

ORIGINAL RESEARCH

Comparison of Behavioral and Cardiovascular Changes to Nociceptive Stimuli among Preterm and Term Neonates in a Tertiary Care Centre, Coimbatore

Aghil R.B¹, S. Kanchana Bobby^{2*}, Narmatha Devi. B³

¹Senior Assistant Professor ,Department of Physiology ,Government Medical College and ESI Hospital ,Coimbatore, Tamil Nadu, India.

^{*2} Senior Assistant Professor, Department of Physiology, Coimbatore Medical College, Coimbatore, Tamil Nadu, India.

³Assistant Professor ,Department of Community Medicine ,Government Medical College and ESI Hospital, Tamil Nadu, India.

Corresponding Author: Dr. S. Kanchana Bobby, Senior Assistant Professor, Department of Physiology, Coimbatore Medical College, Coimbatore, Tamil Nadu, India.

ABSTRACT

Background: The various common nociceptive stimuli for the babies in the Neonatal intensive critical care are during intravenous catheterisation, blood sampling and vaccination. Pain contributes to immediate and late effects in them like hemodynamic fluctuations and behavioral changes. The aim of the study is to compare the behavioral and cardiovascular changes to pain between preterm and term neonates.

Methods: This is a cross sectional study done in the Department of Paediatrics in the Coimbatore Medical College & Hospital ,Coimbatore for a period of February 2021 to January 2022.The study participants who fulfilled the inclusion and the exclusion criteria were included in this study. The final sample size was 71.The participants were divided into 2 groups Preterm(36) and Term(35).Demographic details like name ,gestational age, sex ,day of life were taken. The pain response was assessed by NIPS score .Autonomic reactivity was assessed by heart rate and respiratory rate changes.The collected data was entered in the MS excel and statistics were done with SPSS 23.Categorical variables expressed in numbers and percentages and continuous variables were expressed in terms of mean and standard deviation.P value <0.05 is considered as significant.

Results: Among the study participants male preponderance was seen (Preterm -19,Term - 20).The mean birth weight of Preterm was 1.6±0.6 Kg and Term was 2.8±1.2 Kg.NIPS mean score of term babies was more compared to preterm babies and the difference was found to be statistically significant.Similarly respiratory rate was higher in term babies.The heart rate in both preterm and term are found to be increased after nociceptive stimuli compared to before nociceptive stimuli.

Conclusion: It is concluded from our study that the behavioral pain score response during the Nociceptive stimuli showed a statistically significant difference between preterm and term neonates.Thus the gestational age strongly influences the pain response in neonates. Now many studies have been validated which can be used to avoid inter observer bias and other problems which arise due to this scale.

Keywords: Behavioral, Cardiovascular changes, Respiratory, Autonomic reactivity

INTRODUCTION

In 1980 the researchers first recognised the pain response among the hospitalized newborns. Before that it was believed that the neonates in their early life could not perceive pain. Many researches were done continuously in order to define the neonate pain. Later it was found that myelination of the sensory system was complete for the babies even before birth.^[1] It is also found that they are hypersensitive to pain as the Descending pain modulation system was not properly formed.^[2] Pain may contribute to many effects in them like immediate and late. The immediate effects are hemodynamic fluctuations and the late are significant behavioral changes. Neurodevelopmental sequelae and altered pain behaviors are the longterm effects of pain.^[3] Newborns will experience pain as a part of neonatal care which is routine like administration of Vitamin K injection and screening through heel prick. This is most common in both sick preterm and term babies. It is estimated 15 million preterm babies are born each year in our world.^[4] A baby born before 37 weeks of gestation period is known as Preterm. It is further categorized into extremely preterm(<28 weeks) ,very preterm(28-<32 weeks) and moderate to late preterm(32-<37 weeks).^[5] As the preterm births has been increased ,advancement in medicine has also achieved their increased survival rates. Babies who are term and are sick in the intensive care unit had an average hospital stay for 5 days according to a study.^[6] In contrast the average length of stay in the hospital for the preterm babies was found to be 81 days.^[7] Premature babies are more in NICU compared to the Term babies.^[8]

The nervous system of the neonate is very plastic. This is because it is immature and it undergoes major developmental changes. Therefore a painful stimuli may cause a neurodevelopmental changes. The risk of Neuro-developmental impairment which may be short term or long term tend to occur when the preterm and term babies experiences the Nociceptive input too early. In 1990 an author characterizes the behavioral and the physiological responses to the painful stimuli.^[9] Till now more than 40 scales have been used to assess the neonatal pain but no gold standard instrument was framed.^[10] Pain scales have been recommended by the clinical guidelines for the neonatal pain prevention and management as its validity and reliability was proven.^[11,12,13] The scales are Premature Infant Pain Profile (PIPP),Neonatal Facial coding system (NFCS),Neonatal Pain, Agitation and Sedation scale (N-PASS), Behavioral Infant Pain Profile (BIIP),Comfort scale and Face, Legs, Activity, Cry, Consolability (FLAAC) Scale. Painscales are generally decided based on the intensive care set up we are having. We have used NIPS scale in our study. Researches done today have assessed the relationship between physiological and behavioral pain responses. The aim of the study is to compare the behavioral and cardiovascular changes to pain between preterm and term neonates.

MATERIALS AND METHODS

Study Setting

This study was conducted among the preterm and term babies in the neonatal intensive care unit at Coimbatore which is a tertiary care centre. The study was done for a period of one year from February 2021 to January 2022.

Study Design

Cross sectional study

Sample Size

The study participants fulfilling the inclusion and the exclusion criteria were included in the study throughout the study period. The final attained sample is 71.

Inclusion Criteria

- All the preterm and term babies admitted in the neonatal intensive care unit were included

Exclusion Criteria

- Neonates with any active medical illness and on analgesic or sedative drugs were excluded.

Pain Assessment tools**Neonatal Infant Pain Scale**

This is a behavioral scale neonate facial expression, crying rate, breathing pattern, tone of arms and legs and state of arousal at one minute interval was assessed. Each behavioral indicator is scored with 0 or 1 except cry which has three possible descriptors therefore being scored 0, 1 and 2. Infants were observed five minutes before the venipuncture and 15 minutes after. The total pain scores ranges from 0-7. 0-2 score means no pain to mild pain, 3-4 score means mild to moderate pain and >4 means severe pain.

Autonomic Reactivity

It is estimated by measuring the changes in heart rate and respiratory rate using Pulse oximetry. After getting the ethical clearance the study was started by collecting the baseline data from the patient's record and then the pain was assessed through the scale which was discussed above.

Statistical Analysis

The obtained data was entered in the MS Excel Windows 10. Statistical analysis was done with the help of SPSS 23. Continuous data was expressed in terms of Mean and Standard deviation. Categorical data was expressed in terms of Numbers and percentages. Test of association for Categorical data was Chi square test and for Continuous data was t test and Anova test.

RESULT

The study participants were divided into Preterm and Term group. Preterm group consist of 36 and Term group consist of 35 study participants.

Table 1: Demographic characteristics of the study participants

N= 71	Preterm (n=36)	Term (n=35)
Gestational age	32-36 weeks	37-42 weeks
Birth weight	Mean 1.6 kg	Mean 2.8 kg
Sex		
Male	19	20
Female	17	15
Day of life	Less than 48 hrs	Less than 48 hrs

The mean birth weight of the babies in the preterm group was found to be 1.6 ± 0.6 Kg whereas in the Term group it was found to be 2.8 ± 1.2 Kg. Male preponderance was seen in both the groups (Preterm-19 , Term-20)

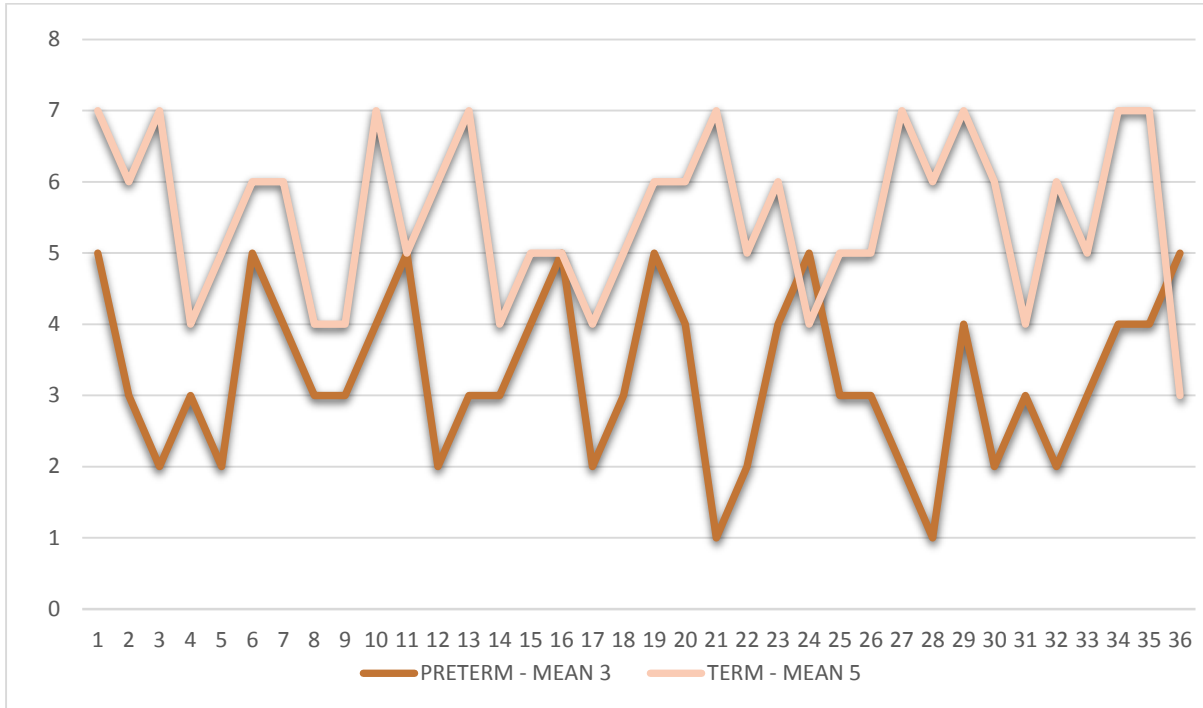


Figure 1: NIPS scoring of the study participants

The mean NIPS score of Term babies was 5 which was more when compared to the preterm babies whose mean score was 3. The difference was found to be statistically significant

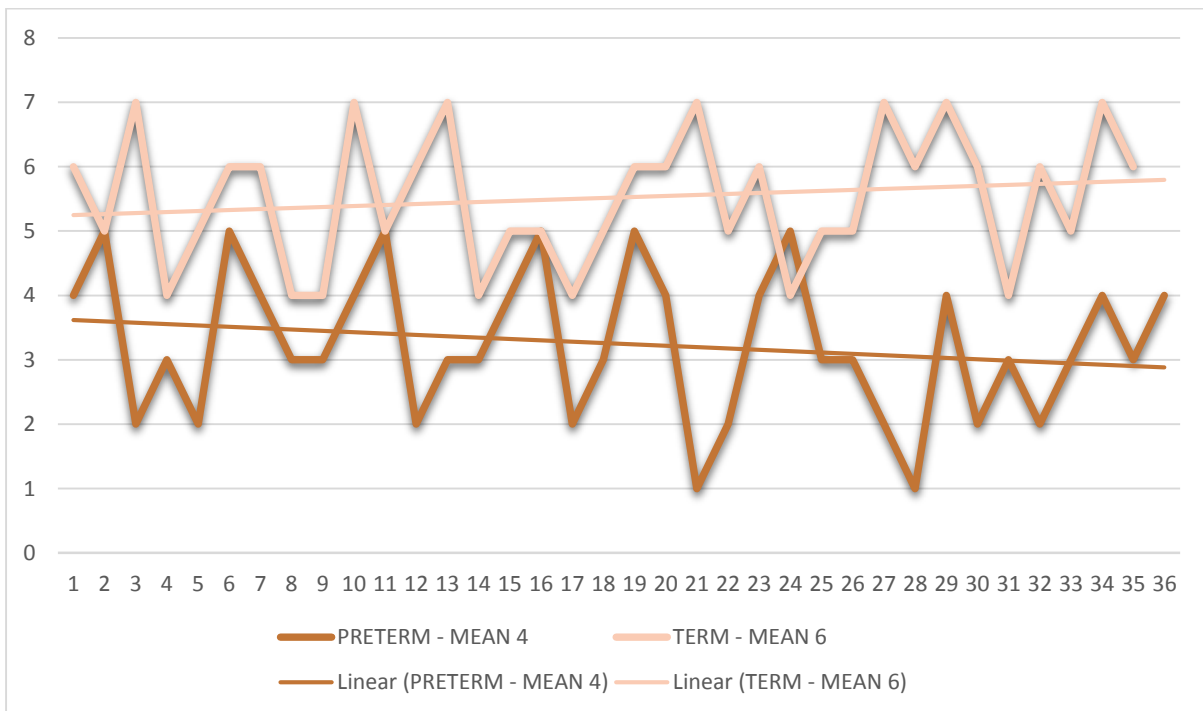


Figure 2: Respiratory Score of the study participants

The mean Respiratory rate score of the preterm babies was found to be 4 which is lower than Term babies where the score was found to be 6. The difference was found to be statistically significant. Irregular chest in drawing pattern of respiration noted in preterm group whereas regular breathing pattern with increase in respiratory rate noted in term group.

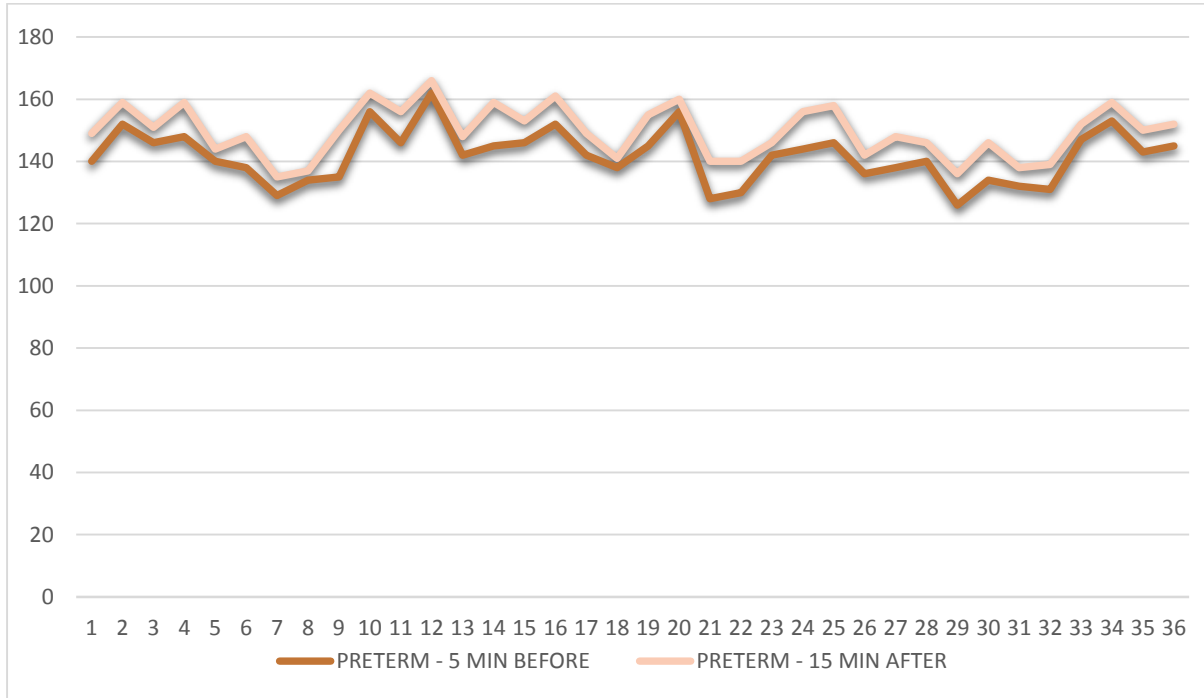


Figure 3: Heart Rate variations of preterm babies 5 minutes before and 15 minutes after the Nociceptive stimulus
Preterm babies

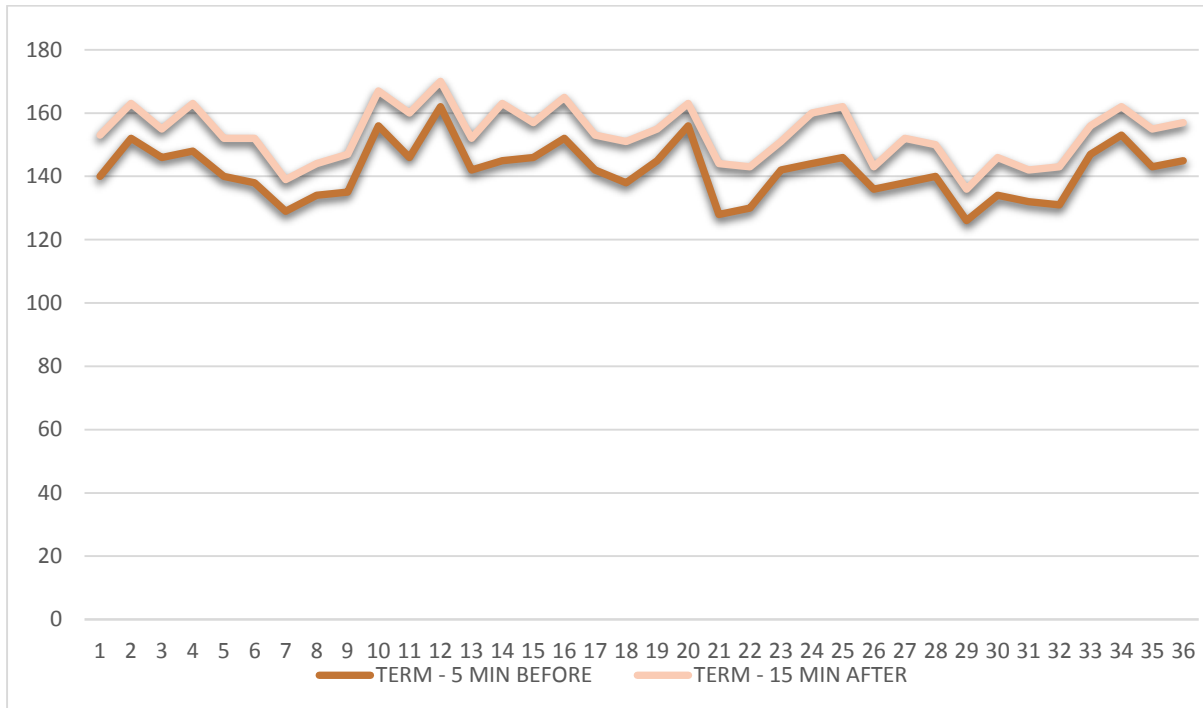


Figure 4: Heart Rate variations of term babies 5 minutes before and 15 minutes after the Nociceptive stimulus

In figure 3 and 4 it was found that after the nociceptive stimulus the heart rate increases compared to before the stimulus. The difference was found to be statistically significant. Thus the behavioral pain scores response during nociception showed a significant difference between preterm and term neonates, so it should be monitored. Cardiovascular and respiratory parameters variation almost same in both the groups.

DISCUSSION

The main issue for a clinician is assessing the pain response accurately among neonates or for any nonverbal study subjects.^[14] Though multiple scales are there none of it considered superior to one another. There is no gold standard scale. The two main problems noted are :1)The physiologic and the behavioral parameters that have been specified by the studies after a painful stimulation is due to tissue injury and get subsided after painful stimulation. So they are not seen in all the neonates.2)Second problem is the interobserver variability.^[15,16] This is due to the subjective evaluation of a clinical observer assessing the behavioral and physiologic response.

It is the NICU-specific needs which helps us in choosing the type of pain assessment. But inadequate psychometric testing was seen in many scales. This limits the accuracy of the testing scale. Now a days improvement in measuring the central pain responses in the brain helps us in evaluating the behavioral and autonomic pain indicators specifically. Researches done today have assessed the relationship between physiological and behavioral pain. This is in line with NIPS monitoring in preterm babies undergoing heel lance.^[17]

The mean NIPS score of Term babies was 5 which was more when compared to the preterm babies whose mean score was 3. The difference was found to be statistically significant. This may be due to the fact the preterm babies were immature, asleep or exposed to painful procedures previously will be less likely to demonstrate the specific response to pain.^[18] In our study it was

found that after the nociceptive stimulus the heart rate increases compared to before the stimulus. Irregular chest indrawing pattern of respiration noted in preterm group whereas regular breathing pattern with increase in respiratory rate noted in term group. The difference was found to be statistically significant. Cardiovascular parameters variations was almost same in both the groups.

Limitations of the Study

The sample size is small. Our study was done in a tertiary care centre which is a small geographical area.

CONCLUSION

It is concluded from our study that the behavioral pain score response during the venipuncture showed a statistically significant difference between preterm and term neonates. The cardiovascular parameters changes were same in both the groups. Thus the gestational age strongly influences the pain response in newborn babies.

Recommendations

Some methods are used to alleviate the pain. They are Non-Pharmacological methods like Breastfeeding, Non-nutritive sucking, Rocking and Massaging. Pharmacological methods used are Oral Sucrose and opioids.

Funding

None of the authors received funding for this study

Competing interest

There is no Competing interest

Authors contribution

All authors in our study contributed to the data collection of the patients

Acknowledgement

The authors like to thank the Dean of the Medical College, Head of the Department of Paediatrics, Coimbatore Medical College, Coimbatore, Tamil Nadu, India.

REFERENCES

1. Fitzgerald M, Mc Intosh N. Pain and analgesia in the newborn. *Arch Dis Child* 1989;64(4):441-43
2. Anand KJ. Clinical importance of pain and stress in preterm neonates. *Biol Neonate* 1998;73(1):1-9
3. Grunau RE, Holsti L, Peters JW. Long term consequences of pain in human neonates. *Semin Fetal Neonatal Med* .2006;11(4):268-75
4. Howson CP, Kinney MV, Lawn JE. Born too soon :the Global action report on Preterm Birth. Geneva: World Health Organization 2012. 126
5. Dimes M, PMNCH, Children St, WHO. Born too soon: The Global Action Report on Preterm Birth. Geneva : World Health Organization .2012
6. March of Dimes Perinatal DataCenter: Special Care Nursery Admissions. White Plains, NY: National Perinatal Information System/Quality Analytic Services 2011.
7. Lee HC, Benette MV, Schulman J, Gould JB. Accounting for variation in length of NICU stay for extremely low birth weight infants. *J Perinatol*. 2013;33:872-6
8. Carbajal R, Rousset A, Rancan C, Coquery S, Nolent P, Ducrocq S. Epidemiology and treatment of painful procedures in neonates in intensive care units. *JAMA*. 2008;300:60-70

9. K.D Craig, M.F Whitfield,R.V.E Grunau,J.Linton,H.D.Hadijistavropoulas.Pain in the preterm neonate:behavioral and physiological indices”1993.Pain 52(3):287-299
10. V.Giordano,J.Edobor,P.Deindl.Pain and sedation scales for neonatal and pediatric patients in a prevertebral stage of development:a systematic review,”JAMA Pediatrics,2019;173(12)1186-1197
11. P. Statement Prevention and management of procedural pain in the neonate:an update.Pediatrics 2016.137:1-13.
12. KJS. Anand. Consensus statement for the prevention and management of pain in the newborn. Archives of Pediatrics and Adolescent Medicine.155(2).2001.173-180
13. J. Harris ,A-S Ramelet,M.Van Dijk.”Clinical recommendations for pain ,sedation, withdrawal and delirium assessment in critically ill infants and children :an ESPNIC Position statement for healthcare professions.”Intensive Care Medicine 2016.42(6).972-986.
14. Herr K,Coyne PJ, Key T.Pain assessment in the nonverbal patient:position statement with clinical practice recommendations. Pain Manag Nurs.2006;7:44-52
15. Van Dijk M, Koot HM, Saad HH,Tibboel D, Passchier J.Observational visual analog scale in pediatric pain assessment :useful tool or good riddance.Clin J Pain .2002;18:310-316
16. Lawrence J,Alcock D, McGrath P,Kay J,MacMurray SB,Dulberg C.The development of a tool to assess neonatal pain.Neonatal Netw.199.;12(6):59-66
17. Slater R, Cantarella A, Franck L, Meek J, Fitzgerald M. How well o clinical pain assessment tools reflect pain in the infants? PLOs Med.2008;5e19.
18. Johnston CC, Sstevens BJ, Franck LS,Jack A, Stremmler R,Platt R.Factors explaining lack of response to heel stick in preterm newborns. J Obstet Gynecol Neonatal Nurs.1992;28:587-597