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

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ABSTRACT One of the goals of the Millennium Development Goals (MDG's) is to lower infant and child mortality rates. In 2006 according to the World Health Organization (WHO) infant mortality rate in the world was 49 per1000 births and the most cause of death was Low Birth Weight Babies. In Sidoarjo Hospital the birth rate of BBLR in the last 3 months is still high ranging from 30-38 babies. This study aims to analyze the effectiveness of nesting and lighting in physiological function for LBW babies in RSUD Sidoarjo. This type of research is a quasy experiment with a nonrandomized pretest and posttest with control group design with purposive sampling in the Infant Room and NICU of Sidoarjo Hospital as many as 61 (40 control groups and 21 intervention groups). Measuring instruments used are luxmeters, heart rate meters, oximeters, thermometers and observation sheets. The independent variables are the use of light shields and nesting and the dependent variables are pulse frequency and oxygen saturation. The results showed there was a difference in value between pre and post test heart rate and oxygen saturation in the intervention group with a value of $p< 0.05$ and there was a difference between the control group and the intervention group in the respiration rate counts pre and post intervention, the post heart rate intervention, and the post temperature intervention with a value of $p<0.05$. The physiological condition of the baby is related to temperature, respiration and relatively stable heart rate and the use of nesting and light protection affects the physiological stability of the heart rate and oxygen saturation

INDEX TERMS Heartrate, low birth weight babies, light protection, nesting, oxygen saturation.

I. INTRODUCTION

One of the goals of the Millennium Development Goals (MDGs) is to reduce infant and child mortality. In 2006 according to the World Health Organization (WHO) the Infant Mortality Rate (IMR) in the world was 49 per 1000 births. In Indonesia, according to the 2012 Indonesian Demographic and Health Survey (IDHS), the IMR is 32/1000 live births. The prevalence of low birth weight babies (LBW) according to WHO in 2011 is estimated to be 15% of all births in the world[1]. Statistically, 90% of the incidence of LBW is found in developing countries. The incidence of LBW in Indonesia is 10.5%, still above Thailand's average 9.6% Vietnam 5.2%. In Sidoarjo Regency, in 2018 the Infant Mortality Rate (IMR) reached 4.38 per 1,000 live births. This figure is lower than the determined 2018 target (5.6 per 1,000 live births) and decreased compared to 2017 of 6.27 per 1,000 live births. The causes of death in detail from 2015 to 2018, the majority of neonatal deaths were due to Birth Weight (LBW)[2][3][4]. In 2018, 66% decreased compared to 2017 (66%) and increased compared to 2016 (58.56%), following Asphyxia, which was 18% lower compared to 2016 (17.16%). Low birth weight babies often experience several problems in the period immediately after birth as a result of the characteristics of immature organs. These characteristics include a lack of surfactant and a small number of functioning alveoli causing the baby to have difficulty breathing, lack of vascular smooth muscle and low blood oxygen levels resulting in trauma to the central nervous system and delayed closing of the ductus arteriosus, as well as the inability to regulate incoming stimuli causing babies to tend to experience stress[5]. Low birth weight babies need intensive, careful and precise care. The care provided is designed to support the survival of low birth weight babies. The fact that

intensive care is provided is also a source of stress due to excessive stimulation, for example the noise of incubator alarms, ventilators, patient monitors, invasive procedures and farewell to parents. The stress conditions experienced by low birth weight babies who are undergoing treatment with such environmental conditions and care activities can be seen from the behavior displayed by the baby, including various physiological changes, alertness or attention, and motor activity[6]. Infant behavior is a reflection of the baby's response to various stimuli or situations that occur both internally and externally and is a way for babies to communicate[6]. The behavior of low birth weight babies in response to excessive stimulus can be observed from various changes in body conditions. Changes in the body's condition include hypoxemia and apnea, increased levels of stress hormones, pain, and discomfort. In addition, changes in the body condition of low birth weight babies can also be observed through an increase in pulse rate and a decrease in oxygen saturation. Intensive care environment management strategies to minimize the influence of a care environment that provides excessive stimulation are urgently needed. This strategy can be achieved through developmental care called developmental care, namely care that facilitates infant development through adequate environmental management which will increase physiological stabilization and reduce infant stress[7]. Environmental management in developmental care includes providing an incubator cover to minimize lighting, providing nesting or nests to accommodate excessive movement and giving the baby a comfortable place, setting flexion positions to maintain normal torso and supporting regulation. This developmental care intervention has actually been applied in the care of low birth weight babies such as at Sidoarjo Hospital. The interventions in developmental care that have been carried out include nesting installation, using incubator covers, imposing quiet hours, and unrestricted parental visits. However, at Sidoarjo Hospital, research related to how the effectiveness of using light shields and nesting in maintaining the stability of the physiological functions of low birth weight babies who are undergoing treatment in the baby room and NICU has not been fully carried out. The purpose of this study was to analyze the effectiveness of using light shields and nesting in maintaining the stability of the physiological functions of low birth weight babies at Sidoarjo Hospital. The research contribution can be the basis for using light protection and nesting in the nursery and NICU and motivating parents to implement the use of light protection and nesting when babies are allowed to be cared for independently. by family.

II. METHOD

This type of research is a quasi-experimental research with a non-randomized pre-test and post-test design with a control group design which is used to determine the effect of developmental care (the use of light protection and nesting) is effective[2] in maintaining the stability of the physiological function of low birth weight babies in Sidoarjo Hospital[8][9]. Data collection was carried out in the Baby Room and NICU of Sidoarjo Hospital, Dr. Mawardi Islamic Hospital Krian, Sidoarjo and Siti Khadijah Islamic Hospital Sepanjang, Sidoarjo from September to November 2020 with a sample size of 61 infants (21 intervention groups and 40 control groups) using a purposive sampling technique.

The sample inclusion criteria in this study were: 1) Babies weighing 1000-2500 grams, 2) Babies not using oxygen, 3) Babies not using respirators, and 4) Babies in stable condition. The sample exclusion criteria in this study were: 1) The baby's condition had worsened, 2) The baby had to receive phototherapy, and 3) The baby had congenital abnormalities.

Data collection uses an observation sheet regarding pulse frequency/heart rate seen from a monitor or heart rate by measuring the beat at the peak location of the heart in babies who are monitored before and after the procedure Oxygen saturation was carried out using an oxymetry device. Exposure is controlled using a light meter / luxmeter[10]. Data collection was carried out by observing the following stages: Babies who will be studied are given routine care such as changing diapers, giving drinking/breastfeeding, measuring temperature, vital signs and other care procedures. Then the baby is given a 10 minute rest period for stabilization. Furthermore, the baby's heart rate and oxygen saturation are measured before being installed with light protection and nesting. Lighting strength is also measured using a luxmeter. Then the baby is given the action of installing a light protector and nesting for 2 hours. During the installation of the light shield and nesting, the baby is observed every 30 minutes to 2 hours including heart rate, oxygen saturation, lighting and the results of the observations are recorded in the observation sheet.

Babies who are in the control group still use light protection and nesting which has been done in the room according to the Standard Operating Procedures (SOP) of the room. The instruments/equipment used as light shields and nesting were designed by the researchers themselves based on the results of literature studies, field studies and expert consultations. Then the results of the observations were compared pre and post between the control group and the treatment group. The data that has been collected is then processed, tabulated, and interpreted and analyzed. Pretest and posttest data were analyzed using Paired t-test for normally distributed data and Wilcoxon test for non-normally distributed data. To test the difference between the intervention group and the control group, the Mann Whitney test was carried out. Ethical clearance is carried out at the Sidoarjo General Hospital with number 893.3 / 0059 / 438.6.7 / 2020, at the Siti Khadijah Hospital with number 012 / KET-KEPK / 10-2020 and Dr. Mawardi Hospital with number 030 / RSIM / Ext / IX/ 2020.

III. 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 1000-2500 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.

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

Characteristics of Respondents	Control group		Interventi-on 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 Chilbirth						
▪ 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

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 2000-2500 grams. This is in line with the gestational age of the babies at birth, which is mostly at 34-36 weeks of gestation, which is 56%. Most of the babies were born by caesarean section, which was 52% of the total respondents. 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 20-35 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.

TABLE 2
WILCOXON TEST

Group	Mean Rank	Z	Sig
HR post intervention - HR pre intervention	11,32	-3.271[b]	0,001
	5,83		
Saturation post intervention – Saturation pre intervention	10,75	-2.978[c]	0,003
	9,91		
Temperature post intervention - Temperature pre intervention	8,38	-.052[c]	0,959
	8,63		
RR post intervention - RR pre intervention	11,71	-.155[c]	0,877
	8,09		
HR post control - HR pre control	23,80	-.083[b]	0,933
	15,73		
Saturation post control - Saturation pre control	15,00	-1.897[c]	0,058
	17,29		
Temperature post control - Temperature pre control	16,55	-.576[c]	0,565
	21,58		
RR post control - RR pre control	19,64	-.532[b]	0,595
	13,00		

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 betweenthe 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 thateach 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.

TABLE 3
Table of different group tests with Mann Whitney

	Group	Mean Rank	Z score (Manwhitney)	sig
HR pre	control	32,23	-0,754	0,451
	Intervention	28,67		
Saturation pre	control	33,91	-1,801	0,072
	Intervention	25,45		
Temperature pre	control	33,21	-1,383	0,167
	Interven-tion	26,79		
RR pre	control	37,24	-3,821	0,000
	Intervention	19,12		
HR post	control	37,68	-4,069	0,000
	Intervention	18,29		
Saturation post	control	30,60	-0,246	0,805
	Intervention	31,76		
Temperature post	control	34,73	-2,317	0,020
	Intervention	23,90		
RR post	control	37,39	-3,941	0,000
	Intervention	18,83		

IV. DISCUSSION

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 carriedby 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 ababy 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 orbreathing 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 (Patra, 2016). 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]. Respiratory 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, borns 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.

V. CONCLUSION

From the results of the study it can be concluded that most of the LBW were aged 0-3 days, weight 2000-2500 grams, gestational age 34-36 weeks, male sex, first child, mother's age 20-35 years, and last high school level education . The baby's physiological condition regarding temperature, respiration and heart rate is relatively stable. The use of nesting shields and light affects the physiological stability of heart rate and oxygen saturation. LBW requires extra adaptation in maintaining physiological stability. Therefore it is necessary to modify the environment in the baby care room to support the condition of LBW to be stable and the need for education to parents regarding LBW care, especially in providing nesting and light protection to continue at home when LBW has stabilized and can go home.

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