Effects of Supportive Care Bundle on Sleep Variables and Physiological Parameters of Premature Infants and their Maternal Self-efficacy

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Abstract

Background: Premature infants are prone to suffer multisystem complications, supportive care bundle is a set of nursing intervention used to improve quality of sleep and physiological parameters of premature infant, which can be affective by environmental stress in neonatal intensive care unit. Aim: This study aimed to evaluate the effects of supportive care bundle on sleep variables and physiological parameters of premature infants and their maternal self-efficacy. Design: A quasi-experimental research design was used for this study. Setting: This study was carried out at the neonatal intensive care unit in Sayed Galal Hospital, affiliated to Al-Azhar University. Sample: A purposive sample composed of 64 premature infants and their mothers after fulfilling the inclusion criteria. The sample was divided into two equal groups, the study and the control groups (32 each). Tools: Four tools were used in this study: Tool one: A structured interviewing questionnaire, it included three parts: a) Characteristics of premature infants and medical history. b) Characteristics of the mothers. c) Questionnaire to assess the mothers' knowledge. Tool two: Observational checklist to assess the premature infants’ sleep variables. Tool three: Physiological parameters assessment of the premature infants by assessing the respiratory rate, heart rate, axillary temperature and oxygen saturation level. Tool four: Perceived maternal parenting self-efficacy questionnaire. Results: The present study revealed that, after intervention, 65.6% of premature infants in the study group had deep sleep compared with 9.4% in the control group. There was an improvement in the physiological parameters of the premature infants after intervention in the study group compared with the control group. There was a highly statistically significant difference between both groups at post intervention (X²=29.067 at P<0.001). Conclusion: The present study concluded that, the implementation of supportive care bundle improves sleep variables and physiological parameters of premature infants, as well as increases mothers’ level of knowledge and their self-efficacy scores in the study group than the control group. Recommendations: There is a need to implement strategies of supportive care in NICUs to provide more appropriate premature infant’s sleep state and keep stable physiological parameters. Develop an infant care education program for mothers about care of premature infants to improve their knowledge and self-efficacy.

Key words: Premature infant, sleep, physiological parameters, supportive care bundle, mother’s self-efficacy

Introduction

Premature infants are born before the due date, premature birth considered as a major problem in neonatal health is the leading cause of morbidity and mortality. Since they need special medical care and support. As well, some of them should be hospitalized in neonatal intensive care units (NICU). Reducing this mortality is one of the goals of the United Nations' 2030 agenda. Therefore, it is critical that clinicians focus attention on the health of this fragile population (Vahdati et al., 2017) and (Lan et al., 2018).
Premature neonates have immature body systems, that lead to increasing the risk of respiratory difficulty in addition to having immature regulatory center which lead to periodic breathing, hypoventilation, and frequent periods of apnea, so they may have physiological problems such as a low respiratory rate (RR), irregular heart rate (HR), low level of oxygen saturation, apnea, and increased gastric residual (Punthmatharith & Mora, 2018).

Sleep is a very critical human physiological need and plays a fundamental and preponderant role in neonate’s growth and development. Therefore, sleep problems in preterm infants admitted in the NICU are a growing concern. How to protect and respect the sleep of preterm infants in the NICU, and how to properly assess and implement beneficial care measures have become important for premature infant development (Lou et al., 2018).

Neonatal Intensive Care Unit environment is disturbing and harmful to premature infants, continuous exposure to various environmental stimulations as bright lights, high noise levels, excessive manipulations, repeated invasive and painful procedures, maternal separation, and multiple care in the NICU can negatively affect the premature infant’s health, leading to changes in HR and oxygen saturation (SpO₂) levels, expanding fluctuations in blood pressure, and increasing restlessness. As well, harmful stimuli that often disrupt and shorten their sleep (Vahdati et al., 2017) and (Chora & de Évora, 2019).

Care bundle is a structured method of intervention resulting in an improvement in patient outcomes. It’s a straightforward, small set of evidence-based practical actions or interventions, that once performed reliably, improve patient outcomes (Robb et al., 2010). Developmental supportive care is a broad category of interventions designed to minimize the stress placed on the newborn and the family by the NICU environment. The core principles of supportive care are protected sleep, hearing environment, family centered care and activities of daily living (Elsharkawy, 2014).

Increased sleep time for premature infants can be achieved with supportive care bundle (SCB) intervention as gentle touch, position, holding an infant in a flexed position, facilitated tucking, non-nutritive sucking on a pacifier, kangaroo care, nesting, and swaddling, massage, and calm auditory stimuli. As well, SCB is effective in physiological parameters as helps with thermal regulation, guards against bradycardia, contributes to regular breathing patterns, and provides stability of transcutaneous oxygen level. Generally, SCB improves infant's health, growth, and development and contributes to better neonatal survival Helaly & Mohammed, 2020) and (Correia & Lourenço, 2020).

The ability of parents to care for premature infants is needed in order to minimize complications, reduce morbidity, avoid disabilities, increase growth and development of premature infants optimally, and increase parental confidence and good parents' self-efficacy. Choosing the right educational method can improve the ability of parents to properly care for and provide developmental care for premature infants (Zakaria et al., 2020).

Planned SCB intervention is to improve mothers’ experience and self-efficacy and to reduce the length of stay of premature infants in a neonatal unit. Active mother involvement in premature infant caregiving leads to secure mother premature infant attachment and sensitivity to premature infant cues are essential to long-term quality of life for these premature infants and are significantly improved by NICU interventions that promote parenting self-efficacy and physical and emotional closeness between parents and infants (Franck et al., 2019).

Neonatal nurses have a crucial role in improving the quality of care of premature neonates and providing them with comfort measures in order to improve respiratory rate, heart rate and oxygen saturation and promote good sleep. Positioning neonates in a good body
alignment and changing body position regularly are essential components (Babaei et al., 2019).

Neonatal nurses are an integral part of premature infants’ care. Nurses have the responsibility to implement strategies that protect and promote sleep. They can help mothers develop mutual interaction with their premature infants and encourage mothers to provide care. Nurses can offer support, guidance, and counseling to mothers regarding premature infants’ behavior cues and caring skills. If nurses allow mothers to provide care for premature infants while they are still in the hospital, they will make sure that proper care from competent mothers will continue after discharge (Correia & Lourenço, 2020) and (Jang & Ju, 2020).

Significance of the study

Prematurity has been one of the major causes of neonatal mortality and morbidity. Worldwide, premature birth is seen in almost 11.1% of all pregnancies. Premature birth represents approximately 70% of neonatal and 36% of infant deaths. As the premature neonates are a vulnerable population, they require highly specialized nursing interventions with advanced technology (Das et al., 2020). Globally, there are about 150,000 premature infants each year, ranking for the incidence of 1/10 (Huang et al., 2021). In Egypt, premature birth complications were found to cause 38% of neonatal deaths (Muhe et al., 2019).

Premature infants in the NICUs rarely reach the deep sleep and quietly awake states, which are required for healthy development, studies indicating an average of 132 to 234 (Liao et al., 2018) sleep disruptions, in a given period of 24 hours in NICU (Chora & de Évora, 2019) and (Mony et al., 2018). As well, the environment can affect the maturation and functioning of preterm infant’s central nervous system (CNS). Changes in parameters such as HR, RR, colour, blood pressure and SpO2 show whether there is any physiological instability (Sumathy 2020).

Premature infants need to regulate their sleep-wake states, by reducing environmental stress and adjusting nursing care activities. Several supportive interventions have been shown to help stabilize physiological parameters of preterm infants and promote sleep. Therefore, this study would provide SCB interventions to help in the improvement of deep sleep and quiet awake states for premature infants, mitigate the negative influences of sleep disruption in the NICU, also, to improve physiological parameters and increase maternal efficacy.

Operational Definitions

Supportive care bundle is a set of evidence-based practices’ interventions supported by research that when used together causes a significant improvement in premature infants’ sleep and physiology parameters and parental self-efficacy.

Physiological parameters, such as blood pressure, body temperature, respiratory rate, heart rate, and oxygen saturation, are used for the assessment of premature infants.

Sleep variables deep sleep and quiet awake states of premature infants.

Efficacy is attributed to when mothers feel comfortable in performing premature infant caring skills and verbalized that they feel they can help their infant in times of need.

Aim of study

The aim of this study was to evaluate the effect of SCB on sleep variables and physiological parameters of premature infants and their maternal self-efficacy. This aim was achieved through the following objectives:

- Assessment of sleep variables and physiological parameters of premature infants
- Assessment of mother knowledge and self-efficacy.
- Developing and Implement of SCB intervention.
- Evaluate the effect of SCB on sleep variables and physiological parameters of premature infants.
premature infants and their maternal knowledge and self-efficacy.

**Research hypotheses**

To achieve the aim of this study, the following hypotheses were tested:

**H₁:** Premature infants who receive SCB will have better sleep variables than those who do not and that there will be a statistically significant difference between the study and control groups.

**H₂:** Premature infants who receive SCB will have more stable physiological parameters than those who do not and that there will be a statistically significant difference between the study and control groups.

**H₃:** There will be a significant improvement in mean knowledge scores of mothers and mean maternal self-efficacy scores after SCB intervention in the study group than those in the control group.

**H₄:** There will be a significant correlation between mothers’ knowledge and self-efficacy.

**Subjects and Methods**

1. **Technical Design**

1.1 **Research design:**

A quasi-experimental was utilized in this study using study and control groups pre-test and post-test interventions.

**Setting:**

This study was carried out in fifteen incubators and/or beds in the tertiary care neonatal intensive care unit in Sayed Galal Hospital, affiliated to Al-Azhar University.

**Sampling:**

**Type of sample:** A purposive sample

**Sample size**

Based on data from the literature (Möller et al., 2019), considering level of significance of 5%, and power of study of 80%, the sample size can be calculated using the following formula: 

\[ n = \frac{[(Z_{\alpha/2} + Z_{\beta})^2 \times (2(\text{SD})^2)]}{(\text{mean difference between the two groups})^2}, \]

where, SD = standard deviation obtained from the previous study; Z_{\alpha/2}, for 5% this is 1.96; and Z_{\beta}, for 80% this is 0.84. Therefore, 

\[ n = \frac{[(1.96 + 0.84)^2 \times [2(5.73)^2]]}{(4.05)^2} = 31.4. \]

Based on the above mentioned formula, the sample composed of 64 premature infants and their mothers.

They are divided randomly into two identical groups, the control (32) who receive only usual NICU care, and the study (32) who receive SCB (usual NICU care + positioning + gentle touch + non-nutritive sucking + facilitated tucking + modulating infant states + Kangaroo care (KC) + oral sucrose).

The study sample was selected after fulfilling the **infants’ inclusion criteria** such as gestational age 31 to ≤ 37 weeks of gestation, birth weight from 1500 grams, feeder and grower i.e., being fed via oral feeding, postnatal age of at least 2 days, spontaneous breathing with no need of assisting device, premature infants’ APGAR score over four, premature infants fed every 2 hours, both gender. **Exclusion criteria were:** Premature infants who have congenital anomalies, neurological defects, birth weight less than 1500 grams, nosocomial sepsis and required longer ventilator support were excluded.

**Mothers’ inclusion criteria:** Mothers having premature infants regardless of their age and educational level and attending the previously mentioned setting to manage their premature infants.

**Tools and techniques of data collection**

**Tool one: A Structured Interviewing Questionnaire:**

It was designed by researchers after reviewing related literature. It was written in simple Arabic language and includes the following:

**Part I: Characteristics of premature infants and medical history:** Collected from premature infants medical and nurses’ sheets
e.g. gender, diagnosis, gestational age, birth weight, and method of feeding.

Part II Characteristics of the mothers as: Age, educational level, occupation, family size, and residence.

Part III: Questionnaire to assess the mothers' knowledge: It was developed by the researchers based on related literature Royal College of Occupational Therapists (2017) and Zakaria et al., (2020), it consisted of 60 questions, open, and closed ended questions related to sleep state, positioning, gentle touch, non-nutritive sucking, hunger cues, oral feeding and feeding cues, facilitated tucking, modulating infant states, and KC. This tool was used before and after implementation of the SCB intervention.

Scoring system

The scoring system for mothers' knowledge was developed; the correct answer was given a score (1) and the incorrect or unknown answer was given score (zero). The scores obtained for each question were summed up to get the total score for the mothers' knowledge, the total score was computed and converted into percentages and categorized into: Less than 50% considered poor, 50% to less than 65% considered average, and 65% or more considered good.

Tool two: Observational Checklist to Assess the Premature Infants’ Sleep Variables: It was developed by Als, (1999). The observational checklist was differentiating six state levels, including deep sleep, light sleep, drowsy, quietly awake and/or alert, actively awake and aroused, as well as highly aroused and agitated/crying. Each state level is defined by various behavioral cues such as breathing patterns, facial expressions, body/eye/mouth movements, various sounds, and skin color.

Scoring system

Total scoring system for sleep variables:

The six states were ranked as follows:

- State 1: Deep sleep with closed eyes, no eye movements, regular breathing, and no spontaneous movements.
- State 2: Light sleep with closed eyes, eye movements, irregular breathing, and slight spontaneous movements.
- State 3: Drowsy with eyes opened or closed, eye movements, irregular breathing, and sporadic spontaneous movements.
- State 4: Quietly awake/alert with eyes opened and slight spontaneous movement.
- State 5: Actively awake and aroused with brief periods of being worried and active spontaneous movement.
- State 6: Highly aroused and agitated/crying with violent intense crying and active spontaneous movement.

Tool three: Physiological Parameters Assessment of the Premature Infants for assessing the RR, HR, axillary temperature, and SpO₂ level.

Oxygen saturation level: It was indexed via pulse oximeter levels acquired from medical and nursing records, also by observation of pulse oximeter device attached to the premature infants' leg.

Tool four: Perceived Maternal Parenting Self-Efficacy Questionnaire

It was adopted from Barnes and Adamson-Macedo (2007), and it was utilized to evaluate mothers’ perceptions of their self-efficacy in providing premature infant care. This scale consists of 20 items divided into four subscales: Caretaking procedures, evoking behaviors, reading behaviors and signaling, and situational beliefs. Responses to each item use a four-point Likert Scale, rated from 1-4, with (1) strongly disagree, (2) disagree, (3) agree, and (4) strongly agree.

Scoring system:

The total self-efficacy score ranged from 20 to 80; the responses of the maternal self-
efficacy were summed up and the total score was categorized as a higher level of maternal self-efficacy (≥60%) with a score ranged from 48≤ 80, or lower level of maternal self-efficacy (<60%) with score ranged from 20-<48. This tool was administered pre and post-intervention before infant discharge from the NICU.

2- Operational Design

2.1 Preparatory phase:

This phase included reviewing the related literature to cover various aspects of the research problem using books, articles, magazines, and internet searches to develop the study tools for data collection.

2.2 Reliability of tools:

The Cronbach’s alpha value for the reliability (internal consistency) of the knowledge questionnaire was 0.889 and for the self-efficacy questionnaire was 0.907, while the other third and fourth tools were standardized.

2.3 Validity of tools:

Tools were reviewed and tested for validity by a panel of three experts in pediatric nursing before using in the study to ensure their validity and their comments were considered, while the third and fourth tools were standardized.

2.4 Pilot study:

It was done on ten percent of the studied premature infants and their mothers to assess the feasibility, clarity and applicability of the tools, and some modifications required were done. Mothers and premature infants who shared in the pilot were not included in the main study sample.

2.5 Ethical considerations:

An official permission was obtained from the Director of Hospital and the Head of the NICU after explaining the aim, tools, duration, and the usefulness of the study. As well, oral consent was obtained from the mothers of premature infants after explaining the aim, and the usefulness of the study, and they were assured about the confidentiality of the collected data. The researchers informed the mothers about their rights to accept or reject their premature infants’ participation without interference with the care provided to their premature infants, also about their right to withdraw from the study at any time without giving any reason.

2.6 Field work:

Data collection of the present study was carried out over a duration of eight months from the first of May 2020 to the end of December 2020. The researchers were available in the study setting 3days per week from 9.00 a.m. to 12.00 noon. The researcher introduced herself and established a good rapport with the mothers, they explained the aim of the study to the mother and obtained their consent. On the same day, baseline physiological parameters were assessed before intervention.

Each mother was individually interviewed using the previously mentioned study tools. The questionnaires and the answers were marked by the researcher; 15 minutes were needed to complete the questionnaires.

The premature infants were divided into two identical groups, the control (32) who receive only usual NICU care, and the study (32) who receive SCB (usual NICU care + positioning + gentle touch + non-nutritive sucking + oral sucrose + facilitated tucking + modulating infant states and KC). In addition, mothers of this group receive educational intervention about sleep variables, positioning, gentle touch, non-nutritive sucking, hunger cues, oral sucrose, and feeding cues, facilitated tucking, modulating infant states, and routine KC, and how to provide care to premature infants.

Nurses in NICU and mothers were trained to consistently provide the SCB on three shifts (day, evening, & night) for round the clock care. At least, one well trained nurse working on each shift was responsible for taking care of the premature infants receiving the SCB during the study period.
The researchers met with the nurses taking care of the premature infants to ensure that they consistently provided and recorded the caregiving activities based on the standard procedures in the NICU.

The researchers, and well-trained nurses, were observing and recorded the premature infants' sleep/wake states at 1 minute intervals for 3 hours while premature infants are sleeping. All variables were recorded on an observation sheet. The total frequencies of sleep, wake, and fussing/crying were calculated within the 3 hrs. observation period. The researchers were consistently collecting data on medical and caregiving activities; each infant's medical and nursing chart was reviewed daily.

The application of SCB was carried out in four phases:

1- Assessment phase: It consisted of the pretest for assessing mothers' knowledge about SCB and assessing their self-efficacy using tools (1&4), and tool (2) to assess the premature infants’ sleep state and physiological parameters.

2- Planning phase: It involved designing the SCB intervention topics. The content was composed of usual NICU care, positioning, KC, gentle touch, non-nutritive sucking, oral feeding, facilitated tucking, and modulating infant states.

3- Implementation phase: The SCB intervention was carried out in 3 sessions; one session to cover the theoretical part, which included the premature infant's feeding technique, and educating the mother on how to assess the premature infant for potential feeding on demand. In addition, educate about positioning, KC, gentle touch, non-nutritive sucking, and facilitated tucking. As well, two practical sessions to apply practices regarding SCB intervention as oral feeding, positioning, KC, gentle touch, non-nutritive sucking, and facilitated tucking. At the beginning of each session, the researchers started by a summary about what was given through the previous session and the objectives of the new one, taking into consideration using simple and clear language to suite the mothers’ educational level.

The trained nurses adjusted the levels of light and noise. As well, the trained nurses and mothers (1) Modulated the infant's state by talking to the premature infant with a gentle, quiet voice to gradually awaken them; (2) The premature infants were provided non-nutritive sucking using a standard silicone pacifier from 2 to 5 minutes or the researchers were training premature infants for non-nutrient sucking through her finger during enteral feeding. (3) While sucking, the infants were simultaneously provided oral feeding. (4) In addition, the nurses and mothers were using warm hands to provide gentle touch (placing fingers softly and gently on the premature infant's forehead); and (5) facilitated tucking (the premature infant was maintained in a flexed, midline position with all four limbs close to the body) from 1 minute to 5 minutes, mothers were asked to practice KC.

Every session took about 30 - 45 minutes using many teaching methods such as lectures and group discussions, practical demonstrations, and redemonstrations. Teaching media were used as videos, PowerPoint presentations, and handouts; mothers were interviewed in a private room in the NICU.

After completion of sessions for all mothers, premature infants were observed as regards their sleep state and physiological parameters by the researcher, who observed the existence of signs such as, closed eyes, absence of rapid eye movements, absence of body movements, a regular pulse and respiration, and few short wakes was considered as good quality sleep (QS). Closed eyes with rapid eye movements, existence of body movements, an irregular pulse and respiration, short time wakes, and existence of any movements were considered active sleep. Heart rate was checked and recorded. Oxygen saturation was indexed via pulse oximeter levels acquired from medical and nursing records, also by observation pulse oximeter device attached to the premature infants' leg. Respiration regularity was observed visually. The presence of the criteria related to each sleep stage for at least one minute was considered as the beginning of that stage and
their complete stoppage for one minute as the end of that stage.

The SCB intervention was applied for two weeks before the premature infant’s discharge from NICU, and the researchers educated the mother to apply this technique at home after discharge.

4- Evaluation phase:

This phase was performed through comparison between both groups pre and post-intervention done using the same pretest tools to evaluate the effect of the application of a SCB intervention on premature infants and their mothers.

3. Administrative Design:

The present study was carried out after taking an official permission from the administrators of the study setting at Sayed Galal Al-Azhar University Hospital, and the Head of the NICU after explaining the aim, tools, duration and the usefulness of the study.

4. Statistical Design:

All statistical analyses were performed using the Statistical Package for Social Sciences (SPSS), for Windows, version 24.0 (SPSS, Chicago, IL). Continuous data were expressed in mean ± standard deviation (SD), while categorical data were expressed in number and percentage. The differences between two groups were determined using Student’s t-test for variables with continuous data and Chi-square test for variables with categorical data, and r for correlation between variables. Statistical significance was set at P<0.05 and highly significant at P<0.001.

Results:

Table (1): Shows that, more than half of the studied premature infants (53.1%) were girls in the study group, and slightly less than two-third (65.6%) were males in the control group with a mean gestational age of 34.0±1.7 weeks in the study group and 34.2±1.6 weeks in the control group. As well, the same table shows that slightly less than two-third (65.6%) in the study group and less than three quarter (71.9%) in the control group were diagnosed with hyperbilirubinemia, and more than one-fifth (21.9%) and less than one-fifth (18.8%) in the study and control groups respectively were diagnosed with respiratory distress syndrome (RDS) followed by minorities in both groups (12.5 & 9.4) respectively were sepsis. Mean birth weight was 2264.0±449.7gm in the study group and 2272 ±447.9 gm in the control group. Less than three quarter (71.9%) in the study group and more than three quarter (78.1%) in the control group received their feeding via oral method. No statistically significant differences were detected between the study and control groups for all characteristic items P>0.05.

Table (2): This table reveals that around two third of studied mothers (68.8% & 66.6%) in the study and control groups respectively were in the age group between 20-<30 years. In addition, slightly less than two-third of mothers (65.6%) in the study group and more than two-third (68.8%) in the control group were secondary educational level. As regards mothers’ occupation, more than three-fifths and slightly less than two-third of the mothers (62.5% & 65.6%) in the study and control groups respectively were housewives. In relation to mothers’ residency, less than three-fifth (56.3%) in the study group residence rural areas, while more than half (53.1%) in the control group were urban residency. There were no statistically significant differences between the two groups of mothers P>0.05.

Table (3): Clarifies that there was no statistically significant difference between both groups before intervention (X²= 1.032 at P=0.960) as only 6.3% and 3.1% in study and control groups respectively had deep sleep, which improved after SCB intervention to slightly less than two-third (65.6%) of premature infants in the study group had deep sleep compared with less than one-tenth (9.4%) in the control group. There was a highly statistically significant difference between both groups at post-intervention (X²= 29.067 at P<0.001).

Table (4): Reveals that pre-intervention 87.5% in the study and 84.4% in the control
group were abnormal RR. After intervention most (93.8%) in the study group changed to the normal range compared to more than one-third (34.4%) in the control group. There was a highly statistically significant difference between both groups (X²= 10.092 at P=0.0015).

As well, table (4) shows that the most (90.6%) of premature infants in both groups were abnormal HR and body temperature before intervention and there were no statistically significant differences between both groups. However, after intervention the majority of premature infants (87.5%) changed to normal HR and body temperature in the study group compared to less-one third (28.1%) in the control group and the difference was highly statistically significant (X²= 23.127 at P<0.001).

As regards SpO₂ level the same table (4) indicates that three-quarter (75.0%) in the study group and more than two-third (68.8%) in the control group were abnormal range before the intervention, which changed to more than two-third (68.8%) in the study and slightly more than two-fifth (40.6%) in the control group were normal range after intervention and the difference was statistically significant (X²= 5.107 at P=0.024).

**Figure (1):** Illustrates that, the majority (81.3%) of the mothers in the study group and three-quarter (75%) in the control group had poor knowledge about the SCB before the intervention, while after the intervention, less than three-quarter (71%) of the mothers in the study group had good knowledge about the SCB compared with the mothers in the control group who still had no good knowledge. The differences between the two groups after the intervention was highly statistically significant (X²= 41.682 at P<0.001).

**Figure (2):** Clarifies that, the majority (81.3%) of studied mothers in the study group and the majority in the control group (87.5%) were lower self-efficacy. However, after intervention it was observed that the majority (84.4%) in the study group changed to higher self-efficacy compared with most (90.6%) of mothers in the control group who still were lower self-efficacy. The difference was highly statistically significant between both groups after intervention (X²= 36.141 at P<0.001).

**Table (5):** Shows that there were statistically significant positive correlations between mothers’ total knowledge score and their self-efficacy scores at pre and post-intervention in both groups.

### Table (1): Characteristics Data Distribution of the Premature Infants in Both Study and Control Groups (n=64).

<table>
<thead>
<tr>
<th>Variables</th>
<th>Study group (n=32)</th>
<th>Control group (n=32)</th>
<th>Chi-square test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No</td>
<td>%</td>
<td>No</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
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<tr>
<td>Boys</td>
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<td>Girls</td>
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<td>1500 – &lt; 2500</td>
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</tr>
<tr>
<td>≥ 2500</td>
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<tr>
<td>Mean ±SD</td>
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<td>31- &lt; 34</td>
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<td>Orogastric feeding tube</td>
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P > 0.05 Statistically insignificant
Table (2): Characteristics Data Distribution of the Mothers in Both Study and Control Groups (n=64).

<table>
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<tr>
<th>Variables</th>
<th>Study group (n=32)</th>
<th>Control group (n=32)</th>
<th>Chi-square test</th>
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<td>22</td>
<td>68.8</td>
<td>21</td>
</tr>
<tr>
<td>30 - &lt;40</td>
<td>4</td>
<td>12.5</td>
<td>3</td>
</tr>
<tr>
<td>Mean ±SD</td>
<td>25.0 ±4.9</td>
<td></td>
<td>24.5 ±4.9</td>
</tr>
<tr>
<td>Educational level</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary</td>
<td>1</td>
<td>3.1</td>
<td>0</td>
</tr>
<tr>
<td>Preparatory</td>
<td>3</td>
<td>9.4</td>
<td>5</td>
</tr>
<tr>
<td>Secondary</td>
<td>21</td>
<td>65.6</td>
<td>22</td>
</tr>
<tr>
<td>Higher education</td>
<td>7</td>
<td>21.9</td>
<td>5</td>
</tr>
<tr>
<td>Mother’s occupation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Housewife</td>
<td>20</td>
<td>62.5</td>
<td>21</td>
</tr>
<tr>
<td>Employee</td>
<td>12</td>
<td>37.5</td>
<td>11</td>
</tr>
<tr>
<td>Residence</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban</td>
<td>14</td>
<td>43.8</td>
<td>17</td>
</tr>
<tr>
<td>Rural</td>
<td>18</td>
<td>56.3</td>
<td>15</td>
</tr>
</tbody>
</table>

P> 0.05 Statistically insignificant

Table (3): Distribution of Premature Infants Sleep State in Both Study and Control Groups Pre and Post SCB Intervention (n=64).

<table>
<thead>
<tr>
<th>Sleep state</th>
<th>Pre-intervention</th>
<th>Post-intervention</th>
<th>Chi-square test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Study group (n=32)</td>
<td>Control group (n=32)</td>
<td>Study group (n=32)</td>
</tr>
<tr>
<td>State 1: Deep sleep</td>
<td>2</td>
<td>6.3</td>
<td>1</td>
</tr>
<tr>
<td>State 2: Light sleep</td>
<td>3</td>
<td>9.4</td>
<td>4</td>
</tr>
<tr>
<td>State 3: Drowsy</td>
<td>7</td>
<td>21.9</td>
<td>7</td>
</tr>
<tr>
<td>State 4: Quiet awake/alert</td>
<td>5</td>
<td>15.6</td>
<td>7</td>
</tr>
<tr>
<td>State 5: Actively awake and aroused</td>
<td>10</td>
<td>31.3</td>
<td>8</td>
</tr>
<tr>
<td>State 6: Highly aroused and agitated/crying</td>
<td>5</td>
<td>15.6</td>
<td>5</td>
</tr>
</tbody>
</table>

P> 0.05 Statistically insignificant  
P< 0.001 Highly statistically significant
Table 4: Distribution of Premature Infants Physiological Parameters in both study and Control Groups Pre and Post SCB Intervention (n=64).

<table>
<thead>
<tr>
<th>Physiological parameters</th>
<th>Pre-intervention</th>
<th>Post-intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Study group (n=32)</td>
<td>Control group (n=32)</td>
</tr>
<tr>
<td>No %</td>
<td>No %</td>
<td>No %</td>
</tr>
<tr>
<td>Respiratory rate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal range</td>
<td>4 12.5</td>
<td>5 15.6</td>
</tr>
<tr>
<td>Abnormal</td>
<td>28 87.5</td>
<td>27 84.4</td>
</tr>
<tr>
<td>Chi square test</td>
<td>$X^2=0.129$</td>
<td>$P=0.719$</td>
</tr>
<tr>
<td>Heart rate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal range</td>
<td>3 9.4</td>
<td>3 9.4</td>
</tr>
<tr>
<td>Abnormal</td>
<td>29 90.6</td>
<td>29 90.6</td>
</tr>
<tr>
<td>Chi square test</td>
<td>$X^2=0$</td>
<td>$P=1.000$</td>
</tr>
<tr>
<td>Body temperature</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal range</td>
<td>3 9.4</td>
<td>3 9.4</td>
</tr>
<tr>
<td>Abnormal</td>
<td>29 90.6</td>
<td>29 90.6</td>
</tr>
<tr>
<td>Chi square test</td>
<td>$X^2=0$</td>
<td>$P=1.000$</td>
</tr>
<tr>
<td>Oxygen saturation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal range</td>
<td>8 25.0</td>
<td>10 31.3</td>
</tr>
<tr>
<td>Abnormal</td>
<td>24 75.0</td>
<td>22 68.8</td>
</tr>
<tr>
<td>Chi-square test</td>
<td>$X^2=0.309$</td>
<td>$P=0.578$</td>
</tr>
</tbody>
</table>

P> 0.05 Insignificant P< 0.001 Highly statistically significant

Figure 1. Percentage of Total Mothers’ Knowledge Level about SCB in both Groups Pre and Post Intervention (n=64).
Correlation between mothers’ Total Knowledge and the Total Perceptions of their Self-Efficacy Scores Pre and Post-intervention.

<table>
<thead>
<tr>
<th></th>
<th>Study group</th>
<th>Control group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correlation pre-intervention</td>
<td>0.369</td>
<td>0.371</td>
</tr>
<tr>
<td><em>p</em></td>
<td>0.038*</td>
<td>0.039*</td>
</tr>
<tr>
<td>Correlation post-intervention</td>
<td>0.411</td>
<td>0.367</td>
</tr>
<tr>
<td><em>p</em></td>
<td>0.019*</td>
<td>0.039*</td>
</tr>
</tbody>
</table>

*P* < 0.05 Statistically significant

**Discussion**

Premature infants need to receive intensive care in NICU to survive. Repeated, painful and stressful stimuli can trouble premature infants’ sleep and change their physiological parameters. For this reason, planning care for premature infants is vital for their survival during and after their hospitalization (Lan et al., 2018).

There is a need to implement SCB like positioning, gentle touch, non-nutritive sucking, oral feeding, facilitated tucking, modulating infant states, and KC that provides more appropriate premature infant’s sleep state and stable physiological parameters. Therefore, the aim of this study was to evaluate the effect of implementation of SCB on sleep variables and physiological parameters of premature infants and their mothers’ self-efficacy.

Regarding premature infant characteristics, the present study finding showed that, there were no statistically significant differences between both groups of the study regarding to gender as more than half in both groups were girls. Around two-third of premature infants belong to the gestational age between 34 ≤ 37 weeks. Also, more than half were birth weight between 1500 – < 2500 gm. As well, no statistically significant difference was detected between the study and control groups regarding to method of feeding.

This study results are nearly in the same line with those of Sumathy (2020) whose study entitled “Effectiveness of nesting technique on posture and physiological parameters” among preterm and low birth weight infants, in India, reported that, the most (92.5%) had their weight between 1.5 and 2.0 kg. As well, Asghari et al., (2021) whose study on “The effects of telenursing on stress in mothers with premature infants”, in Iran, revealed that, birth weight of the majority of preterm infant (86.6% & 88.4%) in both groups were more than 1500 gm and there was no statistically significant difference between both groups.

1926
However, this study result disagrees with that of Das et al., (2020) who studied the “Effect of nesting on selected physiological parameters among preterm babies”, in India, found that more than half of the premature infants in the experimental group (59.4%) and the control group (52.8%) belong to the gestational age between 31-34 weeks compared with the current study highest percentage 34 ≤ 37 weeks. Most of the premature infant in the experimental group (60%) and the control group (63.3%) were male. Less than three-quarter (72.6%) of premature infants in the experimental group and less than half (49.5%) of premature infants in the control group have a birth weight between 1001gm-1500gm. This may be related to different studied sample, area, and environmental characteristics.

A relatively high percentage representing around two-thirds of premature infant in the study and control groups were diagnosed with hyperbilirubinemia, followed by respiratory distress syndrome and minorities sepsis, these current study results were supported by those of Huff et al., (2019) study entitled “Late preterm infants: Morbidities, mortality, and management recommendations”, in the United States, which stated that, the main reasons for hospital readmission in late-preterm infants include jaundice, breastfeeding difficulties, and infection. This may be due to immaturity of the body system of the premature infants which make them liable to many health problems like increased jaundice, respiratory distress, infection and feeding difficulties which increase the incidence of NICUs admissions.

As regards the studied mothers’ characteristics, the findings of the present study revealed that, more than two-third of studied mothers in the study group and two-third in the control group were in the age group range from 20-<30 years. In addition, slightly less than two-third of mothers in the study group and more than two-third in the control group were secondary educational level. Moreover, more than three-fifth and less than two-third of the mothers in the study and control groups respectively were housewives. There was no statistically significant difference between both groups.

As well, the current study reported that, less than three-fifth in the study group reside rural area and more than half in the control group reside urban areas. There were no statistically significant differences between the two groups. These findings of the current study were nearly similar to those of the study carried out by Sumathy (2020) who found that, more than half of the mothers (55%) were in the age group between 25 years and 30 years.

Concerning mothers’ educational level and occupation, the present study findings were supported by those of Jang and Ju (2020) who studied the “Effects of an infant care education program for mothers of late-preterm infants on parenting confidence, breastfeeding rates, and infants’ growth and readmission rates”, in Busan, Korea, who mentioned that, there was no significant difference between both groups, as more than three-quarter (76.9% & 85.2 %) of preterm mothers in the experimental and control groups respectively were college and beyond, slightly less than two-third (65.4%) in the experimental group and two-third (66.7%) in the control groups were having no job. Furthermore, these results were inconsistent with those of Gomes et al., (2021) whose study entitled “Mothers’ knowledge of premature newborn care and application of kangaroo mother care at home”, carried out in Northern Brazil, revealed that, two-fifth (40%) of the mothers’ age ranged from 19 to 22 years. As for education level, the majority of mothers (80%) had completed high school and 20% had incomplete high school. This may be related to different areas and environmental characteristics of studied samples.

Sleep is a very critical human physiological need and is important for maintaining the homeostasis of the organism as clarified by (Stokes et al., 2018). On assessing the sleep variable of premature infants in both the study and the control groups, the current study findings displayed that, before intervention only less than a tenth percent of premature infants in both groups were noticed in a deep sleep state, and there no statistically significant difference between both groups before intervention.
This result was supported by those of Correia and Lourengo (2020) whose study entitled “Sleep promotion in neonatal intensive care units: Scoping review”, in Portugal highlighted that, the neonatal intensive care unit’s environment presents as disturbing and harmful for the neonatal sleep. This may be due to that the sleep stages of a premature infant are less well organized than in the full-term infant. Overall, premature infants’ sleep is often identified by lack of sleep cycling, shortened sleep periods, undifferentiated sleep states, and short episodes of quiet sleep compared with full-term infants. In addition, excessive NICU noise, high lighting, and frequent invasive procedures in the NICU interfere with quiet and deep sleep of premature infants.

However, after intervention, there was improvement in deep sleep state of premature infants in the study group compared with the control group. There was a high statistically significant difference between both groups at post-intervention. This result is consistent with that of Huang et al., (2021) who studied the “Effect of non-pharmacological interventions on sleep, in preterm infants, in the neonatal intensive care unit: A protocol for systematic review and network meta-analysis” in China stated that, non-pharmacological interventions have been well highlighted in recent years, which have been used to improve sleep in premature infants in the NICU. This may be due to the effects of a SCB intervention, which includes usual NICU care, integrating modulation of premature infant sleep, providing sucking, positioning, facilitated tucking and oral surcore, and KC for 45 minutes, help in relief pain and facilitate sleep of premature infants which have been shown to help stabilize premature infants and preserve sleep. In addition to modifying the NICU environment to reduce noise and light levels. All of these measures promote comfort, better and deep sleep of premature infants.

Premature infants may spend longer duration in the NICU and are exposed to an environment very different from that in utero. This can lead to short-term sequelae, like changes in HR, RR, blood pressure, and SpO2 levels (Sumathy, 2020).

The result of the present study clarified that, there was no statistically significant differences between both groups before SCB intervention, while after intervention the improvement in normal physiological parameters was observed as a significant increase in the number of premature infants changed to normal range and stable HR, RR, body temperature and normal range of arterial blood SpO2 level of premature infants in the study group compared with the control group. There were highly statistically significant differences between both groups at post-intervention.

These current study results are in accordance with those of Parsa et al., (2018), who conducted a study about “The effect of kangaroo mother care (KMC) on physiological parameters of premature infants in Hamadan City, Iran”, they found that, preterm neonates in KMC group display stable physiological parameters in terms of HR, RR, and SpO2 level compared to those in the control group with a statistically significant difference. Another study carried out by Ranjan and Malik (2019) entitled “Effect of kangaroo mother care on physiological parameters in low birth weight neonates“, in India, they reported that KMC had various physiological effects in term of body temperature, HR, RR, and SpO2. Moreover, Changrani and Menahem (2021) whose study on “Physiological and psychological outcomes of kangaroo mother care of preterm infants: An overview”, in Australia, found that, there is a significant difference in the physiological parameters of preterm neonates after the fifth day than the third day of kangaroo mother care.

This may be related to that SCB is effective in maintaining stable physiological parameters of premature infants, as stable physiological parameters of premature infants can be achieved through correct positioning and use of KC. As well, the SCB measures tend to
improve circulatory physiological parameters and facilitate pain relief which leads to maintaining stable physiological parameters of premature infants.

So, the research hypothesis (H2) which stated that, premature infants who receive SCB will have more stable physiological parameters than those who do not receive it and that there will be a statistically significant difference between the study and control groups was accepted.

Parents of premature infants experience high stress levels, feelings of helplessness, and often lack adequate knowledge on how to interact with their premature infant, during hospitalization in the neonatal intensive care unit (Franck et al., 2019). Mothers of premature infants admitted to the NICU need information to engage in the treatment process (Zakaria et al., 2020). In accordance to mothers’ knowledge about SCB, the present study result demonstrated that, the majority of the mothers in the study group and three quarter in the control group had poor knowledge about the SCB and there was no statistically significant difference between the two groups before the intervention. This result is congruent with that of Aldirawi et al., (2019) whose study entitled ‘Mothers’ knowledge of health caring for premature infants after discharge from neonatal intensive care units in the Gaza Strip, Palestine”, they concluded that mothers’ knowledge of premature infant’s care was not at the optimal level, which might put the neonates at risk. This may be attributed to mothers who did not receive any information about SCB intervention.

However, after SCB intervention, less than three-quarter of the mothers in the study group had good knowledge compared with the mothers in the control group who still had no good knowledge. The differences between the two groups after intervention were highly statistically significant. This finding is consistent with a similar study carried out by Lee et al., (2019) who studied “Feasibility of a guided participation discharge program for very preterm infants in a neonatal intensive care unit: A randomized controlled trial, in Chinese”, they found that, education programs for parents of preterm infants during the hospitalization period contributed to higher levels of parental knowledge of parenting infants. Similarly, a study conducted by El-Hadary et al., (2020) entitled “Impact of discharge educational program on preterm infants’ mothers’ knowledge and practice”, in Egypt, reported that, after implementation of the discharge educational program mothers in the study group reported a higher satisfaction level of knowledge and practice about how to care for their preterm infants than those in the control group.

This was explained by the point view of the researcher as the study group who received knowledge about SCB in caring for their premature infants they had more chances to receive information, so, they got higher level of knowledge.

Self-confidence is essential for mothers to successfully perform their roles. Concerning mothers’ self-efficacy, the present study findings reflected that, the majority of the studied mothers in the study group and a higher majority in the control group were lower self-efficacy before SCB intervention and there was no statistically significant differences between the two groups. Interestingly, after intervention it was observed that, a majority in the study group changed to higher self-efficacy compared with most of mothers in the control group who still had lower self-efficacy. The difference was highly statistically significant between both groups after intervention.

This study finding is consistent with a similar study carried by Premji, et al., (2018) who clarified that mothers felt more confident when they were provided with an opportunity to learn about the basics of infant care such as breastfeeding, changing diapers, and measuring body temperature. In addition, Gomes et al., (2021) who in a recent study, highlighted that mother’s awareness of how to properly deal with problems and how to provide essential care during this period can have a major impact on increasing confidence in caring for her newborn and eliminating false beliefs and traditions about the subject.
These findings could be interpreted by the researcher in the light of the fact that, mothers who participated in the SCB, might feel supported so that, they have more confidence, also she believes that SCB gave the mothers increased opportunities to practice what they had learned, and providing appropriate feedback to their responses after a face-to-face session using the booklet and PowerPoint slides improved their information toward their infants’ care, which contributed to improvements in their mothers confidence. As well, this might be attributed to the increase of mothers’ knowledge that helps understand how to provide care for the premature infant which leads to increase of self-efficacy.

The above mentioned results proved the research hypothesis (H3) which revealed that, there will be a significant improvement in knowledge scores of mothers and mean maternal self-efficacy scores after SCB intervention in the study group than those in the control group.

Concerning the correlation between the mothers’ total knowledge and the total perceptions of their self-efficacy scores pre and post-intervention, the present study results displayed that there was a statistically significant positive correlation between mothers’ knowledge and their self-efficacy scores at pre and post-interventions in both groups. This study finding is supported by that of Jang and Ju (2020). Accordingly, it could be concluded that, the program developed in this study, which provided mothers with information on preterm infants and regular education and counseling was useful for improving parenting confidence and the quality of preterm-infant nursing care will be enhanced by developing new nursing interventions, they also, said that, providing mothers with information on premature infants’ care and regular education and counseling were useful for improving parenting confidence.

Hence, the research hypothesis (H4) which stated that, there will be a significant correlation between mothers’ knowledge and self-efficacy was accepted.

Finally, by evaluating the effect of implementation of SCB on premature infants and their mothers, improvements of sleep variables, physiological parameters, mothers’ knowledge, and self-efficacy scores were observed after implementation of SCB intervention.

**Conclusion**

The present study concluded that, implementation of SCB improved of sleep variables and physiological parameters of premature infants, as well, it increased mothers’ level of knowledge and self-efficacy scores in the study group than the control group. As well, there were statistically significant differences between two groups. These results supported the proposed study hypotheses.

**Recommendations**

Based on the findings of the study the following recommendations are suggested:

- Future studies should be conducted with a larger sample size, different characteristics, and from multiple medical centers in order to increase the generalizability of the study findings.
- There is a need to implement strategies of supportive care like positioning, gentle touch, non-nutritive sucking, hunger cues, oral sucrose, and feeding cues, facilitated tucking, modulating infant states and KC, in NICU, to provide more appropriate infant state of alertness, posture, comfort, and keep stable physiological parameters.
- How to protect and respect the sleep of preterm infants in the NICU, and how to properly assess and implement beneficial care measures have become important issues to keep into consideration in the conducted research for enhancing premature infant development.
- Develop an infant care education program for mothers about care of premature infants to improve their knowledge and self-efficacy.
- NICU clinicians should incorporate the components of the SCB (positioning, gentle touch, non-nutritive sucking, hunger cues, oral feeding and feeding cues, facilitated tucking,
modulating infant states and KC) into clinical practice, which could protect sleep integrity and improve sleep quality for preterm infants.

- NICU clinicians can create a healing environment to protect sleep and nurture preterm infants.

References:


1931


