



Hypothermia in Neonates

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Hypothermia is defined by the World Health Organization as a core temperature $< 36.5^{\circ}\text{C}$ (97.7°F). In preterm infants, hypothermia increases morbidity and mortality. Hypothermia may be purely environmental or represent intercurrent illness (eg, sepsis). Maintaining an appropriate environmental temperature in the delivery room or operating room is critical in preventing neonatal hypothermia. Hypothermic infants should be rewarmed, and any underlying condition must be diagnosed and treated.

Normal rectal temperature in term and preterm infants is 36.5 to 37.5°C . Although hypothermia is a core temperature $< 36.5^{\circ}\text{C}$, there may be cold stress at higher temperatures whenever heat loss requires an increase in metabolic heat production.

Pathophysiology of Hypothermia in Neonates

Thermal equilibrium is affected by relative humidity, air flow, direct contact with cool surfaces, proximity to cool objects, and ambient air temperature. Neonates are prone to rapid heat loss and consequent hypothermia because of a high surface area to volume ratio, which is even higher in low-birth-weight neonates. There are several mechanisms for heat loss:

- Radiant heat loss: Bare skin is exposed to an environment containing objects of cooler temperature.
- Evaporative heat loss: Neonates are wet with amniotic fluid.
- Conductive heat loss: Neonates are placed in contact with a cool surface or object.
- Convective heat loss: A flow of cooler ambient air carries heat away from the neonate.

Prolonged, unrecognized cold stress may divert calories to produce heat, impairing growth. Neonates have a metabolic response to cooling that involves chemical (nonshivering) thermogenesis by sympathetic nerve discharge of norepinephrine in the brown fat. This specialized tissue of the neonate, located in the nape of the neck, between the scapulae, and around the kidneys and adrenals, responds by lipolysis followed by oxidation or re-esterification of the fatty acids that are released. These reactions produce heat locally, and a rich blood supply to the brown fat helps transfer this heat to the rest of the neonate's body. This reaction increases the metabolic rate and oxygen consumption 2- to 3-fold. Thus, in neonates with respiratory insufficiency (eg, the preterm infant with [respiratory distress syndrome](#)), cold stress may also result in tissue hypoxia and neurologic damage. Activation of glycogen stores can cause transient hyperglycemia. Persistent hypothermia can result in hypoglycemia and metabolic acidosis and increases the risk of [late-onset sepsis](#) and mortality.

Despite their compensatory mechanisms, neonates, particularly low-birth-weight infants, have limited capacity to thermoregulate and are prone to decreased core temperature. Even before temperature decreases, cold stress occurs when heat loss requires an increase in metabolic heat production.

The **neutral thermal environment** (thermoneutrality) is the optimal temperature zone for neonates; it is defined as the environmental temperature at which metabolic demands (and thus caloric expenditure) to maintain body temperature in the normal range (36.5 to 37.5°C rectal) are lowest. The specific environmental temperature required to maintain thermoneutrality depends on whether the neonate is wet (eg, after delivery or a bath) or clothed, its weight, its gestational age, and its age in hours and days.

Etiology of Hypothermia in Neonates

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Hypothermia may be caused by environmental factors, disorders that impair thermoregulation (eg, [sepsis](#), [intracranial hemorrhage](#), [drug withdrawal](#)), or a combination.

Risk factors for hypothermia include [prematurity](#), delivery in an area with an environmental temperature below the recommended levels, [maternal hypertension](#), [cesarean delivery](#), and low [Apgar score](#).

Treatment of Hypothermia in Neonates

- Rewarming in an incubator or under a radiant warmer

Hypothermia is treated by rewarming in an incubator or under a radiant warmer. The neonate should be monitored and treated as needed for [hypoglycemia](#), hypoxemia, and [apnea](#). Underlying conditions such as [sepsis](#), [drug withdrawal](#), or [intracranial hemorrhage](#) may require specific treatment.

Prevention of Hypothermia in Neonates

Maintaining an appropriate environmental temperature is the most important step in preventing hypothermia in neonates. The World Health Organization (WHO) recommends the delivery room temperature be at least 25 to 28° C (77.0 to 82.4° F) and that neonates be dried immediately and placed in skin-to-skin contact with the mother and covered. (See also the WHO's [practical guide to thermal protection of the newborn](#).)

Preterm infants who are hypothermic when admitted to the neonatal intensive care unit (NICU) have increased morbidity and mortality; increasing the temperature in the delivery and operating rooms has been found to reduce the incidence of hypothermia on NICU admission. Thus, the American Academy of Pediatrics and the American Heart Association recommend that delivery and operating rooms where preterm infants are delivered have a temperature of 23 to 25° C (74 to 77° F) (1). Because raising room temperature only when delivery is anticipated may allow radiant heat loss to cool surfaces and convective heat loss caused by rapid airflow, the room should be maintained at the recommended temperature continually.

At the time of birth, neonates should be immediately dried and then swaddled (including the head) in a warm blanket to prevent evaporative, conductive, and convective losses. For a preterm infant, placement into a polyethylene bag immediately after delivery has been found to help maintain the infant's temperature; some clinicians do not dry the infant before placement in the bag because the increased humidity may be beneficial (2).

A neonate exposed for [resuscitation](#) or observation should be placed under a radiant warmer without anything blocking heat to the neonate, such as a blanket, to prevent radiant losses. Sick neonates should be maintained in a neutral thermal environment to minimize the metabolic rate. The proper incubator temperature varies depending on the neonate's birthweight and postnatal age, and humidity in the incubator. Alternatively, heating can be adjusted with a servomechanism set to maintain skin temperature at 36.5° C.

Prevention references

1. [Weiner GM, ed](#): *Textbook of Neonatal Resuscitation*, ed. 8. Itasca, American Academy of Pediatrics, 2021.

2. [Oatley HK, Blencowe H, Lawn JE](#): The effect of coverings, including plastic bags and wraps, on mortality and morbidity in preterm and full-term neonates. *J Perinatol* 36(Suppl 1):S82-S88, 2016. doi: 10.1038/jp.2016.35

Key Points

- Neonates, particularly very low-birth-weight infants, are susceptible to environmental hypothermia; disorders that impair thermoregulation (eg, intracranial hemorrhage, sepsis) increase risk.
- The optimal ambient temperature for neonates is that at which caloric expenditure needed to maintain normal body temperature is lowest, typically between 36.5° C and 37.5° C.
- Rewarm neonates in an incubator or under a radiant warmer and treat any underlying conditions.
- Prevent hypothermia by maintaining an appropriately warm environmental temperature in newborn care areas, immediately drying the neonate, and then swaddling full-term neonates or placing preterm infants in a polyethylene bag.

More Information

The following English-language resource may be useful. Please note that THE MANUAL is not responsible for the content of this resource.

World Health Organization (WHO): [Thermal protection of the newborn: A practical guide](#)



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