= .001). Those who received formal training in neonatal pain management were about four times more likely to exhibit good practices than those without training (AOR = 3.97; 95% CI: 1.22-12.90, p = .046).

Conclusion: The results highlight the importance of improved nurses' knowledge and training, emphasizing the need for nursing curriculum reviews and hands on experiences to improve neonatal pain management practices in Botswana.

INTRODUCTION

Pain in neonates has remained a clinically significant yet often under-recognized concern in healthcare, particularly in low- and middle-income countries (LMICs) such as Botswana. Scientific evidence has confirmed that neonates, including preterm infants, can experience pain from as early as 24 weeks of gestation.[1, 2] In Neonatal Intensive Care

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Units (NICUs), routine procedures such as heel pricks, intubation, and intravenous insertions have been known to cause considerable discomfort and stress if not appropriately assessed and managed. When left untreated, neonatal pain may result in long-term consequences including altered brain development, increased pain sensitivity, and behavioural disturbances extending into later childhood.[3,4]

Despite international recognition and the availability of evidence-based guidelines, the management of neonatal pain has remained inconsistent in many LMICs. Contributing factors have included limited resources, lack of standardized assessment tools, inadequate training, and the absence of local protocols.[5,6] In the Botswana healthcare context, such challenges have been compounded by organizational and cultural influences that may affect how healthcare professionals (HCPs) recognize and respond to neonatal pain.

Although professional guidelines, such as those issued by the American Academy of Paediatrics, have emphasized the importance of using validated neonatal pain assessment tools and advocated for pain to be treated as the fifth vital sign these standards have not always been applied in practice.[7,8] Reports of inconsistent documentation and limited formal training among HCPs have highlighted persistent gaps in neonatal pain management. These challenges have underscored the need to assess current clinical practices and identify areas for improvement, especially in referral-level NICUs.

While various international studies have explored neonatal pain management practices, limited evidence had previously been available from Botswana. This study was therefore conducted to assess the neonatal pain management practices of healthcare professionals working in the NICUs of two major referral hospitals in Botswana. The aim was to generate locally relevant evidence regarding current practices, barriers, and enablers of neonatal pain management to support improvements in clinical care, guide training initiatives, and inform policy development.

METHODOLOGY

Study Design

This study adopted a quantitative approach with a descriptive cross-sectional design to assess the neonatal pain management practices by HCPs at the NICUs of NRH and PMH in Botswana. The approach was chosen because it allowed for the collection of numerical data, which was essential for analysing trends in neonatal pain management practice. The cross-sectional design was selected because it is scientifically appropriate for determining the prevalence of specific practices and associations between variables at a single point in time, without requiring long term follow up.

Study Setting

The study was conducted within the NICUs of NRH in Francistown and PMH in Gaborone, Botswana. These hospitals were chosen because they harbour level III NICUs with highly specialized equipment and personnel and serve as government owned teaching hospitals. NRH is situated in the Northern part of Botswana while PMH serves the Southern part.

Study Population and Sampling

The study population comprised HCPs working in the NICUs of NRH and PMH who were directly involved in neonatal care and willing to participate. A census method was employed to include all eligible participants, yielding a total sample of 110 respondents 51 from NRH and 59 from PMH out of 128 potential participants. Inclusion criteria required participants to have completed a minimum of six months of continuous service in the NICU, ensuring adequate clinical exposure to neonatal pain management. Participants were also required to hold either permanent or contractual employment in roles directly related to neonatal care, such as nursing, medical, or allied health professions. HCPs who took part in the pilot study or were unavailable during data collection were excluded from the study. These criteria ensured that the sample reflected professionals with relevant and consistent

experience in neonatal pain assessment and management.

Data Collection Tool and Technique

An online structured questionnaire was used to collect primary data for the study. This method was chosen for its suitability in capturing large volumes of data efficiently, enabling wide distribution across participants within a short timeframe. To ensure methodological transparency, the CHERRIES (Checklist for Reporting Results of Internet E-Surveys) guidelines were followed during the online survey process.[9] The questionnaire was adapted from previously validated instruments used in related studies.[10,11]

Data collection was conducted over a two-week period, from October 30 to November 12, 2024. Prior to administering the survey, necessary approvals were obtained from hospital superintendents, matrons, and NICU unit heads at both study sites. Participants provided informed consent electronically before accessing the questionnaire, thereby aligning the process with ethical research standards.

To enhance participant support, two staff nurses from each hospital were trained over two days by the principal investigator. These assistants addressed inquiries through dedicated WhatsApp groups, which were also used to disseminate survey links. Respondents submitted completed questionnaires via the Kobo Toolbox platform. All data were stored on encrypted, password-protected systems with access limited to authorized research personnel.

Validity and Reliability

Several steps were taken to ensure the validity and reliability of the data collection tool. Content validity was ensured by aligning the questionnaire with clearly defined research questions and objectives. The draft tool underwent expert review by a neonatologist, six neonatal nurses, and a paediatrician to verify that all items accurately captured the concept of neonatal pain management.

Construct validity was reinforced through a comprehensive literature review that informed item development. To establish external validity, the study defined a clear target population and set rigorous inclusion and exclusion criteria. The use of a census sampling method enhanced representation, allowing generalizability to the broader population of HCPs working in similar NICU contexts.[12] Internal validity was strengthened by limiting the study sample to healthcare providers working in level III NICUs, which minimized variability due to differences in institutional capability. Additionally, the questionnaire was translated and back translated between Setswana and English to maintain consistency in interpretation.

To ensure reliability, a pilot study was conducted with 10% of the sample size using probability proportional to size sampling. Participants involved in the pilot were excluded from the main study to avoid contamination or response bias. The internal consistency of the questionnaire was high, with a Cronbach's alpha coefficient of 0.80, indicating good reliability.

Data Analysis

Microsoft Excel served as the primary tool for data cleansing, followed by exportation to STATA version 18 software for comprehensive statistical analysis. Data was summarized, organized, and visually represented using graphs, frequency and contingency tables. The statistical significance of associations between dichotomous variables was analysed using the Chi-square test and Fisher's exact test. Analyses were conducted at a 95% confidence interval with a significance level of 5%. For the dependent variable, good practice was determined by score of 80% and above on the practice questions while those with less than 80% score were classified as having poor practices in neonatal pain management. The model was tailored to classify practice as either 1 (good practice) or 0 (poor practice). Knowledgeable respondents were those who scored *more than 80% on knowledge questions while not knowledgeable respondents were those*

who scored less than 80% on knowledge question. Logistic regression determined the relationship between dependent and independent variables. The odds ratios were used to calculate the strength of the association between independent variables and neonatal pain management practices.

Ethical Considerations

Ethical clearance was obtained from the University of Zambia Biomedical Research Ethics Committee (UNZABREC) (REF. No. 5630-2024) and the Biomedical Health Research Development Committee (BHRDC) (REF. No. HPRD: 6/14/1). Researcher registration was obtained from the National Health Research Authority (NHRA), reg. NHRAR-R- 1493/15/04/2024. Authorization to conduct the study was secured from Princess Marina Institutional Review Board (REF: PMH 2/11A II (496), and Nyangabgwe Referral Hospital Institutional Review Board (NH/PF 1171) as well as the Hospital Superintendents of the two study sites. Consent was obtained, throughout the study, the researcher adhered to ethical principles.

RESULTS

Socio-demographic characteristics of Respondents

The socio-demographic characteristics of the respondents are shown in Table 1.

Table 1: Socio-demographic Characteristics of Respondents *(N=110)*

VARIABLE	NUMBER	PERCENTAGE
SITE		
Nyangabgwe	51	46%
Princes Marina Hospital	59	54%
GENDER		
Female	92	84%
Male	18	16%
AGE GROUP		
18-25 years	19	17%
26-35 years	38	35%
36-45 years	37	34 %
46 years and above	16	15%
RELIGIONS		
Christian	108	98%
Muslim	1	1%
Botswana Traditional Religion	1	1%
PROFESSION		
Medical Officer	46	42%
Registered Nurse	52	47%
Paediatrician	12	11%
WORK EXPERIENCE		
5 years and above	57	52%
Between 2 and 5 years	18	16%
Between 1 -2 years	35	32%
EDUCATIONAL LEVEL		
Diploma	53	48%
Degree	40	36%
Master's	17	15%

Table 1 shows that most respondents were from PMH (54%) and predominantly female (84%). The largest age groups were 26 to 35 years (35%) and 36 to 45 years (34%). Almost 100% of the respondents were Christians. Nurses formed most participants (47%), and over half (52%) had more than five years of work experience. Most participants held diplomas (48%) or degrees (36%).

Neonatal Pain Management Practices of the respondents

The neonatal pain management practices of the respondents are shown in Figure 1.

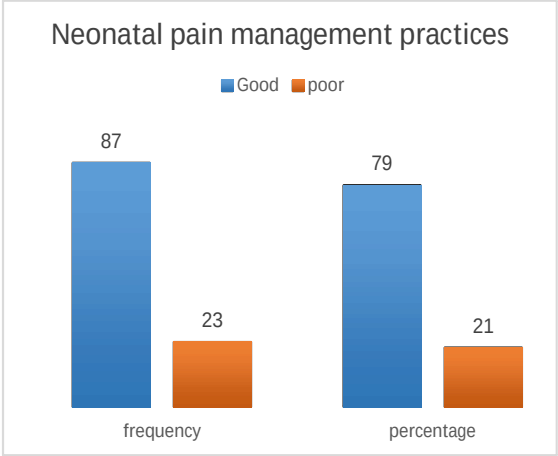

Figure 1: Neonatal Pain Management Practices of the respondents *(N=110)*

Figure 1 shows overall neonatal pain management practices, where the majority (79%) of the respondents had good neonatal pain management practices, while 21% had poor neonatal pain management practices.

Neonatal Pain Management Practices vs Socio-demographic Characteristics of Respondents

Table 2 presents the results of the chi-square and fishers exact tests, examining the associations between neonatal pain management practice and socio-demographic characteristics of respondents.

Table 2: Pain Management Practices vs Socio-demographic Characteristics (N=110)

Variables	Neonatal pain management Practices				P-value?
	Poor		Good		
	(No)	(%)	(No)	(%)	
Gender					0.955[FE]
Female	21	19	71	65	
Male	4	4	14	13	
Age group					0.797 X^2
18 to 25 years	3	3	16	15	
26 to 35 years	8	7	30	27	
36 to 45 years	10	9	27	25	
46 years and above	4	4	12	11	
Religions					0.008[FE]
Christian	23	21	85	77	
Other	2	2	0	0	
Professional Experience					0.234 X^2
Medical Officer	11	10	35	32	
Nurse	14	13	38	35	
Pediatrician	2	2	10	9	
Work Experience					0.014 X^2
5 years and above	18	16	39	35	
between 1 and 2 years	2	2	33	30	
between 2 and 5 years	5	5	13	12	

FE= Fisher`s Exact test

*Indicates significant p-value at $p < 0.05$ P-value: Probability value X^2: Pearson's Chi- Squared Test

Table 2 shows that there was statistically significant association between neonatal pain management practices and religion of the HCPs (p = .008). However, there was no statistically significant association between neonatal pain management practices and gender of the HCPs (p = .955), age group (P = .797), and professional experience (P = .234). Although there was a statistically significant association between neonatal pain management practices and work experience of the HCPs (p = .014), the data failed the X^2 test of association.

Neonatal Pain Management Practices vs Independent variables

Table 3 presents the results of the chi-square test, examining the associations between neonatal pain management practices and the independent variables.

Table 3: Pain Management Practices vs Independent Variables (N=110)

Variables	Neonatal pain management Practices				P-value?
	Poor		Good		
	(No)	(%)	(No)	(%)	
Pharmacological interventions					0.599[FE]
No	3	3	7	6	
Yes	22	20	78	71	
Total	25	23	85	77	
Nonpharmacological interventions					*0.047[FE]
No	0	0	12	11	
Yes	25	23	73	66	
Total	25	23	85	77	

Knowledge					*0.043[FE]
Not knowledgeable	25	23	2	2	
Knowledgeable	0	0	83	75	
Total	25	23	85	77	
Formal training					*0.025[FE]
No	14	13	58	53	
Yes	11	10	27	25	
Total	25	23	85	78	
Protocols					*0.042[FE]
No	1	1	6	5	
Yes	24	22	79	72	
Total	25	23	85	77	

* Indicates significant p-value at p < 0.05 Fisher's Exact Test

The results in table 3 shows significant differences in neonatal pain management practices based on the use of non-pharmacological interventions (p = .047), knowledge (p = .043), formal training (p = .025), and access to protocols and guidelines (p = .042), with those who used these resources demonstrating better practices. However, pharmacological interventions did not have significant association with neonatal pain management practices (p = .599).

Factors Associated with Practice of Respondents

Univariable and multivariable logistic regression of factors associated with neonatal pain management practices of the respondents are presented in table 4.

Table 4: Multivariable binary logistic regression model determining factors influencing neonatal pain management practices of the respondents (N=110)

Variable	UOR (95% CI)	AOR (95% CI)	P-Value
Knowledgeable	9.21 (2.10–30.20)	6.34 (2.10–19.10)	0.001*
Formal Training (Yes)	2.81 (1.22–6.51)	3.97 (1.22–12.90)	0.046*

Reference groups: Not Knowledgeable; No formal Training

UOR: Unadjusted Odd Ratio

AOR**:** Adjusted Odd Ratio

*Significance at p < 0.05

Respondents who were knowledgeable about neonatal pain management were significantly more likely to report good practices. The odds of good practice among knowledgeable respondents were over six times higher compared to those not knowledgeable (AOR = 6.34; 95% CI: 2.10–19.10; p = 0.001). Similarly, participants who received formal training in neonatal pain management had approximately four times higher odds of reporting good practices compared to those who did not receive training (AOR = 3.97; 95% CI: 1.22–12.90; p = 0.046). Other variables were excluded from the final model due to non-significant p-values or confidence intervals spanning 1.0, indicating a lack of statistical robustness.

DISCUSSION

Neonatal pain management faces significant challenges worldwide, particularly in sub-Saharan Africa due to limited resources, insufficient knowledge, and a lack of clear guidelines, leading to inadequate pain relief despite its critical importance. Effective management requires evidence-based guidelines, proper training, and validated assessment tools, alongside improved education for healthcare providers to prevent long-term developmental effects. At NRH and PMH in Botswana, pain management is often insufficient, with no specialized training and the absence of pain assessment guidelines. Despite high neonatal admissions, pain assessment scores are frequently missing, emphasizing the need for research to address these gaps. Literature highlights the ongoing disparity between theory and practice, especially in low- and middle-income countries (LMICs), like Botswana. This study aimed to assess healthcare professionals' practices in neonatal pain management at NRH and PMH to establish data to inform targeted interventions to improve care. The results revealed critical gaps in knowledge, training,

and the availability of protocols, with variations in adherence to evidence-based practices.

Socio-Demographic Characteristics of the Respondents

The current study examined the socio-demographic characteristics of HCPs and their influence on neonatal pain management practices at NRH and PMH. Most respondents (54%) worked at PMH, 46% worked at NRH, and almost 100% were Christians. A significant majority (84%) were female, reflecting global trends in neonatal care. Some studies in other countries reported more balanced gender distributions.[13, 14, 15] Most respondents fell on the category of 26 to 35 years of age and almost half were nurses, in line with Jember *et al.*[16] The study also found that nearly half (52%) of respondents had more than five years of experience, suggesting a workforce with significant practical knowledge consistent with other findings.[15,17] Almost half (48%) of respondents held a diploma, 36% held a bachelor's degree, and 15% held a master's degree.

Neonatal Pain Management Practices of Respondents

The current study showed that most healthcare professionals (79%) had good neonatal pain management practices, while a smaller proportion (21%) had practices that could be improved. Similarly, high adherence to neonatal pain management practices were reported in several European countries, with France (100%), the Netherlands (80%), and Belgium (75%).[2] Comparable findings have also been documented in other African settings, with Ethiopia and Ghana reporting approximately 50% adherence to recommended practices.[10, 18] These studies support the current results and suggest that growing awareness and institutional support may be improving neonatal pain management in both high- and low-resource contexts.

However, other studies have reported less favourable results. Suboptimal practices were identified in Greece, Rwanda, Ethiopia, Ghana, Iran, South Africa.[13, 14, 19, 20, 21, 22] These studies highlight ongoing challenges in implementing pain management protocols, including gaps in knowledge, lack of access to standardized tools, and limited professional development opportunities. The results of the current study reflect a relatively high level of compliance with neonatal pain management protocols in Botswana, compared to several other African countries. This suggests that existing training programs, guidelines, and institutional policies may be having a positive impact. The results highlight the importance of addressing key enablers such as knowledge, attitudes, and access to pain assessment tools.[10, 23] Results also reaffirm previous findings that opportunities for professional development are linked to better pain management practices.[13] What is new and noteworthy in this study is the relatively high adherence rate in a resource-limited setting like Botswana, which exceeds rates reported in many comparable contexts. While the results align with trends observed in better-resourced healthcare systems, they also represent a positive deviation from the norm in similar African settings. This may indicate that Botswana is making important strides in neonatal care and offers a model for improving pain management practices in similar environments.

These results support the need for healthcare institutions to continue strengthening pain management systems. This includes developing and implementing evidence-based guidelines, incorporating validated pain scales into routine care, and conducting regular audits and feedback sessions. Such measures can help ensure consistent, high-quality neonatal care and promote the continuous professional growth of healthcare providers. While knowledge and formal training significantly influenced neonatal pain management, protocols availability, religion and pain relievers' availability did not influence pain management among health care professionals at NRH and PMH in Botswana. The current study revealed a significant association between knowledge and neonatal pain

management practices, with participants who were knowledgeable being 6.34 times more likely to engage in good neonatal pain management practices compared to those who were not knowledgeable (AOR = 6.34; 95% CI: 2.10–19.10; p = .001). Similarly, studies in Ethiopia reported positive associations between knowledge and neonatal pain management practices where nurses with adequate knowledge were 12.8 times and 1.51 times more likely to practice good neonatal pain management.[10, 11] In addition, healthcare professionals with good knowledge were more than three times as likely to provide effective neonatal pain management compared to their less knowledgeable counterparts.[16]

However, despite this consistent trend, some healthcare settings continue to report poor neonatal pain management practices even when knowledge levels are relatively high, suggesting that knowledge alone may not always be sufficient.[15, 17] The positive relationship observed between knowledge and neonatal pain management in this study likely reflects the fact that informed healthcare providers are better equipped to understand and apply evidence-based protocols. What is noteworthy about the current findings is their alignment with existing literature, yet they contribute new data specific to the Botswana context, where empirical evidence on this subject has been limited. These results underscore the importance of investing in training and professional development to enhance knowledge among healthcare providers.

The current study also showed that healthcare professionals who had received formal training in neonatal pain management were nearly four times more likely to practice good neonatal pain management than those who had not (AOR = 3.97; 95% CI: 1.22–12.90; p = .046). Similarly, in Ethiopia healthcare providers who received training in neonatal pain management were twice as likely to implement good neonatal pain management practices compared to those without training.[11] Trained healthcare providers were 2.12 times more likely to demonstrate good practice.[10] In Ghana, it was found that healthcare professionals without formal training had only an 8% chance of practicing good neonatal pain management.[18] These findings reinforce the positive effect of training on clinical practice. This may be due to increased familiarity with both national and international clinical guidelines, which fosters a more standardized and consistent approach to neonatal pain management.

However, while the current findings align with most of the existing literature, there are settings where formal training alone does not translate into improved practice.[25] Other systemic challenges such as resource constraints and weak institutional support can limit the effectiveness of even well-designed training programs. These results validate what has already been established in the literature. However, the new contribution of this study lies in providing local evidence from Botswana, where empirical data on this issue has been limited. Results of this study underscore the importance of strengthening and scaling up structured training for healthcare providers

Study Limitations

The study had some limitations that warrant acknowledgment. A cross-sectional study design provided a snapshot of the current state of neonatal pain management in the participating NICUs. While this design limited the ability to conclude long-term trends or causal relationships, data was collected from two NICUs in different geographical locations to capture variability in practice, thereby enhancing external validity and increasing the sample size. A longitudinal study would be more effective in concluding long-term trends or causal relationships between variables. Additionally, the study relied on self-reported data from HCPs, which can introduce bias. To mitigate this, anonymity was ensured in surveys, reducing social desirability bias and encouraging more honest responses. Moreover, standardized, validated questionnaires helped improve the reliability of the data.

CONCLUSION

The study highlighted that a substantial (79%) of HCPs demonstrated good neonatal pain management practices, while a smaller proportion (21%) exhibited poor neonatal pain management practices. Botswana's high adherence (79%) suggests potential for regional leadership in neonatal pain management. The study also revealed that robust knowledge and formal training enhanced the likelihood of good neonatal pain management practices, emphasizing the critical role of these factors in improving clinical outcomes. The results point to a pressing need for comprehensive, targeted educational programs and the integration of pain management training into healthcare curricula together with ensuring consistent availability of pain management protocols in the NICUs.

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Conflict of interest

The authors declare that there is no conflict of interest in this study.

Author's Contribution

We declare that this work was completed by the authors named in this article and all liabilities pertaining to claims relating to the content of this article will be borne by the authors. Barulaganye Difsele conceived and designed the study. Barulaganye Difsele, Emmanuel Mwila Musenge, Caroline Zulu and Natalia Mbewe Shitima contributed to the conduction of the study. Febiano Phiri, Barulaganye Difsele and Emmanuel Musenge analysed the data. Emmanuel Mwila Musenge supervised the whole study process. All the authors wrote and approved the final version of the manuscript for publication.

REFERENCES

1. Mencía S, González-Luis GE, Hernández-Platero L, de León-Luis J. Neonatal pain: Current perspectives. *J Neonatal Perinatal Med*. 2022;15(1):1–10.
2. Sarkaria S, Gruszfeld D. Neonatal pain management in European NICUs: State of the art and future perspectives. *Eur J Pediatr*. 2022;181(6):2199–2207.
3. Eriksson M, Campbell-Yeo M. Assessment and management of pain in newborns: An update. *J Neonatal Nurs*. 2019;25(4):177–181.
4. Johnston CC. Pain in infants: The neglected issue. *J Perinat Neonatal Nurs*. 2020;34(1):4–11.
5. Williams AC, Lascelles BD. Neonatal pain: Mechanisms and long-term consequences. *Clin Perinatol*. 2020;47(3):535–551.
6. Wade R, Coller RJ, Lin A, et al. Barriers to neonatal pain management in LMICs. *BMJ Glob Health*. 2020;5(3):e002280.
7. Gao J, Liu H, Yang Y, et al. Neonatal pain assessment tools and their implementation in low-resource settings. *Int J Nurs Sci*. 2023;10(1):70–78.
8. American Academy of Paediatrics. Prevention and Management of Procedural Pain in the Neonate: An Update. *Paediatrics*. 2021;148(3):e2021053120.

9. Eysenbach G. Improving the quality of web surveys: The Checklist for Reporting Results of Internet E-Surveys (CHERRIES). *J Med Internet Res*. 2004;6(3):e34.
10. Kebede M, Bulto GA, Tadesse DB. Knowledge, attitude, and practice of neonatal pain management among nurses in Ethiopia. *BMC Nurs*. 2023;22(1):19.
11. Wari T, Yirdaw M, Ademe B. Assessment of neonatal pain management practice among nurses working in NICUs. *Int J Afr Nurs Sci*. 2021;14:100278.
12. Findley SE, Kikuta A, Denly A. Sampling techniques for surveys in neonatal health studies. *Glob Public Health*. 2021;16(10):1500–1508.
13. Popowicz N, Mares J, Trnavský K. Gender diversity and neonatal care outcomes in NICUs. *J Neonatal Perinatal Med*. 2021;14(2):121–128.
14. Okiri L, Kiperemero B, Mukabana B. Neonatal pain management practices in East Africa. *Afr Health Sci*. 2023;23(1):66–75.
15. Abebe W, Tesfaye T, Belachew T. Knowledge and practice of neonatal pain assessment and management among NICU nurses. *BMC Pediatr*. 2024;24(1):115.
16. Jember W, Woldehaimanot TE, Yismaw AE. Determinants of neonatal pain management in Ethiopia: A cross-sectional study. *J Nurs Health Sci*. 2024;13(2):45–52.
17. Roga E, Bognini D, Musiime V. Experience and knowledge of healthcare providers on neonatal pain. *Afr J Midwifery Womens Health*. 2023;17(1):14–21.
18. Wuni A, Atabila A, Mohammed B. Practices and challenges in neonatal pain management in Ghana. *Int J Nurs Midwifery*. 2020;12(4):210–217.
19. Agakidou E, Alexopoulou E, Mavrikou M. Neonatal pain management practices in Greece: A multicenter survey. *J Matern Fetal Neonatal Med*. 2021;34(7):1100–1106.
20. Muteteli C, Tengera M, Gowan M. Neonatal pain recognition and response in Rwandan NICUs. *Afr J Paediatr Neonatal Health*. 2019;8(3):155–161.
21. Neshat H, Kazemi M, Ghanbari M. Pain assessment and management in Iranian NICUs: A national survey. *Iran J Nurs Midwifery Res*. 2023;28(2):145–150.
22. Mabaso T, Mkhize N, Ntuli T. Neonatal pain care knowledge and practice among nurses in South Africa. *Curationis*. 2022; 45(1):a2337.
23. Llerena MS, Roberts KD, Jones K. Standardizing neonatal pain assessment in low-resource NICUs. *J Perinatol*. 2023; 43(1):45–52.
24. Christoffel MM, Castral TC, Lopes-Junior LC. Effects of educational programs on nurses' knowledge and neonatal pain practice. *Pain Manag Nurs*. 2019;20(1):46–53.
25. Mehrnoush N, Tirgari B, Keshavarz Z. Barriers to effective neonatal pain management: A qualitative study. *J Pediatr Nurs*. 2018;42:e53–e61