Effect of Gustatory versus Auditory Stimulations on Physiological and Behavioral Indicators of Neonates undergoing Endotracheal Suctioning

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Abstract

Background: Neonatal stress is often poorly managed and many stressful procedures such as suctioning are carried out without paying attention to relieve stress. So, gustatory and auditory sensory stimulations help nurses provide developmental care for neonates during stressful procedures. **Aim:** This study aimed to determine the effect of gustatory versus auditory stimulation on physiological and behavioral indicators of neonates during endotracheal suctioning. **Hypothesis:** Neonates who receive gustatory stimulation exhibit stable physiological and behavioral indicators than those who do not. Neonates who receive auditory stimulation exhibit stable physiological and behavioral indicators those who do not. **Design:** A quasi experimental design was used to accomplish this study. **Setting**: This research was carried out in Neonatal Intensive Care Unit at specialized Smouha hospital in Alexandria. **Sample**: This study comprised of 75 neonates. **Data collection**: Two tools were used namely; Bio-demographic characteristics and medical history of neonates' assessment sheet which includes characteristics of neonates and their medical data and Neonatal Infant Pain Scale. **Results**: The main result showed that, after suctioning, all neonates in the gustatory stimulation group and the majority in the auditory stimulation group exhibited stability in physiological and behavior indicators compared to none of the neonates in the control group. Moreover, three quarters of the neonates among the control group had severe level of stress compared to none of neonates among the gustatory and auditory stimulations groups. The difference was statistically significant between the three groups (p=0.000). **Conclusion**: gustatory and auditory stimulations were effective in improving neonates' physiological and behavioral indicators of stress during and after endotracheal tube suctioning. **Recommendation:** Gustatory and auditory stimulations should be incorporated in NICUs policies to relive neonate stress during stressful procedures**.**

Keywords: Gustatory Stimulation, Auditory Stimulation, Physiological and Behavioral indicators

INTRODUCTION

The neonatal period is considered a vulnerable period during which series of biologic, physiologic and metabolic changes occur ***(Simpson and Creehan, 2018)***. Many neonates are born with problems that interfere with their adequate adaptation to the extra-uterine life. Neonates with life-threatening conditions frequently require admission to the Neonatal Intensive Care Unit (NICU), where they may be intubated

and mechanically ventilated ***(Perry S., et al., 2017)***.

Neonates admitted to the NICUs are exposed to a variety of environmental stressors arising from exposure to noise such as monitors or loud voices ***(Durrmeyer et al., 2015)***. This is in addition to their daily exposure tomany invasive procedures such as intravenous cannulation, blood sampling and endotracheal suctioning. The endotracheal suctioning is primarily used to provide patent airways.Clearance of secretions is mandatory in mechanically ventilated neonates, because accumulation of secretions may lead to airway occlusion and serious physiological abnormalities ***(Carman and Kyle, 2017)***.

The endotracheal suctioning represents one of the central elements of routine intensive care for critically ill neonates.Although, endotracheal suctioning is the most common procedure used in NICUs, it is considered a potentially harmful and certainly stressful procedure with acute and long term consequences on neonates ***(Shah and Kelly 2017)***.

Management of acute stress can be established through using sensory stimulations ***(American Pain Society, 2018)***. These interventions are directed toward stimulating neonates' sensory system. Sensory stimulations are many; encompasses the tactile, visual, olfactory, gustatory and auditory stimulations ***(Adele and Timothy, 2019)***.

Auditory stimulation is a sense which is developed during pregnancy. Recorded heart beats, intrauterine sounds, and music are considered different types of auditory stimulation that aid in distracting the neonates***(Cevasco, 2011)***. The music has an effect on the limbic system and temporal lobes of the cerebral cortex. This system is concerned with neonates' instinct and mood. It controls the basic emotions such as fear, stress and pain. This assisting neonate to maintain lower arousal states in the presence of any stressful stimuli***(Standley, 2011)***.

Soothing music such as Brahm's lullaby may regulate neonates' behavioral state through the innate qualities of gentle rhythm, tone and harmony.Listening to Brahm's lullaby may improve neonates' physiological outcomes such as heart rate and oxygen saturation. It also helps decrease neonates level of arousal and allows them to spend more time in quiet sleep ***(Elserafy and Alsaedi 2012).***

Gustatory stimulation is another sense which sucrose is instilled on neonates' tongue to stimulate an increase in plasma concentrations of ß-endorphin by a pre-absorptive mechanism ***(Dilen and Elseviers 2011)***. It has been proven that sucrose stimulates analgesic like reactions in the body and stress relieving properties ***(Sadek, 2020)***. Furthermore sucrose is thought to activate endogenous opiates through stimulation by the sweet fluid in the mouth, which releases endogenous opiates, and the presence of opioid receptors on the tongue ***(James et al., 2013)***.

Unfortunately, neonatal stress is often poorly managed and many procedures such as suctioning are carried out without paying attention to pain alleviation***(University of California, 2010)***. Provision of comfort and prevention of stress and pain are two primary goals of nursing care. Basically, gustatory and auditory

sensory stimulations help nurses provide comprehensive care for neonates during stressful procedures***(Cignacco and Hamers, 2018)***. So, it was necessary to study the impact of sensory stimulations on improving physiological and behavioral indicators of stress in an attempt to achieve neonatal comfort***(Britto, 2014)***.

AIM OF WORK

Determine the effect of gustatory versus auditory stimulation on physiological and behavioral indicators of neonates undergoing endotracheal suctioning.

Hypotheses of this research are:

1. Neonates who receive gustatory stimulation exhibit stable physiological and behavioral indicators than those who do not.
2. Neonates who receive auditory stimulation exhibit stable physiological and behavioral indicators those who do not.

Operational Definitions:

- **Gustatory stimulation**: It refers to orally instillation of 25% glucose by means of a strip of gauze soaked in the glucose.
- **Auditory stimulation**: It is listening to recorded piano music of Brahm's Lullaby with a relatively constant rhythm and volume to achieve relaxation .

SUBJECTS AND METHODS

1.1. Research Design:

A quasi experimental design was used to accomplish this study.

2.2. Setting:

The study was conducted in Neonatal Intensive Care Unit at specialized smouha hospital in Alexandria.

2.3. Sample:

A convenience sampling of 75 neonates who fulfilled the following criteria comprised the study subjects:

- Free from cardiac and neurological congenital malformations.
- On mechanical ventilator and attached with endotracheal tube.

Neonates were randomly assigned into three groups. Each group consisted of 25 neonates as follows:

- **Group 1:** The gustatory stimulation group where neonates received gustatory stimulation.
- **Group 2:** The auditory stimulation group where neonates received auditory stimulation.
- **Group 3:** The control group where neonates received the hospital routine.

Neonates of the control group were chosen first and neonates of the two other groups were chosen alternatively.

2.4. Tools for data collection

Two tools were used to collect the data.

2.4.1. Tool I: Bio-demographic characte - ristics and medical history of neonates' assessment sheet was developed by the researcher after thorough review of the related literature to assess neonates' characteristics and medical history. It included two parts:

- **Part I:** Characteristics of Neonates such as age, sex, and body weight.

- **Part II:** Medical History of Neonates such as type of delivery, date of admission and current diagnosis.

2.4.2. Tool II: Neonatal Infant Pain Scale (NIPS):

This tool was developed by Lawrence et al (1993). It was updated by the University of California, San Francisco Children's Hospital Medical Center in (2005) ***(Britto, 2014)***. The tool was used to assess pain experienced by neonates through assessing their physiological and behavioral parameters. This NIPS scale is divided into eight subscales to assess the following: neonates' facial expression, cry, breathing patterns, arms and legs movements, state of arousal, heart rate, and oxygen saturation.

All subscales were a two points likert scale (0-1) except crying and heart rate subscales were a 3 points likert scale (0,1,2). The total score ranged from 0-10, where zero score represents no stress, a score of 1-3 represents mild stress, a score of 4-6 represents moderate stress and a score of 7-10 represents severe stress.

2.4.3. Pilot study

9 neonates to test the applicability of the tools and no modifications were done. Those neonates were excluded from the study subjects.

2.4.4. Procedure of the study

An official letter for conducting the study was obtained from the Faculty of Nursing and was sent to the director of specialized smouha hospital to take their permission to facilitate the research implementation after explaining the aim and nature of the study.

- Tool one was developed by the researcher after review of the related literature.
- Content validity of the tool II was done by five experts in the pediatric nursing field.
- Data concerning characteristics and medical history of each neonate in the three groups were assessed using tool one.
- Assessment of physiological and behavioral indicators were carried out before performing endotracheal suction procedure for each neonate in the three groups after being attached to pulse oximeter.
- Assessment of physiological and behavior indicators were carried out parallel to gustatory and auditory stimulations of neonates.

For Gustatory stimulation group

Gustatory stimulation was performed as follows:

- Neonates were orally administered2ml of 25% glucose two minutes before suction procedure through a strip of gauze soaked in the glucose solution.
- The oral glucose solution was warmed to 37^0C before it was given.
- The solution was administered slowly on neonate's tongue over a period of 30 seconds

For Auditory stimulation group

Auditory stimulation was performed as follows:

- The neonate was allowed to listen to piano music of Brahm's Lullaby with a relatively constant rhythm and

volume through a headphone attached to neonate's ears.

- Stimulating the neonates was performed two minutes before performing the suction procedure. It was continued throughout the suction procedure.

For the Control group

The control group received the routine care of the unit.

Assessment of physiological and behavior indicators were also assessed during and after 5 minutes of suctioning for each neonate in the three groups.

Ethical considerations:

Written informed consents were obtained from the neonates' parents after explaining the aim of the study and have the right to refuse to participate or to withdraw from the study at any time.

Neonates' parents were assured that confidentiality of the collected data will be maintained during implementation of the study.

Statistical Analysis:

Data collected was coded and transferred into specially designed formats so as to be suitable for computer feeding. Following data entry, checking and verification processes were carried out to avoid errors during data entry. Frequency analysis, cross tabulation and manual revision were all used to detect any errors. The Statistical Package for Social Sciences (SPSS version 16) was utilized for both data presentation and statistical analysis of the results**.**

The following statistical measures were used:

Descriptive Statistics:

- Number and percentage were used for describing and summarizing qualitative data.
- Minimum and maximum were used for describing and summarizing quantitative data.
- The mean was used to measure central tendency in statistical tests of significance.
- The standard deviation (**SD**) is an average of the deviations from the mean. It was used for measuring the degree of variability in a set of scores.

Analytical Statistics:

- Kolmogorov – Smirnov test was used to examine the normality of data distribution
- Chi-square test, Fisher's Exact test, and Monte Carlo test were used to test the significance of results of qualitative variables
- Comparison of stress level among the three groups using Chi-Square Test (X2) for comparison of sample proportion.
- The 0.05 level was used as the cut off value for statistical significance (e.g. significant at $P \leq 0.05$).

RESULTS

Table 1 illustrates bio-demographic characteristics and medical history of the neonates. It was found that 48% among neonates in the gustatory stimulation and the control groups and 52% among neonates in the auditory stimulation were aged 2 to less than 9 days. Male neonates constituted 52%, 56% and 52% among the gustatory

stimulation group, the auditory stimulation group and the control group respectively. The same table clarified that neonates who weighted 2000 to less than 3000 grams constituted 56% in the gustatory stimulation group, 48% in the auditory stimulation and control group.

Table (1): Bio-demographic Characteristics and Medical History of the Neonates

Characteristics	Gustatory Stimulation Group (n=25)		Auditory Stimulation Group (n=25)		Control Group (n=25)	
	No.	%	No.	%	No.	%
Age/ days						
• 2-	12	48.0	13	52.0	12	48.0
• 9-	10	40.0	10	40.0	10	40.0
• 16-23	3	12.0	2	8.0	3	12.0
Sex						
• Male	13	52.0	14	56.0	13	52.0
• Female	12	48.0	11	44.0	12	48.0
Weight / grams.						
• <1000	0	0.0	1	4.0	1	4.0
• 1000-	10	40.0	11	44.0	10	40.0
• 2000-	14	56.0	12	48.0	12	48.0
• ≥3000	1	4.0	1	4.0	2	8.0

The medical history of neonates was presented in table 2. The table portrayed that almost similar percentages of neonates in the gustatory stimulation group, the auditory stimulation group and the control group suffered from respiratory distress (40%, 44 % and 40% respectively).

The table also illustrated that 80%, 52% and 80% of neonates among the gustatory stimulation group, the auditory stimulation group and the control group were delivered by cesarean section respectively.

Table (2): Medical History of the Neonates

Medical History	Gustatory Stimulation Group (n=25)		Auditory Stimulation Group (n=25)		Control Group (n=25)	
	No.	%	No.	%	No.	%
Current diagnosis						
• Respiratory distress	10	40.0	11	44.0	10	40.0
• Congenital pneumonia	5	20.0	2	8.0	5	20.0
• Meconium aspiration	5	20.0	6	24.0	5	20.0
• Transient tachypnea of newborn	3	12.0	3	12.0	3	12.0
• Neonatal sepsis	2	8.0	3	12.0	2	8.0
Type of delivery						
• Normal delivery	5	20.0	12	48.0	5	20.0
• Cesarean Section	20	80.0	13	52.0	20	80.0

Table 3 highlights oxygen saturation of neonates among gustatory, auditory stimulations and control group**.** It was obvious that all neonates (100%) in the gustatory stimulation group, the auditory stimulation group and the control group were not in need of oxygen to maintain their required oxygen saturation before suctioning.

The tablet also portrayed that 72% of neonates in the gustatory and 40% of those among the auditory stimulation groups were also not in need of oxygen to maintain oxygen saturation during suction. On the contrary, only 20 % of neonates among control group revealed that they were not in need for oxygen to maintain oxygen saturation during suction. The difference was statistically significant between the three groups (p=0.000). Furthermore, the need for oxygenafter 5 minutes of suctioning was observed among the majority of neonates (96%) in the control group compared to none neonate among gustatory and auditory stimulations groups and again there was statistically significant between the three groups (p=0.000).

Table (3): Oxygen Saturation of Neonates among Gustatory, Auditory Stimulations and Control Groups

Physiological Parameters Oxygen Saturation	Gustatory Stimulation Group (n=25)		Auditory Stimulation Group (n=25)		Control Group (n=25)		Significance
	No	%	No	%	No	%	
Before suctioning							
• No O_2 Needed	25	100.0	25	100.0	25	100.0	-
• Additional O_2 Required	0	0.0	0	0.0	0	0.0	
Mean ± SD	94.1±1.2		95.3±1.0		95.9±1.9		X^2=0.531 P= 0.848
During suctioning							X^2=58.235 P=0.000 *
• No O_2 Needed	18	72.0	10	40.0	5	20.0	
• Additional O_2 Required	7	28.0	15	60.0	20	80.0	
Mean ± SD	95±3.2		95.2±2.7		84.1±1.5		X^2=0.080 P= 0.000*
After 5/minutes of suctioning							
• No O_2 Needed	25	100.0	25	100.0	1	4.0	-
• Additional O_2 Required	0	0.0	0	0.0	24	96.0	
Mean ± SD	96.1±3.0		95.9±1.4		94.1±4.9		X^2=0.956 P= 0.568

***X^2*: Chi-Square Test * Significant at P ≤0.050**

Table 4 presents breathing pattern of neonates among gustatory and auditory stimulations and control groups. Before suctioning, it was noticed that all neonates in the gustatory stimulation group, the auditory stimulation group and the control group experienced relaxed breathing pattern (100% each). During suctioning, it was clear from the table that 76% of neonates in the gustatory stimulation group and 52%of neonates in the auditory stimulation group showed relaxed breathing pattern compared to 20% of those in the control group. The difference was statistically significant between the three groups(p= 0.000). After 5 minutes of suctioning, it was found that all neonates (100%) in the gustatory stimulation group, the auditory stimulation group and control group showed relaxed breathing pattern

Table (4): Breathing Pattern of Neonates among Gustatory, Auditory Stimulations and Control Groups

Physiological parameters Breathing Pattern*	Gustatory Stimulation Group (n=25)		Auditory Stimulation Group (n=25)		Control Group (n=25)		Significance
	No	%	No	%	No	%	
Before suctioning							
• Relaxed	25	100.0	25	100.0	25	100.0	-
• Change In Breathing	0	0.0	0	0.0	0	0.0	
During suctioning							
• Relaxed	19	76.0	13	52.0	5	20.0	**X^2=46.581**
• Change In Breathing	6	24.0	12	48.0	20	80.0	**P=0.000 ***
After 5/minutes of suctioning							
• Relaxed	25	100.0	25	100.0	25	100.0	-
• Change In Breathing	0	0.0	0	0.0	0	0.0	

Breathing Pattern*: Relaxed =Usual pattern for the neonates infant

Changes in breathing =Irregular, faster than usual, breath holding

X^2: Chi-Square Test * Significant at P ≤0.05

Table 5 shows heart rates of neonates among gustatory, auditory stimulations and control groups. It was obvious that heart rates of all neonates among the gustatory, the auditory stimulation groups and the control group were within normal range (100% each) before suctioning.

During suctioning, the table reflected that heart rates of 76% of neonates among the gustatory stimulation group were within normal range and 48% of neonates in the auditory stimulation group compared to none of those in the control group. The difference was statistically significant between the three groups (P=0.000).

After 5/minutes suctioning, the heart rates were within normal range among all neonates in the gustatory, the auditory stimulation groups and the control groups respectively.

Table (5): Heart Rates of Neonates among Gustatory, Auditory Stimulations and control groups

Physiological parameters Heart rate	Gustatory Stimulation Group (n=25)		Auditory Stimulation Group (n=25)		Control Group (n=25)		Significance
	No	%	No	%	No	%	
Before suctioning							
• Within 10% Of Baseline	25	100.0	25	100.0	25	100.0	-
• >10-20% Of Baseline	0	0.0	0	0.0	0	0.0	
• >20% Of Baseline	0	0.0	0	0.0	0	0.0	
Mean ± SD	140.5 ±3.8		139±2.6		142.1 ± 1.3		X^2=0.585 P= 0.871
During suctioning							
• Within 10% Of Baseline	19	76.0	12	48.0	0	0.0	X^2=54.531
• >10-20% Of Baseline	6	24.0	13	52.0	2	8.0	P=0.000 *
• >20% Of Baseline	0	0.0	0	0.0	23	92.0	
Mean ± SD	144.1 ±4.3		166±2.3		177.1 ± 1.4		X^2=0.035 P= 0.020*
After 5/minutes of suctioning							
• Within 10% Of Baseline	25	100.0	25	100.0	25	100.0	-
• >10-20% Of Baseline	0	0.0	0	0.0	0	0.0	
• >20% Of Baseline	0	0.0	0	0.0	0	0.0	
Mean ± SD	142.1 ±2.6		140±1.5		139.2 ± 1.1		X^2=0.234 P= 0.800

X^2: Chi-Square test * Significant at P P≤0.05.

Facial expressions of neonates among gustatory, auditory stimulations and control groups are presented in Table 6. Before suctioning, it was noticed that all neonates in the gustatory stimulation group, the auditory stimulation group and the control group (100% each) showed relaxed facial expression before suctioning. While during suctioning, grimace was observed among all neonates in the control group (100%) compared to 52% of neonates among auditory group and only 28% among neonates of gustatory group.

Five minutes following suctioning procedure, all neonates in the gustatory stimulation group andthe majority of those in the auditory stimulation group showed relaxed facial expression(100% and 84% respectively) compared to 60% of neonates among control group. The difference was statistically significant between the three groupswhere p= 0.000.

Table (6): Facial Expressions of Neonates among Gustatory, Auditory Stimulations and Control Groups

Behavioral parameters Facial Expressions*	Gustatory Stimulation Group (n=25)		Auditory Stimulation Group (n=25)		Control Group (n=25)		Significance
	No	%	No	%	No	%	
Before suctioning							
• Relaxed	25	100.0	25	100.0	25	100.0	-
• Grimace	0	0.0	0	0.0	0	0.0	
During suctioning							
• Relaxed	18	72.0	12	48.0	0	0.0	-
• Grimace	7	28.0	13	52.0	30	100.0	
After 5/minutes of suctioning							X^2**=73.200**
• Relaxed	25	100.0	21	84.0	15	60.0	**P=0.000 ***
• Grimace	0	0.0	4	16.0	10	40.0	

Facial Expression *: Relaxed = Restful face, neutral expression
Grimace = Tight facial muscles, furrowed brow, chin and jaw
X^2: Chi-Square Test * Significant at P ≤0.05

Table 7 highlights arm movements of neonates among gustatory, auditory stimulations and control groups. Before suctioning, the table clarified that all neonates in the three groups (100% each) showed relaxed arm movements i.e. movements without muscular rigidity. During suctioning, it was observed that flexed/extended arm movements noticed among 20% of neonates in the gustatory stimulation group. Meanwhile, the same kind of movements was recognized among 40% of neonates in the auditory stimulation group compared to 80% of those in the control group. There was statistical significant difference between the three groups(p=0.000). After 5 minutes of suctioning, the table revealed that none of the neonates among gustatory and auditory stimulation groups experienced flexed/extended arm movements compared to 96% of those in the control group.

Table (7): Arm Movements of Neonates among Gustatory, Auditory Stimulations and Control Groups

Behavioral parameters Arm Movements*	Gustatory Stimulation Group (n=25)		Auditory Stimulation Group (n=25)		Control Group (n=25)		Significance
	No	%	No	%	No	%	
Before suctioning							
• Relaxed	25	100.0	25	100.0	25	100.0	-
• Flexed/Extended	0	0.0	0	0.0	0	0.0	
During suctioning							
• Relaxed	20	80.0	15	60.0	5	20.0	X^2=7.531
• Flexed/Extended	5	20.0	10	40.0	20	80.0	P=0.000 *
After 5/ minutes of suctioning							
• Relaxed	25	100.0	25	100.0	1	4.0	-
• Flexed/Extended	0	0.0	0	0.0	24	96.0	

Arm Movements*: Relaxed =No muscular rigidity, occasional random movements
Flexed/Extended=Tense, straight arms, rigid or rapid extension, flexion
X^2: Chi-Square Test * Significant at P ≤0.05

Table 8 clarifies state of arousal of neonates among gustatory, auditory stimulations and control groups. Before suctioning, it was observed that all neonates in the gustatory stimulation group, the auditory stimulation group and the control group (100% each) were in quite sleeping /awake state.

During suctioning, the table revealed that 73.3% of neonates in the gustatory stimulation group were in fussiness and restlessness condition. The same conditions were recognized among the majority of neonates (93.3%) in the auditory stimulation group while, all neonates in the control group were fussy and restless. Statistical significant differences were found between the three groups p=0.003.

Five minutes after suctioning, all neonates (100%) in the gustatory and the auditory stimulation groups were in quite sleeping/Awake state compared to 20% of those in the control group. The difference was statistically significant between the three groups (p=0.000).

Table (8): State of Arousal of Neonates among Gustatory, Auditory Stimulations and Control groups

Behavioral parameters State of Arousal*	Gustatory Stimulation Group (n=25)		Auditory Stimulation Group (n=25)		Control Group (n=25)		Significance
	No	%	No	%	No	%	
Before suctioning							
• Quite sleeping/ Awake	25	100.0	25	100.0	25	100.0	-
• Fussy	0	0.0	0	0.0	0	0.0	
During suctioning							**X^2=11.779**
• Quite sleeping/Awake	8	26.7	2	6.7	0	0.0	**P=0.003 ***
• Fussy	22	73..3	28	93.3	30	100.0	
After 5/ minutes of suctioning							**X^2=85.574**
• Quite sleeping/ Awake	25	100.0	25	100.0	5	20.0	**P=0.000***
• Fussy	0	0.0	0	0.0	20	80.0	

State of Arousal*: Sleeping/Awake =Quiet, peaceful, sleeping or alert and settled
Fussy =Alert, restless and thrashing
X^2: Chi-Square Test * Significant at P ≤0.05

Table 9 portrays level of stress perceived by neonates among the gustatory, the auditory stimulation groups and the control groups. It was noticed from the table that all neonates (100%) in the three groups exhibited no stress level before suctioning.

During suctioning, it was found that 48% and 24% of neonates in the gustatory and auditory stimulation groups had mild stress level respectively compared to none of those in the control group. Furthermore, 76 % of neonates in the gustatory stimulation group had moderate stress level, while the same level of stress was noticed among half of neonates (52%) among the auditory stimulation group. Only 24% of neonates in the control group experienced moderate level of stress. On the contrary, three quarters of the neonates (76%) among the control group had severe level of stress compared to none of neonates among the gustatory and auditory stimulations groups. The difference was statistically significant between the three groups(p=0.000).

After suctioning, the table reflected that all neonates (100%) in the gustatory stimulation group and 92% in the auditory stimulation group had no stress level compared to none of the neonates in the control group. The difference was statistically significant between the three groups(p=0.000).

Table (9): The Total Stress Level Perceived by Neonates among the Gustatory, Auditory Stimulation Groups and the Control Groups

Stress Level	Gustatory Stimulation Group (n=25)		Auditory Stimulation Group (n=25)		Control Group (n=25)		Sig.
	No	%	No	%	No	%	
Before suctioning							
• No stress	25	100.0	25	100	25	100.0	
• Mild stress	0	0.0	0	0.0	0	0.0	-
• Moderate stress	0	0.0	0	0.0	0	0.0	
• Severe stress	0	0.0	0	0.0	0	0.0	
During suctioning							
• No stress	0	0.0	0	0.0	0	0.0	X^2=60.157
• Mild stress	12	48.0	6	24.0	0	0.0	P=0.000 *
• Moderate stress	13	52.0	19	76.0	6	24.0	
• Severe stress	0	0.0	0	0.0	19	76.0	
After 5 /Minutes of suctioning							
• No stress	25	100.0	23	92.0	0	0.0	X^2=80.429
• Mild stress	0	0.0	2	8.0	5	20.0	P=0.000 *
• Moderate stress	0	0.0	0	0.0	20	80.0	
• Severe stress	0	0.0	0	0.0	0	0.0	

X^2: Chi-Square test * Significant at P ≤0.05.

DISCUSSION

Endotracheal suctioning is commonly performed procedure in intubated neonates. Despite the risks associated with suctioning, failure to suction when needed can result in a plugged endotracheal tube and the trauma of reintubation, and decreased oxygenation, because accumulated secretions will cause little oxygen to pass down the bronchioles so, a mismatch between ventilation and perfusion will occur***(Newborn Services Clinical Guidelines, 2014)***. Neonates are experienced distress and being adversely affected by it physiologically and behaviorally during endotracheal suctioning procedure. The neonates' physiological alterations include increase in their heart rate, change in the breathing pattern and decrease in oxygen saturation. While, neonates' behavioral alterations encompass crying, fussiness, muscular rigidity of their extremities and sleep/wake cycle changes***(Axelin et al., 2012)***.

Oxygen saturation is the most observed physiological response that experienced by neonates during suctioning. The current study findings concluded that during suction procedure about one fifth and two thirds of neonates among gustatory and auditory stimulation groups exhibited less oxygen desaturation levels. On the other hand, the majority of neonates among the control group exhibited more oxygen desaturation levels during suction procedure. These findings

could be attributed to the fact that sensory stimulations through gustatory and auditory stimulations increase blood flow to the body tissues and the brain thus improve oxygen saturation***(Azarmnjad and Sarhangi 2015)***. These findings were congruent with the findings of **Bellieni C et al**. who reported that sucrose and music improve oxygen saturation of neonates ***(Bellieni et al., 2011)***.

Sensory stimulations have crucial role in improving condition of neonates. Findings of the current study showed that distress level among neonates in the gustatory stimulation group was decreased during endotracheal suctioning and none of them experienced stress five minutes after endotracheal suctioning. On the contrary, assessment of physiological and behavioral indictors reflected that the majority of neonates in the control group suffered from distress during or after endotracheal suctioning. These findings could be explained in light of the fact that gustatory stimulation usually leads to reduction of distress and promotes relaxation of neonates ***(Cignacco and Hamers, 2018)***. These findings are supported by the findings of **Axelin et al.** who stated that administration of sucrose over the tongue, where the sweet sensation receptors are located leading to release of endogenous opioids which in turn inducing the relaxation among neonates ***(Axelin et al., 2012)***.

Auditory stimulation is another effective sensory stimulation that can be applied to relieve stress and improve physiological and behavioral responses to it. It stimulates the brain to secrete endorphins which is the body's own morphine ***(Cevasco, 2011)***. It also provides relaxation which leads to reduction of stress ***Cignacco and Hamers, 2018)***. This fact could explain the findings of the current study where neonates in the auditory stimulation group exhibited decrease in stress level. This was documented in physiological and behavioral assessment during and after endotracheal suctioning. On the contrary, the majority of neonates in the control group experienced physiological and behavioral instability either during or after endotracheal suctioning. These findings were supported by **Azarmnjad et al.** who reported that lullabies had beneficial effect on reducing stress of neonates undergoing painful procedures ***(Azarmnjad and Sarhangi 2015)***.

Findings of the current study illustrated that neonates' physical and behavioral responses were positively improved in the gustatory and the auditory stimulation groups. These findings might be explained in the light of the fact that gustatory and auditory stimulations have securing, calming, soothing and better arousal state for neonates***(Bellieni et al., 2011)***. These findings were congruent with the findings of **Gibbins et al. (2010)**who reported that neonateswho received sucrose became less fussy, less muscular rigidity and less grimacing ***(James et al., 2013)***. In addition, the current study was also in line with **StandleyJ.**who reported that neonates who received music therapy had more stabilized physiological and physical condition that induces relaxation and positive sleeping pattern ***(Standley, 2011)***.

Although neonates of both studied groups experienced less level of stress throughout endotracheal suctioning procedure than the control group, findings of the current study highlighted that neonates among the gustatory stimulation group experienced less level of stress compared to neonates among the auditory stimulation group. This finding may be related to the fact of the binding of endogenous opioids from action of oral sucroseto nociceptors thereby modulating neuronal transmission of adverse stimuli ***(Dilen and Elseviers 2011)***. The findings of **Dilen et al.** supported the current study results ***(Dilen and Elseviers 2011)***. Moreover, the findings of **Azarmnjad et al.** also illustrated that listening to lullabies was poetically effective in decreasing stress responses in neonates especially when they are combined with other sensory stimuli such as gustatory stimulation ***(Azarmnjad and Sarhangi 2015)***.

Conclusion

According to findings of the present study, it can be concluded that gustatory and auditory stimulations were effective in improving neonates' physiological and behavioral indicators during and after endotracheal tube suctioning. Furthermore, neonates who received gustatory stimulation exhibited less level of stress than those who received auditory stimulation.

Recommendations

Based on the previous findings and conclusion drawn from the current study, the following recommendations are suggested:

- Educational programs about sensory stimulations techniques should be provided to NICU professionals to enhance their skills regarding neonatal care management plan.
- Health care institutions should incorporate sensory stimulations during care of neonates in their policies especially gustatory and auditory stimulations.
- Neonatal Intensive Care nurses should use sensory stimulations interventions to improve physiological and behavioral of neonates undergoing endotracheal suctioning.

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