

# A Comparison of Health Care Workers Assessment and Management of Pain between a Neonatal Intensive Care Unit in India and Norway

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## Abstract

**Objective:** Describe and compare health care worker's assessment and management of neonatal procedural pain between two Neonatal Intensive Care Units (NICUs) in India (PGI: Post Graduate Institute of Medical Education and Research) and Norway (OUH-U: Oslo University Hospital Ullevaal), and to investigate the factors influencing the assessment and compare the pain management with international guidelines.

**Methods:** A survey was conducted among NICU staff at both institutions assessing how painful specific neonatal procedures were considered to be using the Visual Analog Score (VAS). Kruskal Wallis H- and Mann-Whitney tests were performed for analysis. Procedural pain management protocols at the NICUs were obtained by interview.

**Results:** There was a significant difference between the units in assessment of subjective pain intensity for the highest and moderately perceived painful procedures [Mean rank PGI - OUH-U ( $\chi^2$ ): 26.04-43.47 (13.291);  $P = 0.000$  and 28.34-41.03 (6.997);  $P = 0.008$  respectively]. In group 3, females rated higher pain intensity than men [Mean rank ( $\chi^2$ ): 37.85-25.87 (5.062)]. No significant difference was found for procedures within the low-pain category and factors such as age, profession, professional experience, and having own children. Procedural pain management differed between the two units, yet was not in accordance with guidelines from UpToDate.

**Conclusion:** Overall, pain recognition and pain management, specifically in the PGI NICU, was low and not consistent with current recommendations. These findings should serve as the basis for quality improvement interventions for both units. This difference also deserves exploration to identify the reasons and its impact on pain management at the NICUs.

**Keywords:** Neonatal pain; Pain assessment; Pain management; Comparison; Procedural pain; India; Norway; Low/middle-income country; High-income country

## Introduction

Misconception about the neonate's ability to perceive and experience pain has led to an under-treatment of pain throughout the history of neonatal medicine [1]. Before the nineteenth century, infants were considered to be more sensitive to pain than adults. However, in the late nineteenth century, studies done on neurologic development in neonates concluded that lack of myelination indicated lack of maturity in the neonatal nervous system and that localization of pain was not present in neonates [2]. These beliefs led to underuse of analgesic or anesthetic agents during invasive procedures, including surgery [3]. However, in the mid 1980's extensive research on neuroanatomy of neonates showed how the pain pathway and cortical centers involved in the perception of pain are well developed in neonates [2].

Today we have adequate evidence that shows how repetitive painful procedures have short [4] and long term [5] adverse consequences for the developing neonatal brain. Although there has been a continued

advance in perinatal care with increased awareness among health care workers (HCW) on the consequences of performing painful procedures on neonates, adequate pain management is still not observed [6]. This study was conducted to investigate the differences in pain perception and management between two large NICUs; one in a high income country and another in a low/middle income country. Since previous studies done on pain sensation and responses have found that different ethnic groups perceive pain in different ways [7], we also aimed to explore possible reasons for a different practice between these two neonatal units.

## Methods

### Overview of the neonatal intensive care units:

**Division of Neonatology, Postgraduate Institute of Medical Education and Research (PGI), Chandigarh, India:** Tertiary care governmental hospital, level III NICU serving the northern Indian states. Approximately 5500 deliveries and 650-750 NICU admissions per year with full bed occupancy rate. In total 40 beds, of which 22 are dedicated high-risk intensive care and 18 beds are step-down beds

primarily for growers and feeders. The neonatal unit is staffed by 5 consultants, 9 senior residents (fellows in Neonatology) and 16-18 junior residents on a rotational basis (Pediatric trainee residents). There are a total of 38 nurses at the NICU with an average nurse to patient ratio of 1:2 or 1:3 in the morning shift and lesser (1:4) during the other shifts. However, this largely depends on the sickness level of the neonates with more sick and ventilated neonates being attended by a dedicated nurse in a shift. The nurse: patient ratio in the step down care area is approximately 1:8.

Department of Neonatology, Oslo University Hospital Ullevaal (OUH-U), Norway: Tertiary state-owned hospital, level III NICU serving the south-eastern regions of Norway. Approximately 6-7000 deliveries and 700 admissions per year. In total 27 beds, of which 7 are dedicated high-risk intensive care, 10 for intermediate care and the last 10 beds are for growers and feeders. The bed occupancy is almost 80% throughout the year. There are 9 consultants and 11 residents at the NICU. The unit has a nursing staff of in total 100 man-year. The ratio of nurse to neonate is 1:1 at the intensive care unit, 1:2 at the intermediate and 1:3-4 at the growing unit.

### Study design:

**Direct observation and interview:** The daily routines, meetings, handovers and specific procedures were observed during a 6 week stay at the PGI and in total 20 days at OUH-U in 2014 (SKB). Using guidelines from UpToDate as a reference [8], the consultants in both NICUs were interviewed about the routines for analgesia during specific neonatal procedures at their unit, including use of pain assessment tools. These guidelines, which are based on the World Health Organization analgesic ladder for pain management in adults

[9] and guidelines from the Italian Society of Neonatology [10], should not be considered gold standard and are used as one of many international approaches. The length of stay of the data collector at PGI was significantly longer than at OUH-U, due to a lack of familiarity with the Indian health care system from before. However, we believe this has not significantly influenced our results as they are mainly based on questionnaires and interview, not so much on observation in itself.

**Questionnaire:** A questionnaire was prepared using demographic features and 27 procedures from a previously published survey [11]. The questionnaire, to be filled out by HCW from the NICUs, also included question about profession (physician/nurse/other health care worker), gender (male/female), age (20-35, 36-50, 50+), professional experience (0-5 years, 5-10 years, 10 years+) and whether they had own children or not (yes/no). The visual analog score (VAS) is a validated instrument to measure subjective responses [12]. The 27 common neonatal procedures were assessed and ranked according to the perceived intensity of pain by HCW on a 10-point VAS assuming absence of analgesia. At both hospitals all the HCW working in different shifts during 4-5 consecutive days were asked to fill out the questionnaire. The HCW were encouraged to fill these surveys without discussing with each other. We listed the scores of all the procedures from the HCW based on their median, maximum and minimum VAS score for pain intensity. For purpose of analysis we subsequently divided all the procedures into three categories of increasing perceived pain intensity: Procedure group 1/low- (Median VAS 1-3), group2/moderate (Median VAS 4-6) and group3/high (Median VAS 7-10) as shown in Table 1.

Procedure	VAS score		Procedure pain group
	Median ( 1 - 3 Q)	Min - Max	
Insertion of a thoracic drain	10 (8 - 10)	6 - 10	3
Intubation	8 (5 - 9)	4 - 10	3
Lumbar puncture	7 (5 - 8)	3 - 10	3
Bladder puncture	6 (5 - 8)	2 - 10	2
Removal of a thoracic drain	6 (5 - 8)	2 - 10	2
Eye screening for retinopathy of prematurity	6 (3 - 8)	0 - 10	2
Thoracic drain with suction	6 (5 - 8)	2 - 10	2
Insertion of a peripheral line	5 (4 - 7)	0 - 10	2
Injections im/sc	4 (3 - 7)	1 - 10	2
Endotracheal suctioning	4 (3 - 6)	1 - 10	2
Heel stick	5 (3 - 7)	1 - 10	2
Venipuncture	4 (3 - 6)	1 - 8	2
Nasopharyngeal suctioning	4 (3 - 5)	1 - 10	2
Insertion of a bladder catheter	5 (4 - 6)	1 - 10	2
Insertion/reinsertion CPAP	3 (2 - 5)	0 - 10	1
Extubation	3 (2 - 5)	0 - 10	1

Removal of a tape	4 (3 - 6)	1 - 10	2
Removal of transcutaneous O2 tape	3 (2 - 4)	1 - 7	1
Insertion of a nasogastric tube	3 (2 - 5)	1 - 8	1
Removal of intravenous cannula	2 (1 - 4)	0 - 8	1
Insertion of an umbilical line	4 (2 - 5)	0 - 8	2
Removal of ECG tapes	3 (2 - 5)	0 - 10	1
Removal of an umbilical line	2 (1 - 4)	0 - 7	1
Removal of a nasogastric tube	2 (1 - 4)	0 - 9	1
X-ray	1 (0 - 3)	0 - 7	1
Cranial ultrasound	1 (0 - 2)	0 - 5	1
Changing diaper	1 (0 - 2)	0 - 5	1

Procedural pain groups (group 1, 2 and 3) are constructed based on ranked median values.

**Table 1:** VAS scores from the filled out questionnaires from health care workers at the neonatal intensive care in India and Norway are presented as medians (1st - 3rd quartile), minimum and maximum scores.

**Statistical analyses:** Kruskal-Wallis H tests were used to assess whether there was a statistically significant differences between medians for each of the groups 1-3. We used the median VAS score for each procedure group as a dependent variable and “country”, “profession”, “age”, “gender”, “professional experience” and “having own children” as an independent variable. Later we used a post-hoc test using Mann-Whitney tests with Bonferroni correction to see which specific groups of our independent variable were statistically significantly different from each other. Two tailed p-values <0.05 were considered statistically significant. The statistical analysis was performed using SPSS statistical software (version 22.0; SPSS Inc., Cary, NC).

## Results

### Pain assessment:

A total of 35 questionnaires were filled out by HCW at PGI (20 from physicians, 15 from nurses) and 33 at OUH-U (8 from physicians, 25

from nurses). The response rate for the questionnaires at PGI was 100% among physicians and 94% for nurses. The response rate at OUH-U among physicians was 57% and among nurses was 83%.

A Kruskal-Wallis H test showed that there was a statistically significant difference in pain score for some parameters, as shown in Table 2. The parameter “country” showed significant p-values and chi-square for group 2 ( $p=0.008$ ,  $\chi^2=6.997$ ) and group 3 ( $p \pm 0.001$ ,  $\chi^2=13.291$ ), with mean rank pain score of 28.34-41.03 for group 2 and 26.04-43.47 for group 3. Mann-Whitney U and p-values for PGI and OUH-U were likewise: group 1 ( $U=497$  and  $p=0.326$ ), group 2 ( $U=362$  and  $p=0.008$ ), group 3 ( $U=281$  and  $p \pm 0.001$ ). From this data, it can be concluded that procedures in group 2 (moderate) and group 3 (high) were rated significantly less painful by HCW at PGI than at OUH-U, whereas the ratings for procedures in group 1 (low) did not differ significantly. The parameter “gender” also showed a significant p-value (0.024) with  $\chi^2$  (5.062) and mean ranks (37.85-25.87) (Table 2).

	Group 1: low pain intensity			Group 2: moderate pain intensity			Group 3: high pain intensity		
	Mean rank	Chi-square	'p'	Mean rank	Chi-square	'p'	Mean ranks	Chi-square	'p'
<b>Department</b>									
PGI	32.21	0.965	0.326	28.34	6.997	0.008	26.04	13.291	<0.001
OUH-U	36.92			41.03			43.47		
<b>Profession</b>									
Nurse	34.77	0.075	0.785	33.61	0.02	0.889	28.93	3.283	0.07
Physician	33.45			34.28			37.64		

Gender									
Female	34.78	0.034	0.854	35.52	0.467	0.494	37.85	5.062	0.024
Male	33.79			31.87			25.87		
Age									
20-35	35.26	0.134	0.935	33.92	1.335	0.513	34.84	0.235	0.889
36-50	33.4			33.44			33.38		
50+	34.6			44.3			37.8		
Professional experience									
0-5 years	37.5	2.262	0.323	35.65	0.729	0.694	37.62	1.588	0.452
5-10 years	35.94			36.38			30.19		
10+ years	29.36			31.57			33.39		
Having own children									
Yes	32.19	0.827	0.363	33.03	0.334	0.563	32.19	0.015	0.902
No	36.56			35.81			34.78		

**Table 2:** Comparison of pain assessment scores among health care workers according to department, (PGI: Post Graduate Institute of Medical Education and Research, OUH-U: Oslo University Hospital Ullevaal), profession, gender, age, professional experience and having own children , using Kruskal-Wallis H tests.

**Pain management:**

Table 3 compares a set of guidelines for neonatal analgesia [8] with the current management of neonatal pain relief at the two sites. The HCW responsible for each procedure is described along with the analgesia provided for the procedures at the unit. As shown in Table 3, analgesia was underutilized for relief of neonatal procedural pain at both NICUs when compared to international guidelines. At PGI step 1 (Non-pharm.) was performed less frequently and often depended on the availability of nurses, while it was performed before any procedure

at OUH-U. Physicians performed almost all procedures at PGI, while it was the opposite at OUH-U where nurses performed more procedures. UpToDate recommends a step-wise approach for some painful procedures, in other words, instead of going directly to Step 6 (Deep sed.) they often recommend trying to combine for instance Step 1 (Non-pharm.), 2 (Top anae.) and 5 (Lidoc.). Proceeding directly to the last steps was more often used at PGI, while OUH-U used this approach for some procedures.

Procedures	Guidelines from UpToDate(7) Stepwise interventions* and Comments	PGI (Post Graduate Institute of Medical Education and Research), Chandigarh, India	OUH-U (Oslo University Hospital Ullevaal), Oslo, Norway
Tracheal aspiration	Step 1 (Non-pharm.), consider Step 4 (Opiod.) or lidocaine via the endotracheal tube. Perform rapidly, limit catheter insertion to the endotracheal tube only	Physician. Nothing	Nurse. Step 1 (Non-pharm.)
Heelstick	Step 1 (Non-pharm.) & use mechanical lance. Venipuncture is more efficient, less painful; Steps 2 (Opioid.), 3 (Acetam.), & heel warming are ineffective	Physician. Nothing or Step 1 (Non-pharm.), depending on the availability of nurses	Nurse. Step 1 (Non-pharm.). Heelstick is not done on a regular basis, it is replaced with venipuncture
Gastric tube insertion	Step 1 (Non-pharm.), consider Step 2 (Top. anae.). Perform rapidly, use lubricant, avoid injury	Nurse. Nothing	Nurse. Step 1 (Non-pharm.)
Venipuncture	Steps 1 (Non-pharm.) & 2 (Top anae.). Requires less time & less resampling than heelstick	Physician or Nurse. Nothing	Nurse. Step 1 (Non-pharm.)
Arterial puncture	Steps 1 (Non-pharm.) & 2 (Top anae.), consider Step5 (Lidoc.). More painful than venipuncture	Physician. Nothing	Physician. Step 1 (Non-pharm.)
Intravenous cannulation	Steps 1 (Non-pharm.) & 2 (Top anae.). Data only available for topical tetracaine	Physician or Nurse. Nothing	Physician. Step 1 (Non-pharm.)

<b>Tracheal intubation</b>	Step 4 (Opiod.) or 6 (Deep sed.), use muscle relaxant only if experienced clinician, consider atropine. Superiority of a specific drug regimen over the others has not been investigated	Physician. Step 6 (Deep sed.) if the neonate is not sedated, if already sedated then nothing.	Physician. Step 1 (Non-pharm.) + Step 6 (Deep sed.)
<b>Central line placement</b>	Steps 1 (Non-pharm), 2 (Top anae.), 5 (Lidoc.), consider Step 4 (Opiod.) or 6 (Deep sed.). Some centers prefer using general anesthesia	Physician. Step 6 (Deep sed.) if the neonate is not sedated, if already sedated then nothing.	Physician. Step 1 (Non-pharm.). Done by a small puncture, not opening up a vessel.
<b>Umbilical catheterization</b>	Step 1 (Non-pharm.), avoid sutures on skin. Cord tissue is not innervated, avoid injury to skin	Physician. Nothing or Step 1 (Non-pharm.), depending on the availability of nurses	Physician. Step 1 (Non-pharm.)
<b>Subcutaneous and intramuscular injection</b>	Avoid if possible, Steps 1 (Non-pharm) & 2 (Top anae.).	Physician or Nurse. Nothing	Nurse. Step 1 (Non-pharm.)
<b>Lumbar puncture</b>	Steps 1 (Non-pharm), 2 (Top anae.), 5 (Lidoc.), careful positioning. Consider Step 4 (Opiod.) if patient is intubated/ventilated	Physician. Nothing or Step 1 (Non-pharm.), depending on the availability of nurses	Physician. Step 1 (Non-pharm.) and/or Step 2 (Top. anae.)
<b>Peripheral arterial line</b>	Steps 1 (Non-pharm), 2 (Top anae.), consider Steps 5 (Lidoc.), 4 (Opiod.)	Physician. Nothing or Step 1 (Non-pharm.), depending on the availability of nurses	Physician. Step 1 (Non-pharm.)
<b>Peripheral insertion of central catheter (PICC line placement)</b>	Steps 1 (Non-pharm), 2 (Top anae.), consider Steps 4 (Opiod.) & 5 (Lidoc.). Some centers prefer using general anesthesia	Physician. Step 6 (Deep sed.) if the neonate is not sedated, if already sedated then nothing.	Physician. Step 1 (Non-pharm.)
<b>Thoracic drainage</b>	Step 1 (Non-pharm.) & Step 6 (Deep sed.) for chest tube placement.	Physician. Step 6 (Deep sed.)	Physician. Step 1 (Non-pharm.) + Step5 (Lidoc.) + Step 6 (Deep sed.) If continuous thoracic drain then Step 3 (Acetam.) + Step 4 (Opiod.)
<b>* Stepwise interventions with increasing analgesia as the degree of anticipated procedural pain increases</b>			
<b>Step 1</b> (Non-pharm.): Nonpharmacologic measures: pacifier, oral sucrose, swaddling, kangaroo care (skin-to-skin contact with the mother), sensorial saturation			
<b>Step 2</b> (Top. anae.): Topical anaesthetics (topical lidocaine, lidocaine-prilocaine cream, amethocaine gel, tetracaine gel)			
<b>Step 3</b> (Acetam.): Acetaminophen: orally (10 to 15 mg/kg per dose every 6 to 8 hours) or rectally (20 to 25 mg/kg per dose every 6 to 8 hours)			
<b>Step 4</b> (Opiod.): Opioids: slow intravenous infusion of fentanyl (1 to 2 mcg/kg per hour) or morphine (10 to 30 mcg/kg per hour)			
<b>Step 5</b> (Lidoc.): Lidocaine: subcutaneous infiltration (0.5 mL/kg of 1 percent lidocaine solution OR 0.25 mL/kg of 2 percent lidocaine solution) or as nerve block			
<b>Step 6</b> (Deep sed.): Deep sedation/analgesia using fentanyl (2 to 4 mcg/kg) or morphine (50 to 100 mcg/kg), with midazolam (50 to 100 mg/kg), ketamine (1 to 2 mg/kg), or thiopental sodium (2 mg/kg)			
<b>Note:</b> Each column states who assessed pain and how it was managed			

**Table 3:** Analgesia for specific neonatal procedures.

## Discussion

This study shows that there is a difference in assessment of pain intensity for the highest and moderately perceived painful procedures between HCW in PGI and OUH-U. None of the other factors such as age, profession, professional experience, or having own children were found to significantly influence the assessment of neonatal procedural pain; whereas the difference between the two countries remained significant (Table 2). In contrast, other studies with larger sample size have shown that there was an influence of profession, with physicians rating the procedures as less painful than nurses [13,14]. There was a significant difference between gender, where female rated higher pain perception compared to male, but this was only seen for group 3. Another interesting finding was that the difference in pain assessment increased with increasing pain intensity. One possible reason for the larger difference in group 3 could simply be that the procedures were performed in a different way, with different techniques or different instruments at the two units. The use of standardized pain assessment tools increases the detection and knowledge of the staff that there are

many painful procedures at the NICU [15-17]. Hence, the difference in assessment could also be explained by lack of usage of these tools for instance because of high patient load in Indian nurses or overestimating pain intensity by HCW in Norway.

A previous study from the NICU's in Norway concluded that procedural pain in neonates was not sufficiently managed and that both pharmacological and comfort measurements were underutilized [18]. Based on the findings from the interviews and observation of management of painful procedures compared to the guidelines from UpToDate we can conclude the same. This discrepancy has been confirmed in studies from other countries [19-21]. One of the most likely identified reasons for the differences in pain management in the current study may be the numbers of nurses at the two hospitals, as there were less nurses per patient at PGI compared to OUH-U. We do not know if the HCW at the two units are educated and trained differently when it comes to pain recognition and management, but while the quality of education can impact the knowledge obtained, skill maintenance requires repeated training sessions with periodic



evaluation [22]. The term knowing-doing gap is often used to describe the phenomenon where there is a discrepancy between what HCW know and what they do about it [23]. Some procedures in our study illustrate this, for instance the procedure “lumbar puncture”, that according to the guidelines from Up-to-date and the guidelines used at PGI from National Neonatology Forum of India [24] recommend minimum use of topical anesthesia. Even though this procedure was ranked as a highly painful procedure by the HCW at PGI, the Indian infants were often not given any analgesia before this procedure, as shown in the table of analgesia for specific neonatal procedures; “Nothing or Step 1 (Non-pharm.), depending on the availability of nurses”.

Shortage of HCW is a reality in many countries and a study from 2014 showed how a significant shortage of trained nurses in the field of newborn care was contributing to poor neonatal outcomes in India [25]. Another recent study from 2015 in India found that 70.5 % of the NICU nurses were identified as perceiving moderate to high stress with 43.6 % attending to more than 4 patients per shift [26]. One approach to the lack of nurses at the NICU could be to involve the parents in the care of their child more, as suggested in a study that states that by entrusting the mothers with simple tasks like changing their baby’s diapers and monitoring for skin color and respiratory movements, the nurses can get more time for other tasks [27].

There can be several other reasons for the underutilization of analgesic measures in neonatology. One obvious factor is the difficulty in using oral sucrose because of its non-availability in India when this study was conducted. Lack of knowledge about the importance and effect of comfort measures, and to some degree lack of experience and training in performing them, are some others [28]. Often medical attention is focused on treatment of medical conditions and therefore procedural pain might be neglected. Comforting measures is often considered a task for the nurse, while physicians often tend to focus on pharmacological approaches for pain management. HCW might also want to perform procedures quickly either because of lack of time or because they believe that if you perform a procedure quickly then it’s less painful. Lack of awareness and knowledge about analgesic methods, including concerns about addiction and side effects of analgesic medicine can also be a contributing factor [29].

The present study had several methodological limitations. The conclusions in this study should be judged with caution as it has a small sample size and a certain degree of bias due to subjective measurements. The number and response rate of physicians at OUH-U is lower than in PGI and analyses of the non-responders have not been undertaken, but it is highly likely that physicians who do not consider pain as an important issue did not respond. In order to assure manageability of the collected data, questionnaires used only a ranking from 0 to 10 and did not include open-ended response items. Although the 27 procedures are the same, it is likely that there is variability between how they are performed at the units and hence the pain itself has a likelihood of varying. Many differences exist between the two centers (staffing, structure, size and ratio of high-risk beds) that may have influenced the assessment of pain within the two centers, yet the individual impact of each of these factors was not possible to assess within the present study. VAS has not been validated for postulating what pain may be felt by neonates as understood by the HCW at the units. It was assumed that all HCW who participated answered all the survey questions independently and that the physicians and nurses interviewed for the analgesia for specific procedures gave answers that reflected the practice at the unit. During the statistical analysis the 27

procedures were grouped into 3 groups based on the median value from all the questionnaires which might have skewed the analysis.

## Conclusion

This study showed that HCW at PGI assessed neonatal procedures to be less painful for the infant than HCW at OUH-U. It also showed that the procedural pain management was not sufficient compared to international guidelines. High patient load for NICU nurses in India, causing lack of pain reducing measures being used, is an important factor that need to be addressed. There is also a need for measures and interventions to get even better pain management of painful procedures in neonates and therefore studies that show the efficacy and effect of interventions need to be performed. However, given the small sample size and the marked differences in structure of the 2 units, the comparisons are difficult to interpret for a broader use.

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## Declaration of Interest Statement

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## References

1. Puchalski M, Hummel P (2002) The reality of neonatal pain. *Adv Neonatal Care* 2: 233-244.
2. Anand KJ, Hickey PR (1987) Pain and its effects in the human neonate and fetus. *N Engl J Med* 317: 1321-1329.
3. Wallerstein E (1985) Circumcision: The uniquely American medical enigma. *Urol Clin North Am* 12: 123-132.
4. Grunau RE, Holsti L, Haley DW, Oberlander T, Weinberg J, et al. (2005) Neonatal procedural pain exposure predicts lower cortisol and behavioral reactivity in preterm infants in the NICU. *Pain* 113: 293-300.
5. Hermann C, Hohmeister J, Demirakca S, Zohsel K, Flor H (2006) Long-term alteration of pain sensitivity in school-aged children with early pain experiences. *Pain* 125: 278-285.
6. Walker SM (2005) Management of procedural pain in NICUs remains problematic. *Paediatr Anaesth* 15: 909-912.
7. Kvachadze I, Tsagareli MG, Dumbadze Z (2015) An overview of ethnic and gender differences in pain sensation. *Georgian Med News* 238: 102-108.
8. Anand KJ (2015) Prevention and treatment of neonatal pain. *UpToDate*.
9. McGrath PA (1996) Development of the World Health Organization Guidelines on Cancer Pain Relief and Palliative Care in Children. *J Pain Symptom Manage* 12: 87.
10. Lago P, Garetti E, Merazzi D, Pieragostini L, Ancora G, et al. (2009) Guidelines for procedural pain in the newborn. *Acta Paediatr* 98: 932-939.
11. Cignacco E, Hamers JP, Stoffel L, van Lingen RA, Schütz N, et al. (2008) Routine procedures in NICUs: factors influencing pain assessment and ranking by pain intensity. *Swiss Med Wkly* 138: 484-491.
12. Price DD, McGrath PA, Rafii A, Buckingham B (1983) The validation of visual analogue scales as ratio scale measures for chronic and experimental pain. *Pain* 17: 45-56.
13. Simons SH, van Dijk M, Anand KS, Roofthoof D, van Lingen RA, et al. (2003) Do we still hurt newborn babies? A prospective study of

- procedural pain and analgesia in neonates. *Arch Pediatr Adolesc Med* 157: 1058-1064.
14. Britto CD, Rao PS, Nesargi S, Nair S, Rao S, et al. (2014) PAIN-perception and assessment of painful procedures in the NICU. *J Trop Pediatr* 60: 422-427.
  15. Taylor BJ, Robbins JM, Gold JI, Logsdon TR, Bird TM, et al. (2006) Assessing postoperative pain in neonates: a multicenter observational study. *Pediatrics* 118: e992-1000.
  16. Bergqvist L, Eriksson M, Kronsberg S, Schollin J, Barton B, et al. (2007) Seeing through the blind! Ability of hospital staff to differentiate morphine from placebo, in neonates at a placebo controlled trial. *Acta Paediatr* 96: 1004-1007.
  17. Anand KJ (2001) International Evidence-Based Group for Neonatal P Consensus statement for the prevention and management of pain in the newborn. *Arch Pediatr Adolesc Med* 155:173-180.
  18. Andersen RD, Greve-Isdahl M, Jylli L (2007) The opinions of clinical staff regarding neonatal procedural pain in two Norwegian neonatal intensive care units. *Acta paediatr* 96: 1000-1003.
  19. Lago P, Guadagni A, Merazzi D, Ancora G, Bellieni CV, et al. (2005) Pain management in the neonatal intensive care unit: a national survey in Italy. *Paediatr Anaesth* 15: 925-931.
  20. Johnston CC, Collinge JM, Henderson SJ, Anand KJ (1997) A cross-sectional survey of pain and pharmacological analgesia in Canadian neonatal intensive care units. *Clin J Pain* 13: 308-312.
  21. Porter FL, Wolf CM, Gold J, Lotsoff D, Miller JP (1997) Pain and pain management in newborn infants: a survey of physicians and nurses. *Pediatrics* 100: 626-632.
  22. Nimbalkar AS, Dongara AR, Ganjiwale JD, Nimbalkar SM (2013) Pain in children: knowledge and perceptions of the nursing staff at a rural tertiary care teaching hospital in India. *Indian J Pediatr* 80: 470-475.
  23. Lundeborg S (2015) Pain in children--are we accomplishing the optimal pain treatment? *Paediatr Anaesth* 25: 83-92.
  24. Bhakoo O, Kumar P, Jain N, Thakre R, Murki S, et al. (2010) Evidence Based Clinical Practice Guidelines. National Neonatology Forum, India.
  25. Kalyan G, Vatsa M (2014) Neonatal nursing: an unmet challenge in India. *Indian J Pediatr* 81: 1205-1211.
  26. Amin AA, Vankar JR, Nimbalkar SM, Phatak AG (2015) Perceived stress and professional quality of life in neonatal intensive care units nurses in Gujarat, India. *The Indian Journal of Pediatrics* 82: 1001-1005.
  27. Fernandez A, Mondkar JA (1993) Status of neonatal intensive care units in India. *J Postgrad Med* 39: 57-59.
  28. Mathew PJ, Mathew JL (2003) Assessment and management of pain in infants. *Postgrad Med J* 79: 438-443.
  29. Walco GA, Cassidy RC, Schechter NL (1994) Pain, hurt, and harm. The ethics of pain control in infants and children. *N Engl J Med* 331: 541-544.