Original Article

A Retrospective Comparison of Hypothermia Proportion Among Newborns Using General Postnatal Nursing Practice versus Baby Warm Practice Guideline

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Abstract

OBJECTIVES: To investigate the proportion of neonatal hypothermia this study compares newborns who received General Postnatal Nursing (GPN) Practice based on previous clinical practice guidelines with those who received Baby Warm Practice (BWP) Guideline based on the latest guidelines for preventive neonatal hypothermia.

MATERIALS AND METHODS: : The study sample consisted of newborn medical records of newborns who were delivered at Bangkok Hospital Chiang Mai between May 1, 2016 and April 30, 2018, with gestational age between 37 and 42 weeks, in good health, and with an Apgar score of more than 7. The study was analyzed and the proportion of neonatal hypothermia occurrence between the group that received care according to the GPN practice and the group that received care according to the BWP Guideline were compared.

RESULTS: A total of 315 neonates who met the selection criteria and had complete data were included in this research project. They were divided into two groups, BWP Guideline group (n = 157, 49.84%) and GPN Practice group (n =158, 50.16%), according to the predefined criteria. The basic demographic characteristics of the two groups were found to be different. The Apgar score at 1 minute was 8 in 30 neonates (19%) in BWP Guideline group, which was higher than the 15 neonates (9.5%) in GPN Practice group. The Apgar score at 5 minutes was 10 in 100 neonates (63.7%) in BWP Guideline group, which was lower than the 118 neonates (74.7%) in GPN Practice group. The temperature in the delivery room and operating room was less than 22 °C in 89 neonates (56.68%) in BWP Guideline group, which was lower than the 140 neonates (88.6%) in GPN Practice group. The temperature in the transition room was less than 24 °C in 13 neonates (8.28%) in BWP Guideline group, which was lower than the 32 neonates (20.25%) in GPN Practice group. The study found that there were 3 neonates (1.9%) in BWP Guideline group and 7 neonates (4.4%) in GPN Practice group with low body temperature, and there was no significant difference between the two groups (p = 0.336).

CONCLUSION: The BWP Guidelines for preventing neonatal hypothermia in newborns have been updated to emphasize continuous warmth provision (The Warm Chain), increasing prevention of heat loss from the newborn's body, increasing the ambient temperature, and using plastic caps (Baby Warm Cap) to prevent heat loss from newborn's head. These guidelines result in a lower proportion of neonatal hypothermia compared to the previous guidelines. Both groups, however, did not differ significantly in the incidence of neonatal hypothermia.

Keywords: Hypothermia, newborns, BWP guidelines, prevention neonatal hypothermia, Baby Warm Cap

Low body temperature in newborns is a frequently encountered problem in delivery rooms. The cause of this problem is the inefficiency of the infant's body temperature control system compared to that of adults including with nursing practices to prevent heat loss, which are insufficient, such as turning off the heater in the transition room, blankets are warmed inadequately, turning off pre-warming the radiant warmer before receiving the infant, and given the anatomical characteristics of the infant's

body, the head of the infant has a surface area that accounts for 25% of the total body surface area, and there is less subcutaneous fat, which leads to ineffective heat preservation. [1-3]

The prevalence of neonatal hypothermia was found in preterm infants with a body weight less than 2,500 grams. [4,5] Moreover, in 2019 the study by Muengpan T et al.[6] hypothermia (21.50%) was met in full term baby with a body weight of more than 2,500 grams. Low body temperature in infants is defined by the World Health Organization (WHO) in 2004 as an axillary or rectal temperature below 36.5 °C. From the beginning in 2014-2016, we cared for newborns to ensure a healthy life and against complications utilizing GPN Practice and discovered that neonatal hypothermia occurred in 9.64, 10.13, and 7.05% of cases, respectively. The root causes were then discovered and analyzed using a fishbone diagram. It was discovered that the clinical staff lacked the knowledge and abilities to care for the newborns, and that the machinery and equipment were prepared inadequately for newborn delivery, such as a cotton hat that was ineffective for keeping the baby warm, a delivery and transition room that were too cold, and GPN practice that was inappropriate for preventing neonatal hypothermia.

According to WHO recommendations for preventing low body temperature in infants, continuous warming practices (The Warm Chain) should be implemented, including adjusting the operating room temperature, allowing skin-to-skin contact between the infant and the mother, avoiding shower and weight immediately, dressing the infant appropriately, keeping the infant with the mother, using an incubator for transportation, providing warmth under resuscitation equipment, providing training and education to caregivers who provide care for the infant.[7,8]

Therefore, the researchers have developed BWP Guideline to prevent hypothermia in newborn infants from the Warm Chain which was recommended by WHO and the study by Auaaree Samugjung.[7-9] The process has been revised in all 10 steps, starting from preparing for childbirth. The heater in the transition room is turned on to adjust the temperature to at least 24°C, and the temperature in the delivery room and operating room is kept at 22°C. [10,11] Equipment for the newborn is prepared by turning on the pre-warm function of the Radiant warmer machine, and once the Radiant warmer is brought into the operating room, it is switched to skin mode at 36°C.[12-14] Then, the Incubator is opened in air temperature mode, set to the Neutral Thermal Environment of the gestational age of the newborn to be delivered.[12-14] The transport incubator is prepared for use and the temperature is adjusted to at least 36°C for at least 15 minutes.[12-14] The newborn's receiving blanket and swaddling blanket are warmed in a cabinet at 40°C for at least 24 hours before use. [15] The procedure for receiving the newborn is adjusted, and when the obstetrician reaches the peritoneal layer, the air conditioner in the operating room is turned off immediately. In the case of natural childbirth, the air conditioner is turned off immediately when the newborn's head is delivered.[6] All procedures with the newborn are performed only under the Radiant warmer, and after the newborn is delivered, the body and head are wiped dry before placing the Baby Warm Cap (as shown in Figure 1) and another warm cloth on the baby's body.[3,12-14] The newborn is transported using a transport incubator to the transition room. [12-14] When the newborn has arrived at the transition room, the baby is then weighed and immediately placed in the incubator. The newborn's temperature was measured twice after delivery, and when the temperature is within the normal range of 36.5 – 37.5 °C, the Baby warm cap will be removed and the newborn is allowed to adjust to the temperature within the incubator for another 2 hours before transferring to nursery ward.[2] We expected that BWP Guideline would protect newborns from neonatal hypothermia, reduce serious complication and lower mortality rate. A hypothesis of this study that was the proportions of neonatal hypothermia were shown in newborns who received GPN practice more than those who received BWP Guideline based on the latest guidelines for preventive neonatal hypothermia.

This study aims to investigate the proportion of neonatal hypothermia this study compares medical records of newborns who received GPN practice based on previous clinical practice guidelines with those who received BWP Guideline based on the latest guidelines for preventive neonatal hypothermia. In addition, this study shows to analyze the factors and causes of hypothermia in newborns, as well as to find other practices to prevent hypothermia and its related complications in newborns.

Materials and Methods

This study is a retrospective comparative analysis of the proportion of neonatal hypothermia among newborns who received GPN practice compared to those who received BWP Guideline. The data was retrospectively retrieved from newborns medical records at Bangkok Hospital Chiang Mai between May 1, 2016 and April 30, 2018.

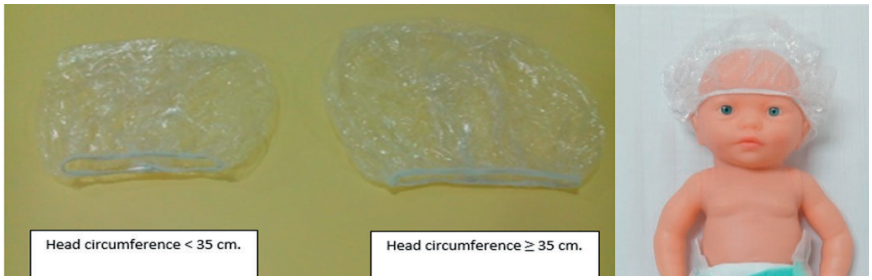

Figure 1: The 2 sizes of Baby warm cap and wearing a Baby warm cap

The inclusion criteria are as follows:

1. Gestational age at birth of 37-42 weeks.
2. Apgar score of 8-10 at 1 and 5 minutes after birth.
3. Birth weight of 2,500 grams or more, and
4. Vaginal or cesarean delivery.

Sample size

To achieve study objectives, the sample size using a statistical significance level of 95% and a test power of 80%, an assumed two different rates of neonatal hypothermia among newborns: one for those receiving general neonatal nursing practice (0.6) and the other for those following the BWP guidelines (0.5). These assumptions were established using the two independent proportions formula with conducted purposive sampling and selected a total of 315 medical records of newborns who met the eligibility criteria .[15-18]

Tools

The data were collected and recorded by the Case Record Form (CRF). The subject of CRF was composed of demographic data (gestational age, birth date and gender), Physical examination (body weight and vital signs), room temperature (operating room/ Labour room and transition room) and body temperature. The used data were de-identified and reviewed from medical records.

Data collection process

The researcher requested to use data from the director of Bangkok Hospital Chiang Mai and conducted the research ethics review by Institution Review Board (IRB) of Bangkok Hospital Chiang Mai BCM-IRB -2019-09-002. The data were obtained from the TrakCare® during January to November 2020. The researcher accessed the medical record system and the data verification was considered by another researcher. A total of 315 newborns medical records which met the inclusion criteria were divided into two groups based on the nursing care they received including one group was the newborns who received BWP Guideline and the second group was newborns who received GPN Practice. The summary of the difference in nursing care practices to prevent neonatal hypothermia between BWP Guideline and GPN Practice are summarized in Table 1.

Table 1: The comparison GPN Practice and BWP Guideline

GPN Practice	BWP Guideline
1. The heater was not used in the transition room and appropriate temperature was not set in the operating room and delivery room.	1. The heater was turned on in the transition room to adjust the temperature to 24 °C or above, and the temperature in the operating room and delivery room was set at 22 °C.
2. Pre-warm was not activated for the radiant warmer.	2. The pre-warm for the radiant warmer was activated, and when it was brought into the operating room, it was switched to skin mode at 36 °C.
3. The incubator was turned on and warm mode was activated before receiving infant.	3. The incubator was set to air temperature mode according to the neutral thermal environment for the gestational age of the infant to be delivered.
4. The transport incubator was turned on and the temperature was set at 36 °C before receiving the infant.	4. The transport incubator was turned on and the temperature was set at 36°C for at least 15 minutes before receiving the infant.
5. The receiving cloth and swaddling blanket for the infant were warmed in the transport incubator with the temperature set at 34 °C.	5. The receiving cloth and swaddling blanket for the infant were taken to the recovery room with the temperature of 40 °C for at least 24 hours.
6. In the case of caesarean section delivery, when the obstetrician makes an incision before the descent fetus, the air conditioning should be turned off immediately, or in the case of natural delivery the air conditioning should be turned off when the infant's head is delivered (if the room temperature is between 25-26 °C, the air-conditioning does not need to be turned off.)	6. In the case of caesarean section delivery, when the obstetrician reaches the peritoneal layer, the air conditioning should be turned off immediately, or in the case of natural delivery, the air-conditioning should be turned off when the infant's head is delivered.
7. All procedures performed on the infant must be done under a radiant warmer. After delivery, the infant should be wiped dry and any amniotic fluid and blood should be removed. Then, a warm cloth cap should be placed on infant's head and the body should be wrapped with another warm cloth.	7. All procedures performed on the infant must be done under a radiant warmer. After delivery, the infant should be wiped dry and any amniotic fluid and blood should be removed. Then, the Baby Warm Cap should be placed on infant's head and the body should be wrapped with another warm cloth.
8. The infant should be transferred to the transition room using a transport incubator.	8. The infant should be transferred to the transition room using a transport incubator.
9. When the infant arrives at the transition room, the weight and measurements should be taken under the radiant warmer before placing the infant in the incubator.	9. When the infant arrives at the transition room, the weight and measurements should be taken under the radiant warmer before placing the infant in the incubator.
10. The infant's temperature should be measured immediately after delivery and again 15 minutes later, while infant is under the radiant warmer or in the incubator. If the temperature falls within the normal range of 36.5-37.5 °C, the cloth cap can be removed, and the infant can remain under the radiant warmer or in the incubator for another 2 hours before being moved to the nursery room.	10. The infant's temperature was measured 2 times after delivery. If the temperature falls within the normal range of 36.5-37.5 °C, the Baby Warm Cap should be removed, and the infant can remain in the incubator for another 2 hours before being moved to the nursery room.

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Data Analysis

Data analysis using STATA version 15 was conducted as follows:

1. Descriptive statistics included percentages of gestational age (GA) at 37 weeks or above, gender, body weight, Apgar scores at 1 and 5 minutes, delivery room temperature, operating room temperature, and transition room temperature. The relations on variables of 2 groups were analyzed by Chi-Square test, p-value < 0.05.
2. Inferential statistics included Test of proportion to compare the incidence of normal body temperature with low body temperature in newborns, and the Wilcoxon-Mann-Whitney test to compare factors related to the occurrence of neonatal hypothermia between the group that used the GPN Practice and the group that used BWP Guideline, p-value < 0.05.

Results

A total of 315 newborns were divided into groups including the BWP Guideline was 157 (49.84%), while that in GPN Practice was 158 (50.16%). There was no significant difference in sex and birth weight between those two groups. However, there was a statistically significant difference ($p = 0.033$) in the Apgar score at 1 minutes after delivery when comparing BWP Guideline and GPN Practice group, as well as at 5 minutes after delivery ($p = 0.035$).

Regarding the temperature of delivery and operating rooms, Temperature less than 22 °C was found in 89 cases (56.68%) in BWP Guideline group which was lower than 140 cases (88.6%) in GPN Practice group. The temperature delivery/operating room greater than or equal to 22 °C in BWP Guideline group was found in 68 cases (43.31%), which was higher than the 18 cases (11.39%) found in GPN Practice group. There was a statistically significant difference ($p < 0.001$) between the two groups. Regarding the temperature of the transition room, less than 24 °C was found in 13 cases (8.28%) in BWP Guideline group which was lower than 32 cases (20.25%) found in GPN Practice group. The transition room temperature greater than or equal to 24 °C in BWP Guideline Group found in 144 cases (91.71%), which was higher than 126 cases (79.74%) found in GPN Practice group. There was a statistically significant difference between the two groups ($p = 0.002$) as shown in Table 2.

The number of normal body temperature of newborns was 154 (98.1%) in BWP Guideline Group and 151 (95.6%) in GPN Practice Group. The number of newborns with low body temperature was 3 (1.9%) in BWP Guideline Group, which was less than the 7 cases (4.4%) found in GPN Practice Group. There was no significant difference in the number of normal body temperature and low body temperature newborns between two Groups ($p = 0.336$), as shown in Table 3.

Factors related to the occurrence of hypothermia in newborns were compared between the group that followed the BWP Guideline and the group that followed the GPN Practice. It was found that there were no significant differences between the two groups, as shown in Table 4.

Table 2: The demographic data of newborns in BWP Guideline Group and GPN Practice Group

Demographic data	BWP Guideline n (%)	BWP Guideline n (%)	p
Total	157 (100)	158 (100)	
Gender			0.061
Male	82 (52.23)	99 (62.66)	
Female	75 (47.77)	59 (37.34)	
Body weight (grams)			0.662
2,500 – 3,000	51 (32.48)	55 (34.81)	
≥3,000	106 (67.51)	103 (65.18)	
Apgar 1 minute (score)			0.033*
8	30 (19.1)	15 (9.5)	
9	120 (76.4)	131 (82.9)	
10	7 (4.5)	12 (7.6)	
Apgar 5 minutes (score)			0.035*
8	0 (0)	0 (0)	
9	57 (36.3)	40 (25.3)	
10	100 (63.7)	118 (74.7)	
Temperature delivery/operating room (°C)			< 0.001**
<22 °C	89 (56.68)	140 (88.60)	
≥22 °C	68 (43.31)	18 (11.39)	
Transition room temperature (°C)			0.002*
< 24 °C	13 (8.28)	32 (20.25)	
≥24 °C	144 (91.71)	126 (79.74)	

Table 3: The proportion of newborns with normal and low body temperature in BWP Guideline group and GPN Practice group

	BWP Guideline n (%)	BWP Guideline n (%)	*p*
Normal body temperature	154 (98.1)	151 (95.6)	0.336
Low body temperature	3 (1.9)	7 (4.4)	

Table 4: Compares the factors related to the proportion of hypothermia in newborns between the group that followed the GPN Practice and the group that followed the BWP Guideline.

Newborns' factors	BWP Guideline (n = 3)		GPN Practice (n=7)		*p*
	Median	Min to Max	Median	Min to Max	
Gestational age (week)	39	37 to 39	38	37 to 39	0.5461
Apgar score at 1 minute	8	8 to 10	9	8 to 10	0.4579
Apgar score at 5 minutes	9	9 to 10	10	9 to 10	0.5127
Newborns weight (gram)	3000	2650 to 3530	3030	2590 to 3470	0.9093
Temperature Delivery/Operating room (°C)	21.1	20.8 to 22	21	19.8 to 21.8	0.6465
Temperature Transition room (°C)	24.2	24 to 24.8	24	23.2 to 24.3	0.1649

Discussion

From this study it was found that the occurrence of low body temperature in newborns in both groups was very low and not significantly different. This is inconsistent with the study by Muengpan T, et al.,[6] which reviewed conventional using activities for newborns in the delivery room/operating room according to the 4-step practice guidelines form caring for newborns, including preparing equipment before receiving the newborn, caring for the newborn during the initial reception phase, monitoring the temperature, and first bathing, until the newborn is transferred to the crib. In addition, training on nursing activities was provided to nursing staff to ensure that all nurses had knowledge and competency in caring for newborns, including monitoring the body temperature in the first 24 hours after birth. However, the mentioned study still found out that 14.40% of newborns had a body temperature lower than 36.5 °C.

The researchers believed that the reason for the low occurrence of low body temperature found in this study may have been due to the fact that the newborns received nursing care according to the Warm Chain principles of the WHO, along with reducing factors that contribute to newborns having low body temperature. Emphasis was placed on maintaining the newborn's body temperature as much as possible and increasing the environmental temperature.

These findings were adapted from the study by Samugjung A.,[9] who studied practical guidelines for newborn caring to prevent low body temperature, including adjusting the delivery room temperature to 26 °C, turning on the Radiant warmer machine 15 minutes before delivery of the newborn, and after clamping the umbilical cord, a warm cloth was used to wipe the newborn's body. The newborn was then given to the mother to hold and breastfeed for 5-10 minutes while being covered with a blanket. All the time while newborn was dressed, cutting the umbilical cord, typing wristbands, they placed the newborn under the radian warmer, and ensuring that the newborn does not urinate or defecate while lying down were all performed. [3, 11] As a result of this study, it was found that the incidence of hypothermia was lower in BWP Guideline Group. Furthermore, there was no significant difference in the incidence of hypothermia between the two groups, which may be due to the small sample size, resulting in insufficient statistical power. This is a limitation of the retrospective study.

According to the data from this study, the gender and weight of the newborns did not affect the control of the body temperature of both groups, which is inconsistent with the study by Muengpan T et al.[6] They studied factors related to the occurrence of hypothermia in newborns upon admission to the neonatal intensive care unit and found that the first weight factor of newborns in the group with normal body temperature and the group with low body temperature, were significantly different at a statistical level of $p < 0.05$ ($p = 0.002$).

In addition, this study also found that the 1-minute and 5-minute Apgar scores of BWP Guideline group and GPN Practice Group differed significantly at a statistical level, which is consistent with the study by Nguyen, et al.,[19] in 2022 that investigated factors contributing to hypothermia in newborns. They collected data in November 2020 and found that the 5-minute Apgar score had a significant effect on hypothermia in newborns at a statistical level of $p < 0.05$ ($p = 0.033$).[15]

Regarding environmental factors, this study found that the temperature of the delivery room/operating room and the temperature of the transition room differed significantly

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between BWP Guideline group and GPN Practice group at a statistical level, which is inconsistent with the study by Muengpan T, et al.,[6] in 2020. They found that environmental factors, such as the temperature of the delivery room of newborns in the group with normal body temperature and the group with low body temperature, were not significantly different at a statistical level of $p < 0.05$.

From this study on newborns with normal body temperature, it was found that BWP Guideline had more newborns with normal body temperature than GPN Practice because they were nursed with new practical cares to prevent hypothermia in newborns by using the Baby Warm Cap made from a polyethylene adult cap that has the property of not conducting heat and can retain heat well. This helps reduce loss of heat from the body of the newborn in the head area, which is in line with the WHO's statement that the surface area of a newborn's body is large compared to its weight, resulting in a large surface area for heat loss. The head of the newborn has a body surface area of 25% of the total body surface area. [4] This is consistent with the study by Possidente, et al.,[5] which studied the use of plastic bags cover the newborn's head to toes and found that wrapping infant with a polyethylene bag could effectively prevent hypothermia ($p = 0.016$). Therefore, it can be concluded that BWP Guideline to prevent hypothermia in newborns, together with the use of Baby Warm Cap made from polyethylene cap can effectively prevent heat loss in newborns.

A suitable thermal constant environment can adjust neonatal temperature to a continuous normal body temperature. As a result of this study, the researchers determined that a delivery/operating room temperature of at least 22 °C and a transition room temperature of at least 24 °C must be maintained in order for the room to be sterilized and have a normal neonatal body temperature.[8,11] They also discovered that the difference in delivery/operating room temperature and transition room temperature between BWP Guideline and GPN Practice was statistically significant, with p values of 0.001 and 0.002, respectively. This is consistent with the study by Samugjung A.,[9] who set the thermo-control in the transition room at 27 °C, where the statistic was significant ($p = 0.001$). However, this is inconsistent with the study by Muengpan T, et al.,[6,9] which set the thermo-control in the transition room at 24-26 °C whose statistic was not significant. While this study found that temperature delivery/operating, temperature Transition room and the other factors related to the occurrence of hypothermia in newborns between the BWP Guideline and GPN Practice showed no significant difference (as shown in Table 4). It was noted that the temperature room was only one risk factor that causes neonatal body temperature to hypothermia and more importantly than that other variables can also induce the hypothermia in newborns.

In future studies, researchers recommend conducting data collection proactively by specifying the number of samples groups needed for statistical analysis. Further studies should be conducted on environment factors affecting the temperature of newborns in delivery/operating rooms. Variables that may affect changes in newborn body temperature should be controlled, such as using the same operating room or control the temperature variables in all three operating rooms. This study found that all three operating rooms were used, resulting in different temperature controls in each room. To obtain accurate research results, temperatures of newborns should be measured within 10 minutes after delivery and again within 30 minutes after the newborns are transferred to the transition room. This is to determine the newborns' temperature immediately after controlling environmental factors in the delivery room/operating room and environmental factors during the newborn's transfer to the transition room.

Conclusion

BWP Guidelines for prevent hypothermia in newborns have been created by reducing factors that lead to hypothermia in newborns. These guidelines emphasize the importance of maintaining the body temperature of the newborns at the maximum level, and increasing environmental temperature. Studies have shown that the proportion of hypothermia in newborns who received care according to the BWP Guidelines was lower than that of newborns who received GPN Practice, with no significant difference.

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