Research Article

Effect Of Gentle Human Touch On Physiological And Behavioral Indicators Of Neonates Undergoing Endotracheal Suctioning

Amna AbdAllah Ramadan[1], Marzoka AbdelAziz Gadallah[2], Nafisa H.R.AbdelAziz[3] & Asmaa AbdelAziz Mohammed[4]

[1]Assistant lecturer of Child and Adolescent Health Nursing ,Badr University Assiut
[2]Professor of Pediatric Nursing, Faculty of Nursing, Assiut University
[3]Professor of Pediatrics, Faculty of Medicine, Assiut University
[4]Assistant Professor of Pediatric Nursing, Faculty of Nursing, Assiut University

Abstract:

Background: Gentle Human Touch (GHT) is a simple non-pharmacological intervention that may reduce procedural pain and improve neonatal outcomes during endotracheal suctioning. **Aim:** To evaluate the effect of Gentle Human Touch on physiological and behavioral indicators of neonates undergoing endotracheal suctioning. **Methods:** A quasi-experimental study was conducted on 60 neonates admitted to the NICU at Assiut University Children's Hospital. Neonates were equally assigned to a Gentle Human Touch group (n = 30) and a Control group (n = 30). Data were collected using a Personal Characteristics and Medical History Assessment Sheet and a Physiological and Behavioral Indicators Sheet, including physiological measures and the Neonatal Infant Pain Scale (NIPS). Assessments were performed before, during, and after endotracheal suctioning. **Results:** No significant differences were found between groups regarding baseline characteristics($P>0.05$) Compared with the Control group, neonates receiving Gentle Human Touch had significantly lower heart rates and higher Oxygen saturation levels during and after suctioning ($P<0.05$) Significant improvements were observed in facial expression, crying, breathing pattern, and state of arousal ($P<0.05$) NIPS scores were significantly lower in the Gentle Human Touch group($P = 0.001$). Significant negative correlations were identified between NIPS scores and oxygen saturation. **Conclusion:** Gentle Human Touch effectively reduced pain and improved physiological and behavioral responses among neonates undergoing endotracheal suctioning. **Recommendations:** Gentle Human Touch should be incorporated into routine NICU care during painful procedures, and nurses should receive training on its application.

Keywords: Behavioral indicators, endotracheal suctioning, gentle Human Touch, neonates, NICU, pain, physiological indicators.

Introduction:

Neonates admitted to Neonatal Intensive Care Units (NICUs) are frequently exposed to numerous invasive procedures that are necessary for monitoring and treatment. Endotracheal suctioning is one of the most commonly performed procedures in mechanically ventilated neonates to maintain airway patency and remove pulmonary secretions. Despite its clinical importance,endotracheal suctioning is recognized as a painful and stressful intervention that may result in significant physiological and behavioral disturbances,including fluctuations in heart rate, respiratory rate, oxygen saturation, blood pressure, crying, and facial expressions indicative of pain. Such responses may compromise neonatal stability and negatively influence recovery and developmental outcomes. (Alaca et al., 2024; Oliveira et al., 2023).

Pain management has become a major concern in neonatal care because neonates possess the anatomical and physiological capacity to perceive pain.Repeated exposure to painful stimuli during the neonatal period may contribute to altered stress responses, impaired neurodevelopment, and long-term behavioral consequences. Premature and critically ill neonates are particularly vulnerable because of their immature nervous systems and the frequent invasive procedures required during hospitalization. Consequently ,contemporary neonatal care emphasizes the importance of minimizing procedural pain and stress through evidence-based interventions. (Shen et al.,2022).

Non-pharmacological interventions have gained increasing attention as effective strategies for reducing procedural pain in neonates. These interventions are widely recommended because they are safe, inexpensive,easy to implement, and associated with minimal adverse effects. Current evidence indicates that non-pharmacological approaches can improve physiological stability and reduce pain-related behaviors during painful procedures. Common interventions include facilitated tucking, kangaroo mother care, non-nutritive sucking, sucrose administration, multisensory stimulation, and therapeutic touch techniques. (García-Valdivieso et al.,2023).

Gentle Human Touch (GHT) is a developmental care intervention that involves the therapeutic placement of hands on the infant in a calm and supportive manner. This technique aims to provide comfort, reassurance, and containment while promoting autonomic regulation and reducing stress responses. Gentle Human Touch is considered a simple nursing intervention that can be easily incorporated into routine neonatal care without additional
equipment or costs. Previous studies have demonstrated that GHT contributes to improved physiological parameters, reduced pain perception, and enhanced comfort among preterm and critically ill neonates undergoing invasive procedures. (Oliveira et al., 2023).

Significance of the Study

Evidence specifically examining the effectiveness of GHT during endotracheal suctioning has shown promising results. Research conducted among preterm infants undergoing suctioning procedures demonstrated significant reductions in pain scores and improvements in physiological stability following the application of Gentle Human Touch. Furthermore,recent investigations have reported beneficial effects of touch-based interventions on neonatal comfort, behavioral organization, and stress reduction during invasive procedures, supporting their integration into developmental and family-centered care practices within NICUs. (Cağlar et al., 2025).

Although several studies have explored non-pharmacological approaches for neonatal pain management, limited evidence is available regarding the specific effects of Gentle Human Touch on both physiological and behavioral indicators during endotracheal suctioning across different clinical settings.Additional research is needed to strengthen the existing evidence and support the implementation of this intervention as a standard component of neonatal nursing care. Therefore, the present study aims to evaluate the effect of Gentle Human Touch on physiological and behavioral indicators of neonates undergoing endotracheal suctioning in order to enhance evidence-based nursing practice and improve neonatal outcomes. (Sutton & Lemermeyer,2024; Cağlar et al., 2025).

Aim of the Study:

The aim of this study is to:

Determine the effect of gentle human touch on physiological and behavioral indicators of neonates undergoing endotracheal suctioning.

Research hypotheses:

1. Neonates who receive gentle human touch may be more physiologically stable and exhibit better behavioral indicators than those who do not.

Operational Definitions:

Gentile human touch:

In this study it refers to place one hand on the infant's head and the other hand on the lower abdomen covering the waist and hips of the neonates.

Physiological indicators:

In this study it refers to (heart rate and oxygen saturation) that recorded before, during and after endotracheal suctioning by using pulse oximetry device.

Subjects and methods

Research Design

A quasi-experimental research design was utilized in the present study to examine the effect of gentle human touch on physiological and behavioral indicators among neonates undergoing endotracheal suctioning.

Setting

The study was conducted at the Neonatal Intensive Care Unit (NICU)of Assiut University Children's Hospital. The NICU consists of nine rooms, each containing six incubators, and provided specialized neonatal services for whole Upper Egypt.

Subjects

A convenience sampling of 60 neonates who fulfilled the following criteria comprised the study subjects; Free from cardiac and neurological congenital malformations, intubated and connected to mechanical ventilation. The sample size was determined using power analysis based on the population flow in the NICU, with a 99.9% confidence interval, a precision level of 5%, and a significance level of p≤0.05. The sample size calculation was performed using the following formula:

$n = [DEFF \times N \times p(1-p)] / [d^2/Z^2(1-\alpha/2) \times (N-1) + p(1-p)]$, where:

Population size(N)=60

Hypothesized % frequency(p)=99%±5

Confidence limits(d)=5%

Design effect (DEFF) =1

Sampling Procedure

The neonates were randomly assigned into two equal groups, Each group consisted of 30 neonates as follows:

Group 1 - Gentle human touch group where neonates received gentle human touch.

Group 2 - Control group where neonates received routine NICU care .

For ethical considerations, neonates in the control group were selected first, followed by alternating allocation to the intervention groups.

Tools of Data Collection

Two tools were used to collect the required data for the study.

Tool I: Personal Characteristics and Medical History Assessment Sheet This tool was developed by the researcher after a thorough literature review and included two parts:

Part I: Personal characteristics of neonates as age, sex, gestational age and body weight.

Part II: Medical history of neonates as method of delivery, date of admission and current diagnosis.

Tool II: Physiological and Behavioral Indicators Sheet, it consisted of two parts

Part I: Physiological indicators (heart rate, oxygen saturation), measured before, during, and after endotracheal suctioning.

Part II: Neonatal Infant Pain Scale (NIPS) developed by Lawrence et al.(1993) and updated by UCSF Children's Hospital (2005) (Britto, 2014). The NIPS consisted of six behavioral parameters: facial expression, cry, breathing pattern, arm movement, leg movement, and state of arousal.

Scoring system:

Crying is assessed on a 3-point scale (0,1,2), the other five indicators are assessed on a 2-point scale (0-1) for pain. The total score ranges from 0 to 7(0-2 points no pain, 3-4 points moderate pain, and >4points severe pain).**Methods of data collection**

1- Official permission was obtained from the Faculty of Nursing and forwarded to the Director of the Neonatal Intensive Care Unit (NICU) at Assiut University Children's Hospital to obtain acceptance for data collection after explaining the purpose and nature of the study.
2- Tool I and Part I of Tool II were developed by the researcher following an extensive review of the related literature.

3- Validity and Reliability

Tool I: Content validity was assessed by five experts, three professors of pediatric nursing and two professors of pediatrics, the validity index was (0.85). Reliability was calculated using Cronbach's alpha (0.82).

Tool II: Validity and reliability were previously established by Hai et al.(2019), with content validity of 90% and Cronbach's alpha = 0.93.

Pilot Study

A pilot study was conducted on 6 neonates (10% of the sample) to assess the clarity, applicability, and time required to complete the tools. No modifications were required. Data from the pilot study were excluded from the final analysis.

Field of the work

1- The data were collected every day for admitted neonates. The period of data collection ranged from beginning of October2022 to end of March 2023(six months). The time used for completing each sheet20=30minutes
2- Data related to the personal characteristics and medical history of each neonate in both groups were collected using Tool I.
3- Assessment of physiological and behavioral indicators was conducted before performing the endotracheal suction procedure for each neonate in both groups, after being connected to the pulse oximeter.
4- Assessment of physiological and behavioral indicators was also performed concurrently with the gentle human touch intervention.

Data Collection Procedure

Intervention Protocols

Gentle Human Touch Group

Gentle human touch was initiated two minutes before suctioning,continued during and after, for a total of 5 minutes. The researcher placed one hand on the infant's head and the other hand on the lower abdomen covering the waist and hips

Control Group

Received routine NICU care without additional interventions.Physiological and behavioral indicators were assessed before, during, and after 5 minutes of suctioning for all groups

Ethical Considerations

1- Ethical approval was obtained from the Faculty of Nursing Ethical Committee.
2- Written informed consent was obtained from parents after explaining the study purpose and procedures.
3- There was no anticipated risk to participants.
4- Parental Participation were voluntary and the parents had the right to withdraw at any time without penalty.
5- Confidentiality and anonymity of the data were maintained, and data were used solely for research purposes.

Statistical Analysis

Data were coded, tabulated, and analyzed using SPSS 20.0 statistical software package. data was presented using descriptive statistics in the form of (mean, standard deviation, frequency, percentage) were used to summarize baseline characteristics. Inferential statistics (ANOVA, chi-square, paired t-test) were used to assess differences between groups. A significance level of p≤0.05was considered statistically significant.

Results:

Table (1): Distribution of personal characteristics of the studied neonates (n.=60).

	Gentle human touch group $(n = 30)$		Control group $(n = 30)$		X2	P. Value
	No	%	No	%		
Age (days)						
1-4	16	53.3	17	56.7	0.673	0.879
5-8	5	16.7	3	10.0		
9-12	3	10.0	4	13.3		
>= 13	6	20.0	6	20.0		
Sex						
Male	20	66.7	19	63.3	0.073	0.708
Female	10	33.3	11	36.7		
Gestationalage (weeks)						
<= 28	6	20.0	4	13.3		
!9-3!	7	23.3	4	13.3		

33-36	10	33.3	13	43.3	0.70	0.602
37-40	7	23.3	9	30.0		
Body weight (grams)						
<1000	4	13.3	5	16.7		
$1000-<2000$	9	30.0	9	30.0		
$2000-<3000$	12	40.0	12	40.0		
$>=3000$	5	16.7	4	13.3		
$Mtan \pm SD$	2015.2 ± 853.6		2032.8 ±1107.9		0.222	0.974

Chi square test for qualitative data between the two groups
*Significant level at P value < 0.05, **Significant level at P value < 0.0

Table (1) reveals that the Gentle Human Touch and Control groups were comparable regarding their personal characteristics. More than half of the neonates in both groups were aged 1-4 days (53.3% and 56.7%, respectively),while males constituted approximately two-thirds of the study participants (66.7% and 63.3%, respectively). Regarding gestational age, the highest percentage of neonates in both groups was within 33-36 weeks (33.3% in the Gentle Human Touch group and 43.3% in the Control group). Concerning body weight, 40.0% of neonates in each group weighed between 2000 and less than 3000 grams, with mean body weights of 2015.2 ± 853.6 grams and 2032.8 ± 1107.9 grams in the Gentle Human Touch and Control groups,respectively. Statistical analysis indicated no significant differences between the two groups regarding age, sex, gestational age, or body weight(P>0.05).

Table (2): Distribution of current diagnosis of the studied neonates.

Current diagnosis	**Gentle human touch group $(n = 30)$**		**Control group $(n = 30)$**		**X2**	**P-value**
	No.	**%**	**$No.$**	**%**		
Respiratory distress	24	80.0	21	70.0		
Intestinal obstruction	0	0.0	1	3.3	8.70	0.560
Diaphragmatic hernia	2	6.7	1	3.3		
Choanal atresia	1	3.3	0	0.0		
Oesophageal atresia	0	0.0	0	0.0		
Other	3	10.0	7	23.3		
Method of delivery						
Vaginal delivery	9	30.0	5	16.7	3.72	0.154
Caesarean section (Emergency)	13	43.3	10	33.3		
Caesarean section (Elective)	8	26.7	15	50.0		

Table (2) shows the distribution of current diagnoses and methods of delivery among the studied neonates in the Gentle Human Touch and Control groups.Respiratory distress was the most common diagnosis in both groups,accounting for 80.0% of neonates in the Gentle Human Touch group and 70.0% in the Control group. Other diagnoses included diaphragmatic hernia (6.7% and 3.3%, respectively), choanal atresia (3.3% in the

Gentle Human Touch group only), intestinal obstruction (3.3% in the Control group only),and other diagnoses (10.0% and 23.3%, respectively). Regarding the method of delivery, emergency cesarean section was the most frequent mode of delivery in the Gentle Human Touch group (43.3%), whereas elective cesarean section was the most common in the Control group (50.0%). Vaginal delivery was reported among 30.0% and 16.7% of neonates in the Gentle Human Touch and Control groups, respectively. Statistical analysis revealed no significant differences between the two groups regarding either current diagnosis or method of delivery(P>0.05).

Table (3): Mean and standard deviation of heart rate and oxygen saturation of the studied neonates before, during, and after the intervention(n=60)

Variable	Gentle Human Touch Group $(n = 30) Mean \pm SD$	Control Group $(n = 30)$Mean ± SD	t-value	P-value
Heart Rate (beats/min)				
Before intervention	141.10 ± 18.47	148.50 ± 15.85	-2.12	0.069
During intervention	143.33 ± 16.58	161.00 ± 14.65	-4.37	< 0.001**
After intervention	125.73 ± 10.02	151.13 ± 19.84	-6.26 □$< .001$米*	
Oxygen Saturation (%)				
Before intervention	92.70 ± 6.64	90.20 ± 6.17	1.51	0.136
During intervention	90.13 ± 6.46	83.33 ± 7.11	3.88	< 0.001**
After intervention	97.73 ± 2.82	88.07 ± 6.88	$7.12 \mid < 0.001$米*	

Independent Samples t-test *Significant atP<0.05 **Highly significant at P <0.001

Table (3) demonstrates regarding heart rate, the gentle human touch group exhibited no statistical significantly heart rates compared to the Control group
before the intervention (141.10±18.47 vs.148.50±15.85beats/min,P=0.069), during the intervention (143.33±16.58 vs. 161.00±14.65 beats/min,P<0.001), and after the intervention (125.73 ±10.02 vs. 151.13 ± 19.84beats/min, P<0.001) Concerning oxygen saturation, no statistically significant difference was observed between the two groups before the intervention(P=0.136). However, the Gentle Human Touch group showed significantly higher oxygen saturation levels during the intervention (90.13±6.46 vs.83.33±7.11, P<0.001)and after the intervention (97.73±2.82 vs.88.07±6.88,P<0.001).

Table (4): Comparison of behavioral indicators of the studied neonates before, during, and after Intervention between the gentle human touch and control groups(n=60)

Behavioral Indicators	Gentle Human Touch $n(\%)$			Control n (%)			x2	P-value
	Before	During	After	Before	During	After		
Facial expression (Relaxed muscles)	26 (86.7)	28 (93.3)	30 (100.0)	17 (56.7)	11 (36.7)	27 (90.0)	21.17	<0.001**
Cry (No cry)	24 (80.0)	23 (76.7)	27 (90.0)	19 (63.3)	12 (40.0)	17 (56.7)	8.52	0.004**
Breathing pattern (Relaxed)	28 (93.3)	19 (63.3)	28 (93.3)	28 (93.3)	10 (33.3)	24 (80.0)	5.41	0.020*
Armmovements (Relaxed/Restrain ed)	23 (76.7)	17 (56.7)	28 (93.3)	17 (56.7)	10 (33.3)	25 (83.3)	3.30	0.069
Leg movements (Relaxed/Restrain ed)	23 (76.7)	19 (63.3)	28 (93.3)	20 (66.7)	13 (43.3)	24 (80.0)	2.41	0.121
State of arousal (Sleeping/Awake)	26 (86.7)	21 (70.0)	29 (96.7)	21 (70.0)	15 (50.0)	20 (66.7)	9.02	0.003**

Chi-square test
* Significant at P<0.05.
** Highly significant atP<0.01.

Table (4) illustrates the comparison of behavioral indicators between the Gentle Human Touch and Control groups before, during, and after endotracheal suctioning. Significant differences were observed in facial expression before and during the intervention (P=0.010and P<0.001, respectively), with a greater proportion of neonates in the Gentle Human Touch group exhibiting relaxed facial muscles. Crying behavior differed significantly during and after the intervention(P =0.004 for both), as neonates receiving Gentle Human Touch demonstrated higher percentages of no crying and lower levels of distress. Breathing pattern showed a significant difference only during the intervention(P=0.020), favoring the Gentle Human Touch group. No statistically significant differences were detected in arm or leg movements throughout the assessment periods(P>0.05) Regarding state of arousal, a highly significant difference was observed after the intervention (P = 0.003), with most neonates in the Gentle Human Touch group maintaining a stable sleeping/awake state compared with the Control group.

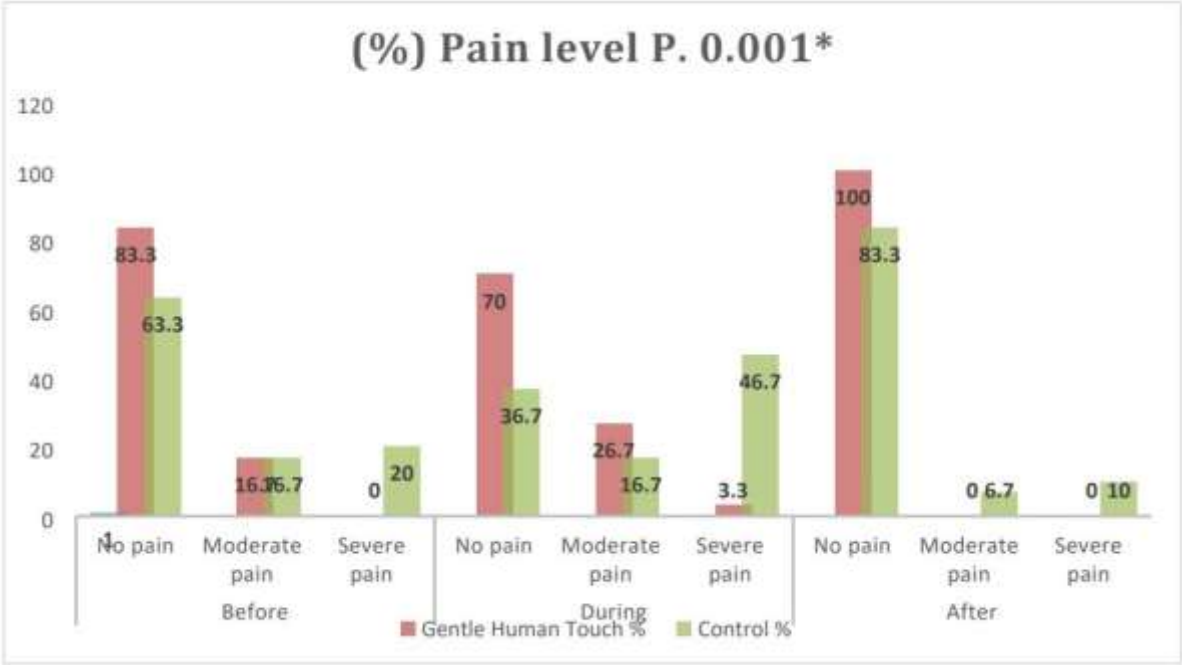

Figure (1). Comparison of pain levels before, during, and after endotracheal suctioning between the gentle human touch and control group

Figure (1). Comparison of pain level percentages before, during, and after endotracheal suctioning between the Gentle Human Touch and Control groups. A statistically highly significant difference was observed between the two groups(P=0.001)

Table (5): Correlation coefficients between NIPS and physiological indicators in the gentle human touch group(n=30)

Physiological Indicator	NIPS Before	NIPS During	NIPS After
Heart rate before	$r = -0.203(P = \|r = -0.1270.282)$	$(P = \|r = -0.147(P =0.503)$	0.439)
Heart rate during		0.622)	0.570)
Heart rate after	0.069)	0.160)	0.097)
Oxygen saturation before	$r = -0.590 ** (P = \|r = -0.543 ** (P = -0.369 * (P =0.136)$	0.002)	0.045)
Oxygen saturation during	$r = -0.499 ** (P = \|r = -0.391^{*}(P = \|r = -0.269(P =0.005)$	0.032)	0.150)

Oxygen saturation after	$r = -0.398^{*}(P = \|r = -0.3500.030)$	$(P = \|r = -0.154(P = 0.058)$	$0.415)$

Pearson correlation coefficient(r)*P<0.05,,**P<0.01

Table (5) shows that there is a generally negative correlation between Neonatal Infant Pain Scale (NIPS) scores and physiological indicators in the Gentle Human Touch group, indicating that higher pain scores are associated with decreased physiological stability. Most correlations with heart rate were
weak and statistically non-significant, except for heart rate after intervention with NIPS before intervention, which showed no significant moderate negative correlation. In contrast, oxygen saturation demonstrated stronger and more consistent significant negative correlations with NIPS at different time points, particularly before and during intervention

Discussion:

Neonates admitted to neonatal intensive care units often undergo endotracheal suctioning, a necessary procedure that can cause pain, stress, and physiological instability. These responses may be reflected by changes in heart rate, respiratory rate, oxygen saturation1, and behavioral indicators such as crying, facial expressions, and pain scores. Gentle Human Touch is a simple, non-pharmacological nursing intervention that provides comfort and security to neonates during stressful procedures. It is believed to help stabilize physiological parameters and reduce behavioral signs of distress. Therefore,this study was conducted to evaluate the effect of gentle human touch on the physiological and behavioral indicators of neonates undergoing endotracheal suctioning.

The present study demonstrated that there were no statistically significant differences among the gentle human touch, and control groups in terms of neonatal demographic and clinical characteristics, including age, sex, gestational age, and body weight. This indicates that the randomization process was effective in producing comparable groups, minimizing selection bias and enhancing the internal validity of the study. This homogeneity is essential because it ensures that any observed differences in physiological and behavioral outcomes after endotracheal suctioning can be attributed to the applied interventions rather than baseline variability among neonates.

The present study showed no statistically significant difference among groups before intervention(p=0.069), with the gentle human touch group.

These finding agreement with, Koukou et al. (2022) and Ren et al. (2022) reported no significant baseline differences in heart rate between study groups($p > 0.05$), attributing this to strict randomization and larger sample sizes, which ensured complete physiological homogeneity at baseline.

The present results demonstrate that gentle human touch are effective in improving neonatal oxygenation and reducing oxygen dependency during and after endotracheal suctioning. These findings indicate that non-pharmacological interventions, particularly gentle human touch, play an important role in improving respiratory stability and reducing oxygen demand in neonates undergoing endotracheal suctioning.

These findings are in agreement with Melo & Hoffman, (2025) and Püschel et al. (2022), who reported that tactile-based interventions significantly improved oxygen saturation and reduced oxygen dependency in neonates undergoing painful procedures($p<0.05$), highlighting their role in enhancing respiratory stability in NICU settings. Similarly, Mohammed et al.(2025)and Bahrami et al. (2023) found that non-pharmacological comfort measures were associated with improved oxygenation parameters and reduced need for supplemental oxygen, especially in intervention groups receiving gentle touch-based care.

In contrast, Koukou et al. (2022) and Ullsten et al. (2024) reported no statistically significant differences in oxygen saturation or oxygen requirement between intervention and control groups($p>0.05$), suggesting that respiratory outcomes may be influenced by disease severity, ventilatory settings, and individual neonatal conditions rather than intervention alone.Likewise, Snijders et al. (2023) and Gupta et al. (2022) observed inconsistent effects of non-pharmacological interventions on oxygenation, indicating that their impact may vary depending on clinical stability and environmental factors.

The present study demonstrated a statistically significant difference among both groups in neonatal facial expression before and during intervention ($p =0.003$ and $p=0.000$respectively), while no significant difference was observed after intervention($p=0.227$). After intervention, nearly all neonates across the groups demonstrated relaxed facial expressions, with complete resolution of grimacing in the gentle human touch group.

These findings indicate that non-pharmacological interventions, particularly gentle human touch, are effective in reducing behavioral indicators of pain and distress during invasive procedures such as endotracheal suctioning.

These findings are in agreement with Püschel et al. (2022) and Popowicz et al., (2026), who reported that tactile and sensory-based interventions significantly reduced facial expressions of pain in neonates during painful procedures ($p<0.05$), highlighting their effectiveness in improving behavioral comfort.Similarly, Kaufmann et al. (2024) and La Rosa et al.(2024) found that gentle touch interventions led to significantly lower pain expression scores and improved facial relaxation compared to standard care.

In contrast, Koukou et al. (2022) and Smith & Palasiewicz, (2025) reported no significant differences in facial expression scores between intervention and control groups($p>0.05$), suggesting that behavioral pain responses may be influenced by individual variability, illness severity, and environmental stressors. Likewise, Marchesini et al. (2025) and Hazel et al. (2022) observed inconsistent effects of non-pharmacological interventions on neonatal facial expressions, indicating that behavioral outcomes may not always parallel physiological improvements.

The present study showed no statistically significant difference among the groups regarding neonatal cry before intervention($p=0.274$), indicating similar baseline behavioral responses across groups. However, significant differences were observed during intervention($p=0.003$)and after intervention($p=0.018$), where the gentle human touch group demonstrated better cry suppression compared to control groups. During intervention, most neonates in the gentle human touch group exhibited no cry, while the control group showed a higher proportion of vigorous crying, reflecting increased procedural stress. After intervention, cry behavior improved in all groups;however, the gentle human touch group maintained the highest proportion of no cry (90%), indicating more effective and sustained behavioral comfort.

These findings suggest that non-pharmacological interventions, particularly gentle human touch, play a significant role in reducing neonatal distress signals such as crying during painful procedures. These results are in agreement with Popowicz et la.,(2026) and Almutairi et al. (2022), who reported that non-pharmacological interventions significantly reduced crying behavior in neonates undergoing painful procedures($p<0.05$), emphasizing their effectiveness in behavioral pain control. Similarly, Khalil et al. (2020) and Sharma et al. (2024) found that gentle touch interventions significantly decreased crying duration and intensity compared to routine care.

In contrast, Augustin et al. (2023) reported no significant differences in neonatal crying behavior between intervention and control groups ($p>0.05$),suggesting that behavioral responses may vary depending on gestational age,clinical condition, and environmental stressors. Likewise, Gorito, (2025) and Pritchard et al. (2022) observed inconsistent effects of non-pharmacological interventions on crying patterns, indicating that behavioral outcomes may not always align with physiological improvements.

The present study revealed no statistically significant differences among the groups in neonatal breathing pattern before, during, and after intervention ($p =0.075$,$p=0.066$, and$p=0.260$respectively). However, a clear clinical trend was observed, where the gentle human touch group consistently showed a higher proportion of relaxed breathing compared to the control groups,particularly during the intervention phase. After intervention, most neonates returned to a relaxed breathing pattern, with the gentle human touch group showing the best recovery.

These findings suggest that although the differences were not statistically significant, non-pharmacological interventions-especially gentle human touch—may contribute to improved respiratory stability in neonates undergoing endotracheal suctioning. These findings are in agreement with Taddio & Katz, (2005) and Koukou et al.(2022), who reported that tactile-based interventions improved neonatal respiratory stability during painful procedures, although some respiratory parameters did not reach statistical significance($p>0.05$), suggesting clinically meaningful but subtle effects. Similarly, Mohammed et al. (2025)and Nist et al. (2022) found that non-pharmacological interventions contributed to more stable breathing patterns and reduced procedural respiratory disturbances in neonates.

In contrast, Steigelmann et al. (2025) and Campbell-Yeo et al. (2024)reported no significant differences in respiratory patterns between intervention and control groups($p>0.05$), indicating that breathing outcomes may be more strongly influenced by gestational age, respiratory diagnosis,and ventilatory support rather than comfort interventions alone. Likewise, Rodríguez-Roza et al. (2026) and Ren et al. (2023) observed inconsistent effects of non-pharmacological interventions on neonatal breathing patterns,suggesting variability in response depending on clinical severity and environmental factors.

The present study revealed no statistically significant differences among the groups in neonatal arm movements before, during, and after intervention ($p>0.05$ across all time points). However, a consistent pattern was observed where the gentle human touch group demonstrated more relaxed or restrained arm movements

compared to the control group, particularly during the intervention phase. After intervention,most neonates returned to relaxed or restrained arm movements, with the gentle human touch group showing the most favorable response.

These findings suggest that non-pharmacological interventions may help reduce motor signs of stress in neonates, even though the differences were not statistically significant. These findings are consistent with García-Valdivieso et al. (2023) and Weng et al.(2024), who reported that tactile-based interventions were associated with improved motor relaxation in neonates during painful procedures, although differences were not always statistically significant($p>0.05$). Similarly, Tao et al. (2025) and Pavlyshyn & Sarapuk found that non-pharmacological interventions contributed to reduced motor agitation and improved neuromuscular stability in NICU patients.

In contrast, Blundenet al. (2022) and Cobo et al. (2022) reported no significant differences in neonatal motor responses between intervention and control groups($p>0.05$), suggesting that motor behavior may be more strongly influenced by neurological maturity, gestational age, and clinical condition than by comfort interventions alone. Likewise, García-Valdivieso et al. (2023) and Gebreegziabher et al. (2023) observed inconsistent effects of non-pharmacological interventions on neonatal motor activity, highlighting variability in behavioral responses.

The present study revealed no statistically significant differences among both groups in neonatal leg movements before, during, and after intervention ($p >0.05$ across all time points). However, a consistent clinical trend was observed, where neonates in the gentle human touch groups demonstrated more relaxed or restrained leg movements compared to the control group j After intervention, most neonates in all groups returned to relaxed or restrained leg movements, with the gentle human touch group showing the most favorable response.

These findings suggest that non-pharmacological interventions may contribute to reducing motor signs of stress in neonates, even though the differences were not statistically significant. These findings are consistent with Pritchard et al. (2022) and Mäki-Asiala et al. (2022), who reported that tactile-based interventions improved neonatal motor stability during painful procedures, although some differences were not statistically significant($p>0.05$). Similarly, Efe et al.(2022) and Khalil et al. (2020) found that non-pharmacological interventions contributed to reduced motor agitation and improved neuromuscular control in neonates in intensive care settings.

In contrast, Lin et al. (2022) and Sutton, & Lemermeyer, (2024) reported no significant differences in neonatal motor responses between intervention and control groups($p>0.05$), suggesting that motor behavior may be more influenced by gestational age, neurological development, and illness severity than by comfort interventions alone. Likewise, Weng et al. (2024) and Gupta et al. (2022) observed inconsistent effects of non-pharmacological interventions on neonatal motor activity, indicating variability in behavioral outcomes.

The present study revealed no statistically significant differences among the groups regarding neonatal state of arousal before and during intervention ($p>0.05$). However, a statistically significant difference was found after intervention($p=0.010$),where neonates in the gentle human touch group showed the highest proportion of stable arousal state (sleeping/awake calm state), while the control group demonstrated a higher proportion of fussy behavior. After intervention, a clear improvement in arousal stability was noted in both intervention groups, especially the gentle human touch group.

These findings suggest that non-pharmacological interventions, particularly gentle human touch, are effective in promoting behavioral regulation and improving neonatal state of arousal following stressful procedures. These findings are in agreement with Riddell et al. (2023) and Luo et al. (2023), who reported that tactile-based interventions significantly improved neonatal state regulation and reduced irritability after painful procedures($p<0.05$). Similarly, Mohammed et al.(2025) and Shayani & Maraes, (2023) found that non-pharmacological comfort measures contributed to improved sleep-wake stability and reduced fussiness in NICU patients.

In contrast, Tucker et al. (2023) and Altay et al. (2024) reported no significant differences in arousal state between intervention and control groups($p>0.05$), suggesting that behavioral regulation may be influenced by clinical condition, gestational age, and environmental stressors. Likewise, Cai et al. (2026) and Hazel et al. (2022) observed inconsistent effects of non-pharmacological interventions on neonatal arousal, indicating variability in behavioral responses.

The present study demonstrated significant differences among bothgroups in neonatal pain levels as measured by the Neonatal Infant Pain Scale (NIPS) before, during, and after intervention. After intervention, although categorical differences were not statistically significant($p=0.146$), mean pain scores remained

significantly different(p = 0.006), with the lowest pain levels observed in the gentle human touch group, while the control group continued to show higher pain scores.

These findings clearly demonstrate the effectiveness of non-pharmacological interventions, particularly gentle human touch, in reducing procedural pain in neonates undergoing endotracheal suctioning. The reduction in NIPS scores reflects improved comfort and decreased stress response, highlighting the role of sensory and tactile stimulation in modulating neonatal pain perception. These findings are consistent with Smith et al. (2021) and Assefa et al. (2022), who reported that non-pharmacological interventions significantly reduced NIPS scores in neonates during painful procedures($p<0.05$), confirming their effectiveness in neonatal pain management. Similarly, Erol et al. (2024) and Bahrami et al. (2023) found that gentle touch interventions significantly decreased procedural pain scores and improved neonatal comfort compared to standard care.

In contrast, Bruinhof et al. (2025) and Ten Barge et al. (2024) reported no significant differences in pain scores between intervention and control groups ($p > 0.05$), suggesting that pain response may be influenced by clinical condition, gestational maturity, and environmental stressors rather than intervention alone. Likewise, Cai et al. (2026) and Pritchard et al. (2022)observed inconsistent effects of non-pharmacological interventions on neonatal pain scores, indicating variability in individual pain sensitivity and clinical settings.

The present study revealed a predominantly negative correlation between Neonatal Infant Pain Scale (NIPS) scores and physiological indicators among neonates receiving Gentle Human Touch during endotracheal suctioning. Significant moderate negative correlations were observed between NIPS scores and oxygen saturation before and during the intervention (r=-0.590, P=0.001;r=-0.543,P=0.002;r=-0.499,P=0.005), indicating that increased pain was associated with decreased oxygen saturation. According to correlation interpretation guidelines, these values represent moderate inverse relationships, suggesting that oxygen saturation is sensitive to pain-related physiological changes. In contrast, most correlations between NIPS scores and heart rate were weak and non-significant, except for the moderate negative correlation between NIPS before intervention and heart rate after intervention(r=-0.469,P=0.009) These findings suggest that Gentle Human Touch may attenuate neonatal stress responses, thereby improving oxygenation and enhancing physiological stability during painful procedures. Oxygen saturation appears to be a more reliable indicator of pain relief than heart rate because heart rate is affected by numerous factors such as gestational age, disease severity, medications, and environmental stimuli.

The current findings are in agreement with Fatollahzade et al. (2022), who reported that preterm infants receiving Gentle Human Touch during endotracheal suctioning exhibited significantly lower pain scores and improved physiological stability compared with those receiving routine care.Similarly, Oliveira et al. (2023) found that Gentle Touch significantly reduced NIPS scores and enhanced neonatal comfort during suctioning procedures, supporting the beneficial role of tactile interventions in minimizing pain and stress responses.

However, the present findings are inconsistent with those of Cai et al. (2023),whose systematic review concluded that although non-pharmacological interventions reduced behavioral pain responses, their effects on physiological indicators, particularly oxygen saturation, were inconsistent and often non-significant. Likewise, Oliveira et al. (2023) reported that while Gentle Touch effectively reduced pain scores, no statistically significant improvements were observed in physiological parameters such as heart rate and oxygen saturation,suggesting that behavioral indicators may be more sensitive than physiological measures in detecting procedural pain relief among neonates.

Conclusion

The findings of this study demonstrated that Gentle Human Touch is an effective non-pharmacological intervention for neonates undergoing endotracheal suctioning. Neonates who received Gentle Human Touch exhibited lower heart rates, higher oxygen saturation levels, improved behavioral responses, and significantly lower pain scores compared with those receiving routine care. Additionally, a significant negative correlation was found between pain scores and oxygen saturation, indicating that reduced pain was associated with greater physiological stability. These findings support the effectiveness of gentle human touch in minimizing procedural pain and enhancing both physiological and behavioral outcomes among neonates in the NICU.

Recommendations

- Integrate Gentle Human Touch into routine nursing care during endotracheal suctioning and other painful procedures in NICUs.
- Provide educational and training programs for neonatal nurses on the proper application of Gentle Human Touch.

- Develop clinical guidelines and protocols to standardize the use of Gentle Human Touch in neonatal care settings.
- Encourage the use of non-pharmacological pain management strategies alongside routine neonatal care.
- Conduct further studies with larger samples and different neonatal populations to validate and generalize the findings.
- Investigate the long-term effects of Gentle Human Touch on neonatal physiological and developmental outcomes.

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