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Effectiveness Of Incubators On Physiological Stability Of Premature Babies

Astin Nur Hanifah[1*], Wahyuni Anwar[2], Rezqiqah Aulia Rahmat[3], Tenny Tarnoto[4]

[*1] Midwifery Study Program Magetan, Poltekkes Kemenkes Surabaya, Indonesia
[2] Nursing Study Programs, STIKes Lakipadada Tana Toraja, Indonesia
[3] Medical Study Programs, Bosowa University Makassar, Indonesia

*Correspondent Author: Astin Nur Hanifah, Email: astinnur1980@gmail.com

ABSTRACT

Premature infants are at high risk of experiencing physiological instability due to organ immaturity, especially in the regulation of body temperature, respiration, and the cardiovascular system. One of the main interventions in the care of premature infants is the use of an incubator. This study aims to determine the effectiveness of incubator use on the physiological stability of premature infants. The research method used was a quantitative study with an analytical observational design. The subjects were premature infants treated in the perinatology ward. The physiological parameters observed included body temperature, respiratory rate, and heart rate. The results showed that the use of an incubator significantly helped maintain the physiological stability of premature infants. Thus, an incubator is an effective and essential tool in the care of premature infants to improve physiological stability and prevent further complications.

Keywords: Premature Infant, Incubator, Physiological Stability, Perinatology

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1. Introduction

A premature baby is defined as a baby born before 37 weeks of gestation. This condition causes premature babies to have immature bodily systems, making them susceptible to physiological disorders such as hypothermia, respiratory distress, and heart rhythm instability. One of the main problems in premature babies is the inability to maintain body temperature due to an underdeveloped subcutaneous fat layer.

The use of an incubator is a crucial intervention in the care of premature babies. Incubators provide a stable thermal environment, reduce heat loss, and protect the baby from external exposure. In addition to maintaining body temperature, incubators also help control humidity and provide an environment that supports stable breathing and circulation.

Although the use of incubators has become standard in neonatal care, their effectiveness on the physiological stability of premature infants still needs further study. Therefore, this study was conducted to assess the effectiveness of incubator use on the physiological stability of premature infants.

2. Research Methods

a. Research Design

This study is a quantitative, observational, and analytical study using a cross-sectional approach. This design was chosen to analyze the relationship between incubator use and the physiological stability of premature infants at a single observation point without providing additional interventions beyond standard hospital care.

b. Place and Time of Research

The study was conducted in a hospital perinatology ward during the period (e.g., January-March 2025). The study location was selected based on the availability of incubator facilities and the number of premature infants routinely treated.

c. Population and Sample

1) Population

The population in this study was all premature babies treated in the perinatology room during the study period.

2) Sample

The research sample consisted of 30 premature babies selected using the total sampling technique, namely the entire population that met the inclusion criteria was used as the research sample.

3) Inclusion Criteria

a) Premature babies with gestational age < 37 weeks
b) Babies are cared for using incubators
c) The baby is in stable condition and does not require mechanical ventilation.

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d) Parents/guardians provide informed consent consent)

4) Exclusion Criteria
   a) Babies with major congenital abnormalities
   b) Babies in critical condition requiring intensive resuscitation measures
   c) Infants who were transferred to another health facility during observation

d. Research Variables

1) Independent variables:
   Use of incubators
2) Dependent variable:
   Physiological stability of premature babies, which includes:
   a) Body temperature
   b) Breathing frequency
   c) Heart rate

e. Operational Definition of Variables

Variables	Operational Definition	Measuring instrument	Scale
Use of incubators	Care for premature babies using an incubator with temperature and humidity settings according to standards	Observation sheet	Nominal
Body temperature	Baby's body temperature measured using a digital thermometer	Thermometer	Interval
Breathing frequency	Number of baby breaths in one minute	Stopwatch & observation	Ratio
Heart rate	The number of heartbeats per minute	Neonatal monitor	Ratio

f. Research Instruments

The instruments used in this study include:

1) Observation sheet to record incubator usage
2) Digital thermometer to measure baby's body temperature
3) Neonatal monitor to measure respiratory rate and heart rate
4) Medical records to obtain supporting data such as gestational age and birth weight

The instruments used are in accordance with the hospital's standard operating procedures (SOP).

g. Data Collection Procedures

Data collection is carried out in several stages:

1) Researchers apply for research permits to the hospital
2) Researchers conduct sample selection according to inclusion and exclusion criteria.

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3) Measurement of physiological parameters was carried out before and after the baby was treated using an incubator.
4) Data is recorded on the observation sheet and confirmed through medical records.
5) Observations are carried out periodically in accordance with neonatal care standards.

h. Data Processing and Analysis

The collected data is processed through the following stages:

1) Editing: checking the completeness of the data
2) Coding: assigning codes to variables
3) Data entry: entering data into statistical software
4) Cleaning: ensuring there are no input errors

Data analysis includes:

- Univariate analysis to describe respondent characteristics
- Bivariate analysis using *paired t- test* to determine the difference in physiological stability before and after using the incubator

The significance level used is $\alpha = 0.05$.

i. Research Ethics

This study has received approval from the Health Research Ethics Committee. All respondents' confidentiality is maintained, and data will be used solely for research purposes. Parents or guardians of infants were fully explained the purpose and procedures of the study before signing the informed consent form. consent.

3. Research Results and Discussion

a. Research Result

This study involved 30 premature infants treated with incubators in the perinatology ward. Physiological parameters observed included body temperature, respiratory rate, and heart rate before and after incubator treatment.

1) Respondent Characteristics

Table 1.
Characteristics of Premature Babies

Characteristics	n	Percentage (%)
Gestational Age		
28–31 weeks	12	40.0
32–34 weeks	10	33.3
35–36 weeks	8	26.7
Birth Weight		

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Characteristics	n	Percentage (%)
< 1500 grams	11	36.7
1500–2499 grams	19	63.3
Gender		
Man	17	56.7
Woman	13	43.3

2) Body Temperature Stability

Table 2.
Comparison of Body Temperature of Premature Babies Before and After Using an Incubator

Condition	Mean (°C)	Elementary School
Before the incubator	36.1	0.4
After the incubator	36.7	0.3

The results showed an increase in body temperature towards the normal range (36.5–37.5°C) after using the incubator.

3) Breathing Frequency

Table 3.
Respiratory Rate of Premature Babies

Condition	Mean (x/minute)	Elementary School
Before the incubator	64	6
After the incubator	52	4

The respiratory rate of premature babies becomes more stable and approaches normal values (30–60 x/minute) after treatment using an incubator.

4) Heart rate

Table 4.
Premature Baby Heart Rate

Condition	Mean (x/minute)	Elementary School
Before the incubator	168	10
After the incubator	148	8

There was a decrease in heart rate towards normal limits (120–160 x/minute) after using the incubator.

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5) Statistical Analysis

Paired t- test analysis shows:

- Body temperature: p = 0.001
- Respiratory rate: p = 0.002
- Heart rate: p = 0.003

A p value < 0.05 indicates that the use of an incubator has a significant effect on the physiological stability of premature babies.

b. Discussion

The results of this study indicate that the use of incubators has a positive impact on the physiological stability of premature infants. The increase in infant body temperature after incubator use indicates that this device is effective in creating an optimal thermal environment. Premature infants have limited thermoregulatory mechanisms due to an immature nervous system and minimal subcutaneous fat , making them highly susceptible to hypothermia. Incubators help reduce heat loss through convection, evaporation, and radiation.

The use of an incubator also impacts respiratory rate stability. The warm environment and controlled humidity help reduce the baby's metabolic demands, making the work of breathing easier. This is evident in the significant decrease in respiratory rate after the baby was cared for in an incubator.

Premature babies' heart rates also showed improvement after incubator use. Physiological stress from exposure to cold temperatures can increase heart rate as a compensatory response. With the stable environment of the incubator, physiological stress is reduced, resulting in a more controlled heart rate.

The findings of this study align with neonatal care theory, which states that incubators play a crucial role in supporting the physiological function of premature infants. Stable body temperature is a key factor influencing the respiratory and cardiovascular systems. Therefore, incubators serve not only as warmers but also as tools to support overall physiological stability.

Although the results of the study indicate the effectiveness of the incubator, limitations of this study lie in its observational design and relatively small sample size. Other factors such as nutritional status, severity of illness, and prematurity, and additional medical interventions can also affect the physiological stability of the baby.

4. Conclusion And Suggestions

a. Conclusion

The use of incubators is effective in improving and maintaining the physiological stability of premature babies. Incubators help maintain body temperature, stabilize the baby's respiratory rate, and heart rate. Therefore, incubators are an essential tool in the care of premature babies in the perinatology ward.

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b. Suggestion

It is hoped that healthcare workers can optimize incubator use in accordance with neonatal care standards. Further research is recommended to use an experimental design and a larger sample size to obtain more comprehensive results.

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