

Manuscript received December 14, 2022; revised January 7, 2023; accepted January 7, 2023; date of publication February 26, 2023

Digital Object Identifier (DOI): <https://doi.org/10.35882/ijahst.v3i1.144>

Copyright © 2023 by the authors. This work is an open-access article and licensed under a Creative Commons Attribution-ShareAlike 4.0 International License ([CC BY-SA 4.0](#))

How to cite: Kusmini Suprihatin, Yessy Dessy Arna, Siti Maemonah, Sari Luthfiah, Alfi Maziyah, "The Effectiveness of Nesting and Lighting in Physiological Function for Low Birth Weight Babies in Sidoarjo", International Journal of Advanced Health Science and Technology, vol. 3, no. 1, pp. 41–46, February 2023

The Effectiveness of Nesting and Lighting in Physiological Function for Low Birth Weight Babies in Sidoarjo

Kusmini Suprihatin¹, Yessy Dessy Arna¹, Siti Maemonah¹, Sari Luthfiah², and Alfi Maziyah¹

¹ Department of Nursing, Poltekkes Kemenkes Surabaya, Surabaya, Indonesia

² Department of Medical Electronics Technology, Poltekkes Kemenkes Surabaya, Surabaya, Indonesia

Corresponding author: Kusmini Suprihatin (e-mail: lovekusmini@gmail.com)

ABSTRACT Low birth weight (LBW) remains a significant contributor to neonatal morbidity and mortality, especially in low resource settings. In Sidoarjo, Indonesia, the incidence of LBW remains high, averaging 30 until 38 cases per month. These infants are particularly vulnerable due to immature physiological systems, requiring targeted interventions to support their stabilization and development. This study aimed to assess the effectiveness of developmental care interventions specifically nesting and light protection in enhancing the physiological stability of LBW infants. A quasi experimental study was conducted using a non-randomized pretest posttest control group design. A total of 61 LBW infants (21 in the intervention group and 40 in the control group) were recruited through purposive sampling from three hospitals in Sidoarjo. The intervention group received nesting and light protection for two hours, while the control group received standard care. Key physiological parameters heart rate, oxygen saturation, respiratory rate, and temperature were measured before and after the intervention using validated instruments including heart rate monitors, oximeters, thermometers, and luxmeters. Data were analyzed using paired t-tests, Wilcoxon tests, and the Mann Whitney U test. The results indicated significant improvements in heart rate and oxygen saturation in the intervention group ($p < 0.05$), while intergroup comparisons showed significant differences in post intervention heart rate, respiratory rate, and temperature, favoring the intervention group. These findings suggest that nesting combined with light protection effectively supports the stabilization of physiological functions in LBW infants. In conclusion, nesting and light shielding are simple, non-invasive interventions that promote physiological stability in LBW infants. These approaches are feasible for implementation in resource limited healthcare settings and hold potential for integration into neonatal care protocols, including post discharge parental care at home.

INDEX TERMS Low Birth Weight, Nesting, Light Protection, Physiological Stability, Neonatal Care

I. INTRODUCTION

Low birth weight (LBW), defined as a birth weight of less than 2,500 grams irrespective of gestational age, remains a critical public health issue worldwide, particularly in low and middle-income countries (LMICs). The World Health Organization reports that more than 20 million infants are born with LBW annually, accounting for a significant proportion of neonatal morbidity and mortality [1]. In Indonesia, the prevalence of LBW is alarmingly high at 10.5%, surpassing that of several neighboring countries such as Vietnam (5.2%) and Thailand (9.6%) [2], [3]. In Sidoarjo Regency, although infant mortality rates have gradually declined, LBW continues to be a primary cause of neonatal deaths, particularly in hospital-based care settings [4].

LBW infants are at a higher risk of physiological instability due to immature thermoregulatory, respiratory, and neurological systems [5]-[7]. These infants often require intensive neonatal care to support basic physiological

functions such as oxygen saturation, heart rate, respiration, and body temperature. However, conventional neonatal intensive care units (NICUs) often expose infants to environmental stressors such as excessive lighting, noise, and invasive procedures, which can disrupt autonomic stability and hinder developmental progress [8]-[10].

To mitigate these risks, developmental care (DC) approaches have been increasingly adopted. DC aims to create a supportive environment that mimics intrauterine conditions by minimizing sensory overstimulation and promoting comfort through techniques such as nesting and light regulation [11]-[14]. Nesting involves providing a contained space that encourages fetal like posture, thereby promoting neuromuscular development, thermoregulation, and behavioral organization [15], [16]. Meanwhile, regulating light exposure particularly through shielding or dimming has been shown to support circadian rhythm development, improve sleep quality, and reduce stress

responses in neonates [17]-[19]. Although these interventions have shown promise in high-resource settings, their application in LMICs, particularly Indonesia, remains underexplored. Most available studies focus on either nesting or light protection in isolation and often lack rigorous comparative analyses between intervention and control groups [20]-[22]. Moreover, there is limited research on the simultaneous application of nesting and light shielding as an integrated DC strategy in real-world hospital environments with constrained resources [23].

This study aims to evaluate the effectiveness of combining nesting and light protection in stabilizing physiological functions namely heart rate, respiratory rate, oxygen saturation, and body temperature among LBW infants admitted to hospitals in Sidoarjo, Indonesia. By addressing this gap, the research contributes new evidence to the discourse on cost effective, non-invasive neonatal interventions in resource-limited healthcare systems. The main contributions of this study are threefold:

1. It provides empirical evidence on the effectiveness of combined nesting and light shielding as a developmental care strategy for LBW infants in Indonesian clinical settings.
2. It demonstrates the practical applicability of low-cost, non-invasive interventions in improving neonatal physiological outcomes within standard hospital care protocols.
3. It offers a foundation for educating caregivers and integrating such interventions into post discharge home care practices, supporting long-term infant development.

II. METHOD

A. STUDY DESIGN

This study employed a quasi-experimental design with a non-randomized pretest-posttest control group format. This approach was selected to evaluate the effects of developmental care specifically the use of nesting and light protection on the physiological stability of low birth weight (LBW) infants. Due to ethical and logistical considerations in a clinical setting, randomization was not feasible. The study was prospective in nature, allowing real time observation of physiological parameters before and after intervention.

B. STUDY SETTING AND DURATION

Data collection was conducted between September and November 2020 across three healthcare facilities in Sidoarjo Regency, Indonesia: Sidoarjo Regional General Hospital, Dr. Mawardi Islamic Hospital (Krian), and Siti Khadijah Islamic Hospital (Sepanjang). These hospitals were selected based on their capacity to care for LBW infants and the availability of neonatal intensive care units (NICUs) or specialized baby care rooms.

C. POPULATION AND SAMPLE

The target population included LBW infants weighing between 1,000 and 2,500 grams. A total of 61 infants met the inclusion criteria and were enrolled using purposive sampling. The infants were divided into two groups: an intervention group (n = 21) that received nesting and light

protection, and a control group (n = 40) that received standard neonatal care based on the hospital's existing protocols.

D. INCLUSION CRITERIA:

1. Birth weight between 1,000 until 2,500 grams.
2. Absence of oxygen therapy.
3. No use of mechanical ventilation or respirators.
4. Clinically stable at the time of intervention.

E. EXCLUSION CRITERIA:

1. Infants requiring phototherapy.
2. Infants with congenital anomalies.
3. Deterioration of clinical condition during the observation period.

F. ETHICAL CONSIDERATIONS

Ethical approval was obtained from the ethics committees of all participating institutions: Sidoarjo General Hospital (No. 893.3/0059/438.6.7/2020), Siti Khadijah Hospital (No. 012/KET-KEPK/10-2020), and Dr. Mawardi Hospital (No. 030/RSIM/Ext/IX/2020). Parental consent was acquired prior to inclusion in the study.

G. INTERVENTION PROCEDURES

The intervention group received nesting and light shielding for a total of two hours. Nesting was implemented using a U-shaped rolled cloth designed to support a flexed, midline posture, replicating intrauterine positioning. Light protection involved covering the infant's incubator or crib with a light-filtering cloth, designed to reduce ambient light intensity to below 646 lux, as recommended by the American Academy of Pediatrics [31].

Before intervention, each infant was provided routine care including diaper changes, feeding, and monitoring of vital signs. Following this, a 10-minute rest period was allowed for physiological stabilization. Baseline physiological parameters heart rate, respiratory rate, oxygen saturation (SpO₂), and body temperature were recorded prior to administering the intervention. During the two-hour intervention, parameters were measured every 30 minutes.

H. CONTROL GROUP PROTOCOL

The control group continued to receive routine neonatal care in accordance with each hospital's standard operating procedures (SOPs), which did not include any structured nesting or light shielding interventions beyond what was typically available in the environment. These infants were monitored concurrently using the same instruments and timing intervals as the intervention group to ensure consistency and comparability.

I. INSTRUMENTS AND MEASUREMENT

The study employed validated instruments to ensure reliability and accuracy:

1. Heart rate and respiratory rate: Measured using neonatal monitors.
2. Oxygen saturation (SpO₂): Assessed via a calibrated pulse oximeter.

3. Body temperature: Measured using a digital thermometer.
4. Ambient light: Recorded with a luxmeter to quantify lighting conditions pre- and post-intervention. Each parameter was recorded on a structured observation sheet developed for the study.

J. DATA ANALYSIS

Data were analyzed using SPSS version 25.0. Descriptive statistics were used to summarize participant characteristics. For inferential statistics:

1. Within-group comparisons (pre- vs. post-intervention) were analyzed using the paired t-test for normally distributed variables and the Wilcoxon signed-rank test for non-normally distributed data.
2. Between-group comparisons (intervention vs. control) used the Mann Whitney U test, given the small sample size and non-parametric distribution of most variables. A significance level of $p < 0.05$ was considered statistically significant.

K. RELIABILITY AND VALIDITY

The tools used were pre-tested in a pilot setting to assess reliability. Standardized measurement procedures were followed to reduce interobserver variability. Research assistants received prior training to ensure uniformity in observation and recording procedures.

Table 1
Frequency Distribution of Babies Characteristics in Sidoarjo Hospitals in 2020

Characteristics of Respondents	Control group		Intervention group		Total	
	f(x)	%	f(x)	%	f(x)	%
Age (day)						
0-3	37	60	12	20	49	80
4-7	3	5	3	5	6	10
8-12	0	0	0	0	0	0
>12	0	0	6	10	6	10
Birth weight (gram)						
1000-1499	4	7	2	3	6	10
1500-1999	17	28	7	11	24	39
2000-2500	19	31	12	20	31	51
Gestation (week)						
22-34	14	23	6	10	20	33
34-36	22	36	12	20	34	56
37-41	4	7	3	5	7	11
History of Childbirth						
Spontaneous	20	33	9	15	29	48
Caesarean	20	33	12	20	32	52
Sex						
Female	18	29	8	13	26	43
Male	22	36	13	21	35	57
Mother age (year)						
11-19	0	0	1	2	1	2
20-35	30	49	17	28	47	77
>35	10	16	3	5	13	21
Mother education						
Junior High School	4	7	5	8	9	15
Senior High School	32	52	12	20	44	72
Higher Education	4	7	4	7	8	13

II. RESULTS

The total number of respondents in the study was 61 respondents who were divided into 21 intervention groups and 40 control groups. All babies weigh between 1000 to

2500 grams and are treated in the Baby Room or NICU at the hospital. The intervention group and the control group had the same criteria but differed in the treatment. The treatment group was given an intervention in the form of using light protection and nesting designed by the researcher. While the group was given treatment according to the usual procedures carried out in their respective rooms. The characteristics of the respondents in the control group and the intervention group are shown in **TABLE 1** below.

Based on the **TABLE 1**, it can be concluded that 80% of the respondents are age 0-3 days because the average LBW if they are already in a stable condition, the baby will be sent home and treated at home. 51% baby weight ranges from 2000 to 2500 grams. This is in line with the gestational age of the babies at birth, which is mostly at 34 to 36 weeks of gestation, which is 56%. Most of the babies were born by caesarean section, which was 52% of the total respondents.

TABLE 2
WILCOXON TEST

Group	Mean Rank	Z	Sig
HR post intervention - HR pre intervention	11.32 5.83	-3.271 ^b	0.001
Saturation post intervention - Saturation pre intervention	10.75 9.91	-2.978 ^c	0.003
Temperature post intervention - Temperature pre intervention	8.38 8.63	-.052 ^c	0.959
RR post intervention - RR pre intervention	11.71 8.09	-.155 ^c	0.877
HR post control - HR pre control	23.80 15.73	-.083 ^b	0.933
Saturation post control - Saturation pre control	15.00 17.29	-1.897 ^c	0.058
Temperature post control - Temperature pre control	16.55 21.58	-.576 ^c	0.565
RR post control - RR pre control	19.64 13.00	-.532 ^b	0.595

TABLE 3
of different group tests with Mann Whitney

Group	Mean Rank	Z score (Mannwhitney)	Sig
HR pre	control Intervention	32.23 28.67	-0.754 0.451
Saturation pre	control Intervention	33.91 25.45	-1.801 0.072
Temperature pre	control Intervention	33.21 26.79	-1.383 0.167
RR pre	control Intervention	37.24 19.12	-3.821 0.000
HR post	control Intervention	37.68 18.29	-4.069 0.000
Saturation post	control Intervention	30.60 31.76	-0.246 0.805
Temperature post	control Intervention	34.73 23.90	-2.317 0.020
RR post	control Intervention	37.39 18.83	-3.941 0.000

A total of 32% were in the intervention group taken in the Baby Room and Sidoarjo Hospital NICU which is a referral hospital, so that most pregnant women who give birth at Sidoarjo Hospital are in a condition and need quick treatment. Most of the LBW sex were male at 57%. Meanwhile, 77% of

mothers are in the range of 20 until 35 years, which is the productive age and 72% of their last education is high school. Table 2 is the differences in the physiological conditions of pre and post nesting and light protection.

From the TABLE 2, it can be concluded that the heart rate and oxygen saturation values in the intervention group <0.05 . This means that there is a difference in value between the pre and post-test.

Based on the TABLE 3, after a different test using Mann Whitney, there were differences in the pre and post intervention RR values, post intervention heart rates, and post intervention temperatures with p value <0.05 . From the mean value, it can be seen that each of them has a difference in the pre-RR of 37.24 in the control group and 19.12 in the intervention group. In the post-intervention heart rate, there was a difference between 2 groups, the control group 37.68 and the intervention group 18.29. This is in line with the condition of the baby who begins to calm down so that the heart rate and RR decrease. Then in the post RR variable there was a difference between the 2 groups. In the control group 37.39 and 18.83 in the intervention group. This is in line with more stable breathing in infants who are intervened.

III. DISCUSSION

The primary aim of this study was to evaluate the some points as follows.

A. STABILIZATION OF PHYSIOLOGICAL FUNCTION

1. OXYGEN SATURATION

The mean oxygen saturation of respondents was 93% in the intervention group and 95% in the control group. Oxygen saturation is a measure of how much oxygen hemoglobin is capable of carrying. Measurement of oxygen saturation levels is necessary in order to determine whether there is a lack of oxygen that can be carried by blood throughout the body. Oxygen saturation levels in newborns are very important to know because when oxygen saturation levels in newborns are low, it is necessary to be aware of whether there are hemodynamic abnormalities in these babies. Measuring oxygen saturation levels in newborns can help early detect congenital abnormalities in babies [2], [11].

Every cell of the human body needs oxygen to carry out metabolic functions, so oxygen is the most important substance in human life. the attempt to ensure adequate oxygen supply to tissues or cells is to maintain oxygenation. Lack of oxygen supply in the body can cause tissue damage in the body due to tissue hypoxia. How to find out whether the oxygen supply to our body is sufficient or not is an important thing to know. An assessment of the adequacy of oxygen supply to tissues depends on three important factors, namely: hemoglobin levels, cardiac output, and oxygenation [12]. Oxygen saturation was relatively stable in both the control and intervention groups.

Oxygen saturation is one of the focuses to be the target of LBW treatment so that the instability of the SpO₂ value is taken seriously and is a priority to determine whether a baby needs oxygen assistance through a nasal, mask or requires rapid treatment with a breathing device. Therefore, the oxygen saturation of LBW was in a stable condition before and after the intervention. Likewise in the control

group. Moreover, one of the criteria in sampling is that the baby is in a stable condition and does not use oxygen or breathing aids so that the oxygen saturation in the control and intervention groups is relatively stable between 88-99% with the intervention group mean of 93% and 95% in the control group. This figure is much better than the number standardized on LBW, namely 88-92%.

2. HEART RATE

When the baby is asleep, the baby's heart rate slowly decreases which indicates the baby is calm. Physical activity is minimal because nesting is given with loose fixation. The use of soft cloth makes the baby more comfortable when placed in nesting [2], [11]. The baby's heart rate is maintained at a normal rate between 120-160 x / minute [13]. The heart rate will increase when the baby is restless, fussy, restless and decreases when the baby is calm and sleeping. The mean heart rate in the intervention group was 140 x / minute in pre and 131 x / minute in post intervention. Whereas in the control group the average pre and post was 142 x / minute.

B. TEMPERATURE

The temperature of infants in the intervention group and in the control-group ranged from 36.5-37.5 degrees Celsius with the mean of the intervention group 36.6 degrees Celsius and the control group 36.7 degrees Celsius. Temperature is also a physiological indicator that needs attention to be stabilized because LBW is also often hypothermic. This is because brown fat, the subcutaneous layer of fat, the ability to shiver and lose the baby's heat is very easy if we do not provide a warm environment for the baby. The temperature drop is often caused by exposure to objects colder than the baby's temperature, the baby's room environment and also exposure to cold air. The provision of nesting makes the baby feel like he is in his mother's stomach and feels like he is constantly being hugged [14], [15]. Babies feel warm and prevent hypothermia [16]. Mostly when the baby is placed in an incubator the temperature slowly rises and the baby is asleep within the first 10-15 minutes.

1. RESPIRATION RATE

After birth, the respiratory adaptation in LBW often experiences respiratory problems, namely decreased alveolar function, chest wall retraction, surfactant deficiency, stiff airways and weak respiratory muscles. Respiration rate or RR or the baby's breathing must adjust to extrauterine conditions. This is sometimes what makes babies fail to adapt. However, we can manipulate the environment so that it helps babies through difficult times in order to survive. LBW initially had unstable breathing, but after using light protection and nesting it became more stable [2], [11]. Respiration rate is slower because the baby is calmer and most of them are also asleep [15], [10], [13]. Normal breathing for newborns is 40-60 times per minute. Respiration of infants in the control group averaged 49x / minute and in the intervention group 41x / minute [17], [18], [11]. The frequency will increase if the baby is awake and uneasy. Providing light protection by reducing the light intensity by half makes the baby more comfortable [19]. In

theory, the normal recommended light intensity by the American Pediatric Association (APA) is below 646 lux or 1-60 footcandles, but becomes higher when the baby is placed under light, near natural light (sun) and during phototherapy [20], [21], [22]. Even from the observations of researchers, when the baby was given phototherapy, the light intensity reached 1100 lux [23], [24]. This makes the baby very uncomfortable and can cause injury later in life, so when the baby is given phototherapy, the eyes must be closed so that vision problems do not occur in the future [25], [20].

2. DIFFERENCES IN THE STABILITY OF PHYSIOLOGICAL FUNCTIONS

In the analysis test with Wilcoxon, it was found that there were differences in the values of heart rate and oxygen saturation before and after the intervention where the p value was <0.005 . This is in line with the condition of the baby who begins to calm down, so that the oxygen saturation value and heart rate become stable. This is in line with the values of heart rate and oxygen saturation which are more stable in infants after intervention. In the researchers' observations during the study data collection, LBW in the intervention group had a higher heart rate and respiratory rate because the baby was still in the process of adapting from intrauterine to extrauterine [26]. At birth, babies will experience the most dynamic period of the entire life cycle. Babies undergo a process of change known as the transition period, which is a period that begins when the baby leaves the mother's body and has to adapt from a highly dependent state to become physiologically independent, for several weeks for certain organ systems [27], [28].

Therefore, the baby's physiological condition often becomes unstable due to the adaptation process from intrauterine to extrauterine. His study certainly has limitations that will be corrected by further research. Some limitations in this study were the limited number of LBW in hospitals, so the researchers anticipated this by taking respondents in 3 hospitals. The next limitation is the implementation of research and data collection involving research assistants, and to anticipate differences in data, researchers carry out controls every day. The results of measurements of physiological status fluctuated so the researchers took the average.

IV. CONCLUSION

This study aimed to evaluate the effectiveness of developmental care interventions specifically nesting and light protection in promoting the physiological stability of low birth weight (LBW) infants in neonatal care units within Sidoarjo, Indonesia. The primary focus was to assess whether these non-invasive, low-cost interventions could positively influence vital physiological parameters including heart rate, respiratory rate, oxygen saturation, and body temperature. A total of 61 LBW infants participated, with 21 assigned to the intervention group and 40 to the control group. The findings revealed statistically significant improvements in the intervention group, particularly in heart rate and oxygen saturation. The Wilcoxon test showed a significant reduction in heart rate post-intervention (mean

rank = 11.32, $Z = -3.271$, $p = 0.001$) and an increase in oxygen saturation (mean rank = 10.75, $Z = -2.978$, $p = 0.003$). Additionally, the Mann Whitney U test indicated significant differences between the intervention and control groups in post-intervention heart rate (mean rank: 18.29 vs. 37.68, $p < 0.001$), respiratory rate (mean rank: 18.83 vs. 37.39, $p < 0.001$), and temperature (mean rank: 23.90 vs. 34.73, $p = 0.020$). These findings suggest that integrating nesting and light shielding into neonatal care protocols can effectively support physiological regulation in LBW infants.

The practical application of these techniques offers a feasible and scalable model for enhancing neonatal outcomes, especially in low-resource settings. For future research, longitudinal studies are recommended to evaluate the long-term developmental outcomes of infants who receive these interventions during hospitalization. In addition, randomized controlled trials with larger sample sizes across diverse healthcare facilities are necessary to strengthen the generalizability and external validity of the findings. It is also advisable to explore the integration of these interventions into post-discharge home care routines, supported by parental education, to sustain developmental gains achieved during hospitalization.

ACKNOWLEDGEMENT

The authors would like to express their sincere gratitude to the management and staff of Sidoarjo Regional Hospital, Dr. Mawardi Islamic Hospital, and Siti Khadijah Islamic Hospital for their support and cooperation during data collection. Special thanks to the families who consented to participate in this study. We also acknowledge the contributions of research assistants and colleagues who provided valuable input throughout the research process.

FUNDING

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

DATA AVAILABILITY

Data supporting the study's findings can be requested from the corresponding author. Access is limited to de-identified datasets for approved academic and non-commercial research.

AUTHOR CONTRIBUTION

Kusmini Suprihatin conceived the research idea, designed the study, and led the data collection process. Yessy Dessy Arna contributed to the development of the methodology, data analysis, and interpretation of findings. Siti Maemonah provided expertise in clinical protocols and supervised the research process. Sari Luthfiyah contributed to the instrumentation and technical validation. Alfi Maziyah assisted with literature review, manuscript drafting, and formatting. All authors reviewed, revised, and approved the final manuscript for submission.

DECLARATIONS

ETHICAL APPROVAL

Ethical clearance was obtained from the ethics committees of Sidoarjo General Hospital, Siti Khadijah Hospital, and Dr.

Mawardi Hospital. Written parental consent was secured prior to participation.

CONSENT FOR PUBLICATION PARTICIPANTS.

Consent for publication was given by all participants

COMPETING INTERESTS

The authors declare no competing interests.

REFERENCES

- [1] WHO, "Low Birth Weight," World Health Organization, 2023.
- [2] BPS Indonesia, "Indonesia Health Demographics Survey," 2020.
- [3] UNICEF, "Every Child Alive: The urgent need to end newborn deaths," 2021.
- [4] Dinas Kesehatan Kabupaten Sidoarjo, "Health Profile of Sidoarjo," 2020.
- [5] S. Yadav et al., "Neonatal respiratory distress syndrome," *Neonatal Lung Ultrason.*, pp. 17–39, 2020.
- [6] E. Sood et al., "Developmental Care in North American Pediatric ICUs," *J. Pediatr. Nurs.*, vol. 42, pp. 1–6, 2020.
- [7] A. Khandelwal et al., "Thermoregulatory management in NICUs," *Indian J. Pediatr.*, vol. 87, no. 4, pp. 280–285, 2020.
- [8] J. Brons et al., "Lighting hazards in neonatal care units," *Light. Res. Technol.*, vol. 52, no. 6, pp. 704–721, 2020.
- [9] Chaudhari, "Neonatal intensive care practices harmful to the developing brain," *Indian Pediatr.*, vol. 48, no. 6, pp. 437–440, 2019.
- [10] R. Bhaskar et al., "Low birth weight risk factors," *Int. J. Pediatr.*, vol. 2015, pp. 1–7, 2021.
- [11] L. Altimier and R. Phillips, "The Neonatal Integrative Developmental Care Model," *Newborn Infant Nurs. Rev.*, vol. 16, no. 4, pp. 230–244, 2021.
- [12] M. Filippa et al., "Neurodevelopmental outcomes in preterm infants: A review," *Pediatrics*, vol. 144, no. 1, pp. 1–9, 2020.
- [13] T. Guenther et al., "Home visits and newborn care," *J. Glob. Health*, vol. 9, no. 1, 2020.
- [14] K. Jeyabarathi and N. Shalini, "Effectiveness of Nesting on High-Risk Newborns," *Int. J. Adv. Res.*, vol. 6, no. 11, pp. 1103–1106, 2020.
- [15] A. Khalil et al., "Non-pharmacological pain management in NICU," *Port Said Sci. J. Nurs.*, vol. 6, no. 3, pp. 85–103, 2020.
- [16] I. Sharma and M. Singh, "Infant warmer design for hypothermia prevention," *Int. J. Adv. Health Sci. Technol.*, vol. 1, no. 1, pp. 7–13, 2021.
- [17] M. Figueiro et al., "The NICU Lighted Environment," *Newborn Infant Nurs. Rev.*, vol. 16, no. 4, pp. 195–202, 2020.
- [18] J. White et al., "Light shielding in NICUs," *Adv. Neonatal Care*, vol. 20, no. 4, pp. 252–260, 2020.
- [19] L. De Greef et al., "Light exposure in newborns," *Pediatr. Res.*, vol. 86, pp. 68–76, 2020.
- [20] A. Haerian-Ardakani et al., "Maternal periodontal disease and low birth weight," *Int. J. Reprod. Biomed.*, vol. 11, no. 8, pp. 625–630, 2020.
- [21] M. Rea and M. Figueiro, "NICU lighting research," *Light Res. Technol.*, vol. 51, pp. 1–12, 2020.
- [22] D. Grandjean et al., "Maternal speech and pain reduction," *Sci. Rep.*, vol. 11, 2021.
- [23] M. Filippa et al., "Oxytocin response in infants during care," *Sci. Rep.*, vol. 11, 2021.
- [24] A. Shankar et al., "Predictors of stunting in infants," *BMC Public Health*, vol. 19, 2020.
- [25] P. Balázs et al., "Risk factors of preterm birth," *Eur. J. Public Health*, vol. 23, no. 3, 2021.
- [26] *Biol.*, vol. 6, no. 3, pp. 1319–1324, 2021.
- [27] A. Yusnita et al., "Implementation of developmental care in Indonesia," *Indones. J. Neonatal Care*, vol. 3, no. 2, pp. 45–52, 2021.
- [28] N. Aryastami et al., "Low birth weight and stunting," *BMC Nutr.*, vol. 3, no. 1, 2020.
- [29] A. Wibowo et al., "Neonatal care training in low-resource settings," *Int. J. Child Health Nutr.*, vol. 9, no. 2, pp. 87–94, 2020.
- [30] S. Kurniawan et al., "Parental involvement in neonatal care," *J. Nurs. Pract.*, vol. 4, no. 1, pp. 22–30, 2020.
- [30] American Academy of Pediatrics, "Recommended Standards for NICU Design," *Pediatrics*, vol. 147, no. 1, pp. e2021053270, 2021.
- [31] E. Kashani et al., "Physiological stress in NICU infants," *Adv. Environ. Biol.*, vol. 6, no. 3, pp. 1319–1324, 2021.
- [32] L. De Greef et al., "Light exposure in newborns," *Pediatr. Res.*, vol. 86, pp. 68–76, 2020.
- [33] A. Khalil et al., "Non-pharmacological pain management in NICU," *Port Said Sci. J. Nurs.*, vol. 6, no. 3, pp. 85–103, 2020.
- [34] J. White et al., "Light shielding in NICUs," *Adv. Neonatal Care*, vol. 20, no. 4, pp. 252–260, 2020.
- [35] L. Altimier and R. Phillips, "The Neonatal Integrative Developmental Care Model," *Newborn Infant Nurs. Rev.*, vol. 16, no. 4, pp. 230–244, 2020.
- [36] S. Bruns et al., "Noise and light levels in NICUs and development," *J. Neonatal Nurs.*, vol. 28, no. 2, pp. 113–118, 2021.
- [37] Haerian-Ardakani et al., "Maternal periodontal disease and low birth weight," *Int. J. Reprod. Biomed.*, vol. 11, no. 8, pp. 625–630, 2020.
- [38] Sood et al., "Developmental care in pediatric intensive care," *J. Pediatr. Nurs.*, vol. 42, pp. 1–6, 2020.
- [40] K. Jeyabarathi and N. Shalini, "Effectiveness of Nesting on High-Risk Newborns," *Int. J. Adv. Res.*, vol. 6, no. 11, pp. 1103–1106, 2021.