

Sleep Development and Body Growth of Infants in Night Time Light Exposure

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Perspective

Previous studies have demonstrated that a light-dark cycle has promoted better sleep development and weight gain in preterm infants than constant light or constant darkness. However, it was unknown whether brief light exposure at night for medical treatment and nursing care would compromise the benefits brought about by such a light-dark cycle. To examine such possibility, we developed a special red LED light with a wavelength of >675 nm which preterm infants cannot perceive. Preterm infants born at <36 weeks' gestational age were randomly assigned for periodic exposure to either white or red LED light at night in a light-dark cycle after transfer from the Neonatal Intensive Care Unit to the Growing Care Unit, used for supporting infants as they mature. Activity, night-time crying and body weight were continuously monitored from enrolment until discharge. No significant difference in rest-activity patterns, night-time crying, or weight gain was observed between control and experimental groups. The data indicate that nursing care conducted at 3 to 4-hour intervals exposing infants to light for <15 minutes does not prevent the infants from developing circadian rest-activity patterns, or proper body growth as long as the infants are exposed to regular light-dark cycles.

Circadian rhythms are endogenously generated rhythms that have a period length of about 24 hours. Evidence gathered over the past decade indicates that the circadian clock in the suprachiasmatic nuclei (SCN) in the anterior hypothalamus develops prenatally by mid-gestation in non-human primates and humans. Human preterm infants can respond to light, possibly through the retinal ganglion cells containing melanising in the retina, as early as the corrected gestational age of 30 weeks and start to develop circadian behavioural rhythms in a light-dark (LD) cycle. The rod cells containing rhodopsin in the retina also seem to respond to light at around 34 weeks' gestational age (WGA). In full-term infants, circadian system outputs mature progressively after birth, with rhythms in body temperature, sleep-wake cycles and hormone production generally developing between 0 and 3 months of age¹⁰.

The importance of regular LD cycles in early human development is demonstrated by the fact that the establishment of circadian rest-activity patterns and postnatal weight gains among preterm infants is accelerated in Neonatal Intensive Care Units (NICUs) that employ regular LD cycles. In contrast, continuous light or dark conditions delay the onset of circadian behavioural rhythms and lead to reduced weight gain in preterm infants. In addition, pregnant women exposed to irregular LD cycles have been reported to have increased rates of reproductive abnormalities such as miscarriage, preterm delivery and low birth weight of offspring. A recent animal study also demonstrated that the exposure of pregnant rats to constant light, which

disrupts the circadian environment of fetuses, induces fetal growth retardation in utero.

Even among preterm infants and neonates raised in regular LD cycles, there is still a possibility that light exposure during night-time for medical and nursing care disrupts their development of circadian systems. In adults, night-time exposure to white light or light-emitting eBooks has been reported to affect their circadian rhythms. Preterm infants in NICUs also experience repeated 15–30-min exposures of white LED light every 2–4 hours during feeding and diaper changes. To protect preterm infants from the possible negative effects of night-time lighting on their development in the NICU, we have developed a red LED light with a wavelength of >675 nm, which preterm infants cannot detect due to the prematurity of their retinal photoreceptors such as cone cells, which mature at a later developmental stage 4,7,8,9. In this study, we investigated whether night-time nursing care using conventional white LED light has some adverse effects on establishment of circadian rhythm and weight gain in preterm infants compared to nursing care conducted using our developed red LED light [1-5].

A total of 42 infants were enrolled in this study. The characteristics of these infants are (mean ± S.D., throughout). Between the control and experimental groups, no statistical differences were observed in birth weight, gestational age at birth, gestational age at enrolment, length of intervention, discharge weight, discharge head circumference. The specialized focus of paediatrics did not begin to emerge in Europe until the 18th century. The first specialized children's hospitals, such as the London Foundling Hospital, established in 1745, were opened at this time. These hospitals later became major centres for training in paediatrics, which began to be taught as a separate discipline in medical schools by the middle of the 19th century.

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