

# Contextual factors associated with pain response of preterm infants receiving non-pharmacologic pain relief interventions for heel-stick procedures

Gila Sellam, MNS, RN<sup>1</sup>; Sandra Engberg, Prof., PhD, CRNP, FAAN<sup>1&3</sup>; Kris Denhaerynck<sup>1</sup> PhD, RN; Eva Lucia Cignacco, PhD, RM<sup>1</sup>

<sup>1</sup>Institute of Nursing Science, University of Basel, Switzerland; <sup>2</sup> Division of Neonatology, Children's Hospital, University Hospital Bern, Switzerland ;  
<sup>3</sup> School of Nursing, University of Pittsburgh, Pennsylvania, USA

## Background

- Enormous advances have been made in pain assessment of preterm infants over the past quarter century by developing valid tools for the evaluation of a pain status. However, the challenges remain, as assessors must rely on behavioral and physiologic non-verbal cues of pain in this population.
- While there is evidence indicating that medical and demographic contextual factors (cFs) impact pain responses in preterm neonates, less is known about their impact on the effectiveness of non-pharmacologic pain relieving interventions.

## Objective of the study

To explore the effect of cFs on the impact of non-pharmacologic interventions on pain response of preterm infants during repeated routine heel-stick procedures.

## Methods

- An observational study as part of a randomized controlled trial examining pain reactivity to non-pharmacologic interventions across repeated heel-sticks in preterms (Cignacco et al, 2012).
- Seventy-one premature infants, 24-32 weeks of gestation, were randomized to 3 groups: sucrose, facilitated tucking, or a combination of both.
- Five heel-sticks across the first 14 days of life were videotaped. Pain response was rated with the "Bernese Pain Scale for Neonates" (BPSN) by 4 raters blinded to three phases (baseline, heel-stick, and recovery) of heel-stick.
- Demographic and medical cFs were extracted from medical charts.
- Mixed single and multiple regression models were performed controlling for the intervention group, site, and heel-stick phase.

**Table 1: Pain scores for all raters across all heel-sticks measured by the BPSN**

Score	Phase	Non-pharmacologic intervention group						GA groups			
		Sucrose		FT		Combination		24-28 weeks		29-32 weeks	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
T-BPSN	Baseline	4.03	2.08	4.99	3.24	4.62	2.88	4.77	2.87	4.41	2.75
	Heel-stick	7.48	3.64	9.75	4.73	7.53	3.75	8.06	4.13	8.35	4.23
	Recovery	4.87	2.04	5.18	2.87	4.23	2.68	4.94	2.34	4.66	2.7
B-BPSN	Baseline	4.02	2.08	4.97	3.25	4.62	2.88	4.76	2.88	4.41	2.75
	Heel-stick	5.58	2.95	7.01	3.59	5.49	2.95	5.73	3.19	6.19	3.27
	Recovery	3.66	1.71	3.9	2.47	3.18	2.24	3.69	1.88	3.52	2.34
P-BPSN	Baseline	0	0	0.04	0.22	0	0.03	0.03	0.19	0.01	0.08
	Heel-stick	1.89	1.79	2.72	1.98	2.03	1.73	2.34	1.92	2.14	1.83
	Recovery	1.23	1.35	1.28	1.31	1.05	1.23	1.27	1.42	1.14	1.22

T-BPSN= total BPSN scores  
B-BPSN= behavioural BPSN scores  
P-BPSN= physiologic BPSN scores

GA= gestational age  
FT= facilitated tucking  
SD= standard deviation

## Results

- Apgar scores at 1 minute were negatively associated with both total ( $p=0.004$ ) and behavioral ( $p=0.002$ ) BPSN scores, while Apgar scores at 5 minutes after birth were positively associated with total ( $p=0.02$ ) and behavioral ( $p=0.006$ ) scores.
- Accumulated number of painful procedures ( $p=0.002$ ) and gender ( $p = 0.02$ ) were positively associated with physiologic BPSN scores, while CPAP ( $p=0.009$ ) and mechanical ventilation ( $p=0.005$ ) were negatively associated.

**Table 2: Contextual factors influencing pain response multivariate mixed regression model**

Outcome variable	Contextual factor	$\beta$	SE	df	t-value	p-value
T-BPSN	Gender	0.197	0.340	57.184	0.581	0.563
	Patent ductus arteriosus	-0.526	0.446	60.745	-1.181	0.242
	Cardiac events	0.638	0.544	60.854	1.174	0.245
	PMA	0.320	0.459	362.985	0.696	0.487
	Apgar (1 min)	-0.310	0.103	60.728	-3.009	0.004**
	Apgar (5 min)	0.344	0.143	61.330	2.395	0.020*
	Number of accumulated painful procedures	0.0001	0.002	447.399	0.087	0.931
B-BPSN	Cardiac events	0.571	0.456	62.366	1.253	0.215
	PMA	0.288	0.371	390.406	0.775	0.439
	Apgar (1 min)	-0.289	0.087	60.765	-3.289	0.002**
	Apgar (5 min)	0.347	0.122	61.293	2.831	0.006**
	Weight	-0.0007	0.0004	68.224	-1.793	0.077
	Number of accumulated painful procedures	-0.002	0.001	459.340	-1.346	0.179
P-BPSN	Gender	0.324	0.136	65.102	2.381	0.020*
	CPAP	-0.400	0.152	252.950	-2.618	0.009**
	Mechanical ventilation	-1.106	0.393	263.964	-2.809	0.005**
	Respiratory distress syndrome	0.286	0.156	61.842	1.833	0.072
	PMA	0.051	0.221	351.397	0.234	0.815
	Apgar (1 min)	-0.004	0.044	58.539	-0.101	0.920
	Apgar (5 min)	-0.036	0.063	63.025	-0.571	0.570
	Weight	0.0004	0.0002	71.562	1.959	0.054
	Duration of HS procedure	0.043	0.022	685.427	1.952	0.051
	Number of accumulated painful procedures	0.003	0.0009	458.362	3.088	0.002**

\* $p<0.05$  ; \*\* $p<0.01$

T-BPSN= total BPSN scores

B-BPSN= behavioral BPSN scores

P-BPSN= physiologic BPSN

PMA= post menstrual age

HS= heel-stick

SE= standard error

DF= degrees of freedom

## Conclusions

- Higher exposure to painful procedures, male infants, and having CPAP or mechanical ventilation were cFs being associated with physiologic response. The only variables significantly associated with total and behavioral BPSN scores were Apgar scores, but these relationships were not consistent. Further research with large samples is needed to permit the examination of multiple cFs and their influence on both behavioral and physiological aspects of pain.

## References

- Cignacco E, Denhaerynck K, Nelle M, Buhner C and Engberg S. Variability in pain response to a non-pharmacological intervention across repeated routine pain exposure in preterm infants: A feasibility study. Acta Paediatr 2009;98:842-846.
- Cignacco E, Sellam G, Stoffel L, Gerull R, Nelle M, Anand KJS, Engberg S. Oral sucrose and "facilitated tucking" for repeated pain relief in preterms: A randomized controlled trial. Pediatrics 2011; online: January 9, 2012 (doi: 10.1542/peds.2012.1542).
- Johnston CC and Stevens BJ. Experience in a neonatal intensive care unit affects pain response. Pediatrics 1996;98:925-930.
- Sellam G, Cignacco EL, Craig KD and Engberg S. Contextual factors influencing pain response to heelstick procedures in preterm infants: What do we know? A systematic review. Eur J Pain 2011; 15:661 e661-661 e615.