



Effect of Foot Massage and Acupressure on Pain Levels and Physiological Parameters during Heel Lancing in Full-Term Neonates

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ABSTRACT

Background: Pain has a deleterious impact on the emotional, physical, and social development of children of all ages. Acupressure and foot massage are two evidence-based non-pharmacological approaches for treating infants' acute pain during heel lancing. This study **aimed to** evaluate the effect of foot massage and acupressure on pain levels and physiological parameters during heel lancing in full-term neonates. **Subjects and method:** The experimental research design was adopted in this study. A systematic random sample of 120 full-term neonates with their parents was included in the study at Tanta City Maternal and Child Health Centers. **Tools:** two tools were used, **Tool I: Structured interview schedule** divided into four parts as follows; Socio-demographic characteristics of neonates, anthropometric physical parameters, physiological parameters, and heel stick procedure time. **Tool II: Neonatal Infant Pain Scale observational checklist.** **Result:** The half of neonates in the acupressure and massage groups had no/ mild pain during the heel lancing, while 65% in the control group had severe pain during heel lancing and there was a statistically significant difference of pain scores with $P= 000$ during the heel lancing in acupressure, massage, and control groups. **Conclusion and recommendations:** The study was concluded that acupressure and foot massage techniques were more effective either in Pain levels, Physiological Parameters and heel lancing time So; the researchers recommended that in-service training program for nurses and mothers should be conducted regularly to teach them non-pharmacological strategies for relieving pain in children of all ages.

Key words: Acupressure, Foot Massage, Neonates' Pain

Introduction

Health practitioners assume that neonates do not feel pain or stress, aspects of pain and stress in neonates are still not taken into account. This assumption has been around for a long time in some countries. It is difficult to persuade health professionals that newborns experience pain and

have a stress reaction. As a result, it's not unexpected that the phrases "pain" and "stress" are still debatable in practice, with some assuming they're interchangeable and others assuming they're not. Distinguishing between pain and stress is necessary. The pain was explored in general and examined from psychological, sociological, and

cultural perspectives in addition to its physical element in an examination of the idea of pain. (Cruz and etal 2016; Orovec and etal., 2019)

According to many of theories, neonates' cognitive development is still in the early phases of the motor-sensory phase, and they are also unable to comprehend events. Furthermore, because prenatal language features have not yet evolved, the pain cannot include psychological, social, or cultural dimensions. As a result, it is vital to define the idea of pain in neonates. (Piaget, 2000., Maciel and etal., 2019; Christoffel and etal.,2021)

Children of all ages require effective and safe procedural pain management for humanitarian reasons and to limit acute physiological and behavioral discomfort. Many procedures, such as vitamin K and Hepatitis B vaccination, are administered to newborns. Furthermore, in some countries, heel lancing is done before discharge from the hospital to detect disorders such as phenylketonuria and hypothyroidism. Pain is experienced by neonates during these activities, which may limit their ability to adjust to the outside environment and contribute to stress and physiological imbalance. (Mangat and etal., 2018; Yilmaz and etal., 2021)

It is critical to prevent and reduce pain. For the acute pain that newborns suffer, a variety of evidence-based non pharmacological approaches have been documented to be used. Kangaroo care, oral sucrose, breastfeeding, music therapy, massage, and acupressure are just a few of the techniques available. Massage is a method of

applying pressure to the body using hands or specific equipment methodically and scientifically. Massage stimulates the mechanoreceptors in the feet and hands, which activate the "non-painful" nerve fibers that keep pain from reaching consciousness. (Speedie and et al.,2021; Napiórkowska-Orkisz and etal., 2022)

Foot massage of neonates has been demonstrated to increase physiological and behavioral stability, reduce the severity of pain reactions to heel lancing, and shorten the time of heel lancing. Furthermore, in neonates intensive care units (NICU), foot massage has been shown to minimize pain reactions to procedures other than heel stick. It is thought that, foot massage is equally beneficial as acupressure in relieving pain. (Fitri and etal., 2012; Kliegman etal., 2022)

Acupressure is a technique for stimulating acupuncture sites with the palms and fingers while applying pressure to the body's meridians. Acupressure is a safe method for reducing pain, maintaining calm, and maintaining a healthy immunological and digestive system. It can be done while the infant is being bathed, massaged, nursed, or dressed for bed. Acupressure and foot massage is useful in decreasing discomfort in neonates in several studies. Both approaches are dependable, simple, quick, cost-effective, and simple to learn and use (Özkan and etal., 2019; Deniz and etal., 2021)

Significance of the study; Neonates are exposed to many interventions inducing pain starting from birth until discharge. Early neonatal pain can lead

to serious short and long-term adverse effects. Complementary care techniques such as foot massage and acupressure which are now part of standard nursing practice, could be employed to relieve procedural pain and provide comfort to neonates.

Pediatric and community health nurses are the first responders in maternal and child health centers, where they have important responsibilities such as minimizing the effects of adverse conditions on neonates admitted for various reasons, relieving their pain, and ensuring comfort. As a result, researchers decided to conduct a study to evaluate the effect of foot massage and acupressure on pain levels and physiological parameters during heel lancing in full-term neonates. (Ibrahim and et al., 2016; Keels and et al., 2016; Kavitha and et al., 2021)

Aim of the Study

To evaluate the effect of foot massage and acupressure on pain levels and physiological parameters during heel lancing in full-term neonates.

Research hypothesis

H1: Study groups who receive either foot massage or acupressure will be exhibited a reduction in pain scores during and after heel lancing than those who do not.

H2: Study groups who receive either foot massage or acupressure will have more improvements in physiological parameters during and after heel lancing than those who do not.

Subjects and Method

Research design; A comparative experimental research design was used in this study.

Setting; This study was conducted at Maternal and Child Health Centers (MCH) such as pottors, Embaby and Segar centers in Tanta City, El-Gharbia governorate, Egypt that is affiliated to the Ministry of Health and Population. These centers are serving a large section of Tanta population. The data was collected on Saturday and Tuesday at the time of Thyroxin Hormone analysis according to MCH rules.

Subjects; A systematic random sample technique was used in this study by selecting from previously mentioned settings one neonate for the message group, one for the acupressure group, and one for the control group and then repeating the cycle until reaches 120 full-term neonates were included in the research. The size of the sample was calculated according to power analysis based on the level of significance (95%), and study power (80%), with a margin of error (5) on Epi info. Software program. The newborns were selected according to **inclusion criteria;** full-term neonates, stable health status, body weight ranging from 2500–4000g, no congenital anomalies, received no other pain interventions, calm and not hungry at the time of the heel lancing procedure. Then the neonates randomly assigned to one of three groups: acupressure, massage, or control group.

- **Group A (Control Group):** not received acupressure or massage (40 neonates).

- **Group B (Massage Group):** massage only was given 2 minutes before the heel lancing procedure to the neonates (40 neonates)

- **Group C (Acupressure Group):** Acupressure only was applied to the neonates 2 minutes before the heel lancing procedure (40 neonates)

Developing the Tools; the researchers used two different data collection tools to achieve the aim and research hypothesis.

Tool I: Structured Interview Schedule: it was constructed by the researchers after reviewing the related and recent literature to assess socio-demographic characteristics of neonates, anthropometric physical parameters, physiological parameters, and heel stick procedure time. It included four parts (Orovec and et al., 2019; Deniz and et al., 2021; Kliegman et al., 2022)

Part I: Socio-demographic characteristics of Neonates such as; age, gestational age (weeks), birth order, postnatal age (days), sex, type of delivery and feeding types, mothers' education, and occupation.

Part II: Anthropometric Parameters of Neonates; such as weight, length, head circumferences of the neonates.

Part III; Physiological Parameters of Neonates: the researcher assessed the effect of massage and acupressure on neonatal physiological parameters, such as (heart rate, respiratory rate, and O₂ saturation) and performed five minutes before, during, and one minute after heel lancing.

Part IIII; Heel Lancing Procedure Time; it was estimated for massage, acupressure, and control groups.

Tool II: Neonatal Infant Pain Scale (NIPS) observational checklist; the researchers adapted Neonatal Infant Pain Scale from **Lawrence et al (1993)** to assess the level of pain and discomfort responses of term neonates. The scale includes six sections; facial expression, crying, breathing pattern, arm and leg movements, and state of arousal, all sections were scored (0-1 point) except the crying section was scored (0-2 points). (Lawrence and et al., 1993)

Facial Expression

- **Score 0** if the neonate has relaxed muscles, a restful face, and a neutral expression.

- **Score 1** if the neonate has a grimace, tight facial muscles, a furrowed brow, chin, and jaw.

Cry

- **Score 0** if the neonate is quiet and has no cry.

- **Score 1** if the neonate has whimper, mild and intermittent moaning.

- **Score 2** if the neonate has vigorous cry, continuous and loud scream.

Breathing Patterns

- **Score 0** if the neonate is relaxed and has a usual breathing pattern.

- **Score 1** if the neonate has a change in breathing such as irregular, faster than usual.

Arms

- **Score 0** if the neonate is relaxed or restrained and has no muscle rigidity.

- **Score 1** if the neonate is flexed or extended, has tense, straight arms, rigid extension, and flexion)

Legs

- **Score 0** if the neonate is relaxed or restrained and has no muscle rigidity.

- **Score 1** if the neonate is flexed or extended, has tense, straight legs, rigid extension, and flexion)

State of Arousal

-**Score 0** if the neonate has quiet, peaceful sleeping or awake.

- **Score 1** if the neonate is Fussy and restless.

Total scores of the Neonatal Infant Pain Scale

(NIPS); Total scores ranged from 0 - to 7 points from 0 to 2 indicate mild to no pain, 3 to 4 points indicated mild to moderate pain, and > 4 indicated severe pain. Higher scores indicate more severe pain. In this research, the Cronbach's alpha of NIPS was calculated as during =0.866 and after=0.84.

Method

1-Administrative process; The Dean of the Faculty of Nursing at Tanta University granted official permission to the competent authorities of maternity and child health centers to secure their approval and cooperation for the study.

2-Ethical and Legal Considerations; Parents were aware of the importance of keeping information about their newborns private and secret. The study's design ensured that their newborns were neither harmed nor in pain. After describing the study's purpose to parents, they gave their written agreement to participate in the study with their newborns. Parents have the right to drop out of the study at any moment, for any reason.

3- Content validity; Before the study, a jury of five professors with competence in the field of Pediatric and Community Health Nursing evaluated the study's tools for face and content validity. and it ranged from 90% to 100% with modifications done (adding heel lancing procedure time to the questionnaire).

4- A pilot study; was carried out on ten percent of the subjects (12 neonates) to assess the tool's clarity and understandability, as well as its feasibility and usefulness. The Pilot study was left out of the analysis.

5-Reliability of the tools; The Cronbach alpha test was used to assess the reliability of the study tools, which were chosen based on the findings of the pilot study. All tools had a reliability rating of 0.902.

6-Data collection procedure; -Data was collected from the previously mentioned settings during the morning from 9.00 A.m. to 12.00 P.m twice-weekly (Saturday and Tuesday) for five months (started from the first of July 2021 to the end of November 2021), according to MCH rules.

Phases of the research; the study applied through four phases; **I&II- Assessment and planning phases:** the researcher interviewed individually with parents and their neonates, then explained the aim of the study and parents' oral and written consent was obtained to participate in the study. Then using prepared tools for collecting data from parents. **III- Implementation phase;** All researchers cooperated in collecting the data collection. The researcher in Community Health Nursing field took sociodemographic data of neonates and their parents, estimated heel stick procedure time for three studied groups, and applied heel stick procedure with assistance from nurses who worked in MCH centers. Researchers in the Pediatric Nursing field measured anthropometric parameters before heel lancing and physiological parameters of neonates performed five minutes before, during, and one minute after heel lancing, using the Neonatal Infant Pain Scale to assess pain

levels during and one minute after heel lancing. All researchers applied foot massage and acupressure to neonates two minutes before the heel lancing procedure for two groups only (80 neonates). Each group is applied intervention for six to seven weeks; about 5-10 neonates per week. **IV- Evaluation phase;** the effect of foot massage and acupressure on pain levels and physiological parameters in full-term neonates were evaluated using two tools. **Tool 1 part III** performed before, during, and one minute after heel lancing and **Tool II** was evaluated during, and one minute after heel lancing for three groups.

Materials that used in the research: pulse oximetry device (Nellcor N560-ABD), measure tape, stop watching, pen and paper, and alcohol (70%) used in this research.

Statistical analysis

Using the SPSS software statistical computer program version 23, the collected data was processed, tabulated, and statistically evaluated. the range, mean and standard deviations were for numerical values . The difference between mean values of more than two categories was done using analysis of variance (ANOVA) and differences within groups repeated measures ANOVA. Pearson and Spearman's correlation coefficient r were used to assess correlation between variables. The level of significant was adopted at $p < 0.05$.

Results;

Table (1); shows the socio_demographic characteristics of studied neonates. It was observed that, the mean age of the control, massage, and acupressure groups were 3.47 ± 4.39 , 3.83 ± 0.87 and 5.200 ± 4.12 respectively. and the range of the mean

gestational age of the three groups was 36-40 weeks. Two thirds of the sample in control and acupressure were females. It was illustrated that, the high percentage of three groups of neonates were the second birth order and born through cesarean delivery. A half of control and acupressure groups depended on breastfeeding while; two thirds of massage group depended on breast and artificial feeding. It was noticed that, the majority of mothers in control and acupressure groups had basic education and were housewives. While the majority of mothers had secondary education in the massage group and worked. It was noticed that, all socio demographic items were similarly distributed within three studied groups of neonates except in their age.

Table (2); shows distribution of the studied groups regarding anthropometric parameters. It was noticed that, the majority of neonates within three groups their weight ranged from 3- 4.5 K.g and their length ranged from 46-56 c.m. there is no a statistically significant differences in all items of anthropometric parameters among the three groups.

Table (3) illustrates physiological parameters mean scores of the neonates in control, massage and acupressure group. It was observed that, all physiological parameters either heart, respiratory rate and O₂ saturation and also, a heel lancing procedure duration mean scores of the neonates were improved from during to one minute after the heel lancing procedure in acupressure and massage groups in compare with the control group in

different times and a highly statistically significant difference with P=.000.

Table (4) shows neonates' pain scores in acupressure, massage, and control groups. It was illustrated that, 50% and 62.5% of them in the acupressure and massage groups respectively had no /mild pain during the heel lancing, while 65% in the control group had severe pain during heel lancing and there was a statically significant difference of neonates pain scores with P= 000 during the heel lancing in acupressure, massage, and control group. The table also reveals that, 100% and 95% of the neonates had no /mild pain one minute after the heel lancing in acupressure and massage groups respectively, while 85% of them in the control group had severe pain and there was a highly statistically significant difference of neonates 'pain scores with P= 000 one minute after the heel lancing in acupressure, massage, and control groups.

Table (5) shows the correlation between neonates' socio-demographic characteristics, physical and physiological parameters, and their total pain scores within acupressure, massage, and control groups. It was found that, there was a highly statistically significant correlation between respiratory rate, O2 saturation, heel stick lancing time, and total pain scores within acupressure, massage, and control groups as p< 0.01.

Table (6) shows the relation between neonates' socio-demographic characteristics and their pain mean scores within the acupressure massage and control group. It was found that, there was a

statistically significant relation in the acupressure group between pain mean scores and neonates' type of feeding, and mothers' education with p=.010, p=.054 respectively. Whereas, in the massage group, and the control group there was a statistical significance relation in neonates' type of feeding, mothers' education with p= .003, p=.028 and p= .028, p= .034 respectively and a statistically significant relation in the massage group between pain mean scores and mothers' occupation: with p=.021.

Table (1) Distribution of the Studied Groups regarding their Socio-demographic Characteristics. (n=120)

Variables	Control group (n=40)		Massage group (n=40)		Acupressure group (n=40)		P value
	N	%	N	%	N	%	
Age (days)	1-29		3-5		3-28		0.001*
Range	3.47±4.39		3.83±0.87		5.200±4.12		
Gestational age/weeks	36-40		38-40		37-40		.369
Range	38.50± 1.41		38.90±.81		38.37±.86834		
Sex	27	67.5	20	50	26	65	0.829
-Female	13	32.5	20	50	14	35	
Birth order	9	22.5	3	7.5	8	20	.101
-First	13	32.5	23	57.5	20	50	
-Second	6	15	3	7.5	7	17.5	
-Third	12	30.0	11	27.5	5	12.5	
Type of feeding	20	50.0	13	32.5	23	57.5	.078
- Breast	2	5	1	2.5	0	0	
-Artificial	18	45.0	26	65	17	42.5	
Type of delivery	15	37.5	5	12.5	18	45.0	.015
Normal	25	62.5	35	87.5	22	55.0	
Mothers' education:	16	40.0	7	17.5	6	15.0	.021
Basic	12	30.0	24	60	25	62.5	
Secondary	12	30.0	9	22.5	9	22.5	
Mothers' occupation:	19	47.5.	17	56.7	25	62.5	.181
Housewife	21	52.5	23	57.5	15	37.5	

Table (2) Distribution of the Studied Groups regarding Anthropometric Parameters. (n=120)

Variables	Control group (n=40)	Massage group (n=40)	Acupressure group (n=40)	P value
Weight of neonate/k.g				.496
Range	3.00-4.50	3.00-4.250	3.00 - 4.20	
Mean± SD	3.29± 0.68	3.08±0.57	3.26 ±0.43	
Length of neonate/c.m				.011
Range	46-53	46-56	46-55	
Mean± SD	48.93± 2.12	50.63± 2.83	51.02±2.60	
Head circumference /c.m				0.783
Mean± SD	35.05±1.01	35.11±1.14	35.08±1.13	

Table (3) Physiological Parameters Mean Scores of the Neonates within Three Groups. n=120

Variables	Acupressure group (n=40)	Massage group (n=40)	Control group (n=40)	Statistics tests (between groups) (F ^a /P)
	Mean± SD	Mean± SD	Mean± SD	
Heart Rate				
Before the heel lancing	118.98± 16.95	131.40± 14.27	127.100±1 5.45	F=10.926 P=.004*
During the heel lancing	136.60± 16.83	153.92± 4.03	153.62±4. 79	F=46.066 P=.000*
After the heel lancing	127.77± 16.43	142.88± 5.83	150.12±4. 82	F=61.834 P=.000*
within groups (f^b/p)	f=24.490 P=.000*	F=60.27 5 P=.000*	F=120.40 7 P=.000*	
Respiratory Rate				
Before the heel lancing	40.50±5 .42	34.38±3.7 3	40.70±7.41	F=15.80 5 P=.000*
During the heel lancing	42.85±5 .18	45.32±4.9 5	54.43±3.38	F=71.03 7 P=.000*
After the heel lancing	39.58±3 .95	40.05±4.1 1	51.10±2.53	F=131.1 69 P=.000*
within groups (f^b/p)	F=8.39 1 P=.001 *	F=95.130 P=.000*	F=110.912 P=.000*	
O₂ saturation				

Table (5); Correlation between neonates' socio-demographic characteristics, physical and physiological parameters, and their total pain scores within acupressure, massage and control groups. n=120

Variable	Acupressure group	Massage group	Control group
	Total pain scores	Total pain scores	Total pain scores

Before the heel lancing	96.88± 2.17	96.97±1. 91	97.45±2.4 8	F=.779 P=.461
During the heel lancing	93.65± 3.69	93.90±2. 75	92.65±2.2 6	F=1.992 P=.141
After the heel lancing	95.63± 2.80	95.58±2. 71	93.03±2.3 1	F=12.931 P=.000*
within groups (f^b/p)	F=12.5 91 P=.000 *	F=17.48 0 P=.000*	F=75.671 P=.000*	
The duration of heel lancing procedure	113.500 ±22.47	91.125±1 4.84	125.60±2 4.73	F=27.460 P=.000*

F= One-way ANOVA * P <0.05

Table (4) Percentage distribution of neonates' pain scores in acupressure, massage and control groups.

Pain scale	Acupressure group (n=40)		Massage group (n=40)		Control group (n=40)		f/p
	N	%	N	%	N	%	
During the heel lancing							F=13.81 6 P=.001*
no pain/mild	20	50	25	62.5	6	15	
moderate	20	50	9	22.5	8	20	
sever	0	0	6	15	26	65	
Mean± SD	4.82±1.64 0-6		4.82±1.64 3-6		5.37±.925 3-7		
Range							
1 minute after heel lancing							F= 76.659 P=.000*
no pain/mild	40	10	38	95	0	0	
moderate	0	0	2	5	6	15	
sever	0	0	0	0	34	85	
Mean± SD	1.050±1.03 0-5		1.025±1.27 0-5		5.375±.77 4-7		
Range							

F^a= One-way ANOVA f^b= Repeated Measures ANOVA * P <0.05

	r	P	R	P	R	P
Age	-.044	.785	-.075	.664	- .310	.052
Gestational age	-.157	.332	-.654	.000**	- .172	.287

Weight	-.160	.408	.046	.776	-.315	.47
Length	-.138	.394	.035	.828	.099	.545
Heart Rate	.147	.004*	.001	.997	.315	.047*
Respiratory rate	.107	.001**	.492	.048*	.157	.035*
O2 saturation	-.539	.001**	-.665	.000**	-.873	.021
Heel sticklancing time	0.404	.010*	.733	.004*	.291	.001**

**Correlation is highly significant at the 0.01 level (2-tailed)

Table (6); Relation between neonates' sociodemographic characteristics and their pain mean scores within acupressure, massage and control groups. n=120

	Acupressure group	Massage group	Control group (n=40)
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Neonates' Sociodemographic Characteristics	(n=40)		(n=40)			
	Pain Scores		Pain Scores		Pain Scores	
	Mean rank	P Value	Mean rank	P Value	Mean rank	P Value
Gender						
Male	22.03	.473	19.28	.508	19.20	.541
Female	19.58		21.50		21.28	
Birth order						
First	23.56	.078	20.67	.000	22.56	.909
Second	24.73		26.22		19.60	
Third	13.25		23.17		21.50	
Fourth	17.25		7.77		19.40	
Type of feeding						
Breast feeding	28.93	.010*	38.19	.003*	19.93	.028*
Artificial feeding	18.75		16.50		0	
Breast& artificial	21.33		21.96		21.26	
Type of delivery						
Normal	19.43	.617	14.50	.175	21.83	.464
Cesarean	21.14		21.36		19.41	
Mothers' education:						
Basic education	20.28	.054*	30.14	.028*	19.39	.034*
Secondary education	20.21		18.79		21.89	
Bacaloric or above	21.08		17.56		22.13	
Mothers' occupation:						
Worked	20.53	.988	24.35	.021*	22.76	.076
Housewife	20.48		17.65		16.73	

*significant= P<0.05

Discussion

The pain is an unpleasant emotional and sensory experience that can originate anywhere in the body and is related with real or potential tissue damage. Painful procedures, such as heel lancing practice, are commonly performed on newborns. Because of repeated painful stimuli early in life can induce physiologic instability, poor brain development, abnormal neurodevelopment, and abnormal somatosensory and stress response systems, the prevention and control of newborn pain is critical. In recent years, the use of non-pharmacologic pain management approaches such as acupressure and massage has expanded. These techniques are simple, low-cost, and successful in assisting neonates in recovering after painful treatments (Karatas and Dalgic, 2020; Stanojevic, 2022).

It was noticed in this study that, the distribution of the sample in three groups was matching in most items of sociodemographic characteristics and all items of anthropometric parameters with no statistically significant difference (Table 1&2). According to the opinions of the researchers this matching was useful for the research in which controlling the extraneous factors that may be a barrier to successful the research. These results were in agreement with the results of **Özkan and etal (2019)** who investigated "The effects of acupressure and foot massage on pain in neonates" and also **Karamisefat and etal (2021)** who study "The effect of foot massage on pain of preschoolers undergoing venipuncture".(Özkan and etal, 2019; Karamisefat and etal, 2021).

The current study found that, physiological parameters (heart rate, respiratory rate) decreased in the acupressure and foot massage groups after heel lancing practice compared to the control group, with a statistically significant difference in heart rate and respiratory rate before, during, and after heel lancing among the three groups (Table 3). This could be related to the effectiveness of acupressure and foot massage as a non-pharmaceutical pain reliever and for improving physiological parameters. This finding was agreement with **Yilmaz& Kurt (2021)** that, found a significant difference in mean scores of newborns in the control and acupressure groups in terms of heart rate during and after the procedure, oxygen saturation before, during, and after the procedure, and duration of crying during and after the procedure in favor of the acupressure group.

on the other hand, this results were incongruent with **Chen and etal (2017)**, who found no significant differences in heart rate and oxygen saturation values before, during, and after the procedure in neonates in order to determine the effect of non-invasive magnetic acupressure on pain during heel lancing. (Yilmaz& Kurt, 2021; Chen and etal, 2021).

The study found that, all neonates in the acupressure group had no/mild pain one minute after heel lancing, while the majority of them in the massage group had no/mild pain one minute after heel lancing, and the majority of them in the control group had severe pain. There were statistically significant differences in neonates' pain scores 1 minute after heel lancing practice in the acupressure, massage, and control groups. This

could be explained by the fact that, acupressure and massage increase physiological and behavioral stability in neonates, as well as reduce the severity of pain reactions to heel lancing and shorten the duration of heel lancing (Table 4). The findings were in line with those of **Özkan and etal (2019) and Zargham and etal (2017)**, who reported that neonates who received acupressure and massage had statistically less pain. These instances demonstrated that, acupressure and massage reduced pain, but there was no evidence that one was superior to the other in terms of pain reduction. Also, according to **Parker and Brown (2016)**, the efficacy of acupressure and massage in reducing pain was identical, and both approaches were beneficial in reducing pain through tactile means. (Özkan and etal, 2019; Zargham and etal, 2017; Parker and Brown, 2022).

In the massage group, it was discovered that, there was a highly statistically significant association between gestational age, O2 saturation, and total pain levels (Table 5, 6). This could be attributed to the fact that foot massage reduces pain perception in neonates of various gestational ages while also enhancing oxygen saturation during and after heel lancing. Similarly, **Parker and Brown (2022)** stated that, parameters such as birth weight, gestational weeks, postnatal age, gender, and type of birth influence neonatal pain perception. In contrast, **Akcan and Polat (2017)** stated that there were no variations in birth weight, gestational weeks, postnatal age, sex, or type of birth between the acupressure, massage, and control group neonates. The neonates' reactions to heel lancing pain were identical in all three groups, indicating

that they would react similarly. (Parker and Brown, 2022; Akcan and Polat, 2017).

Conclusions

Based on the results of the current study, it can be concluded that: Study groups who receive either foot massage or acupressure will be exhibited a reduction in pain scores and improvements in physiological parameters during and after heel lancing than those who do not.

Recommendations

1. An in-service training program for nurses should be conducted on a regular basis to teach them non-pharmacological strategies for relieving pain in children of all ages.
2. Providing procedures manual handbooks containing all necessary information about evidence-based non-pharmacological methods that used for controlling pain in neonates as acupressure, foot massage, kangaroo care, oral sucrose, breast feeding and music therapy.
3. Planning education program for parents about non-pharmacological strategies for relieving pain for their children.

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