

Introduction

Infant sleep is a subject of great interest—and concern—for many new parents. Parental expectations for infant sleep often reflect cultural norms that may not align well with the realities of infant growth and development. Unrealistic expectations for infant sleep have been linked to the early cessation of breastfeeding (Ball 2003) and may contribute to the development of postnatal depression symptoms (Muscat, Thorpe & Obst 2012). Parents frequently consult health providers for advice when their infant's sleep does not meet expectations (Polnay et al. 1999, Douglas, Hill 2013). This article provides a review of infant sleep biology, duration, and development, that offers a solid basis to educate expectant parents and to advise and reassure new parents about normal infant sleep.

The Biological Role of Sleep

Sleep is a biological necessity for all human beings, driven by the body's homeostatic process. The longer a period of wakefulness lasts, the stronger is the sleep pressure that eventually builds up (Davis, Parker & Montgomery 2004). Sleep enables growth, healing and the maintenance of normal body and immune functioning (Davis, Parker & Montgomery 2004, Jenni, O'Connor 2005). A crucial function of sleep appears to be the renewal of the tissues of the brain and central nervous system, as well as supporting learning and memory consolidation (Davis, Parker & Montgomery 2004, Jenni, O'Connor 2005). Sleep contributes to brain plasticity, the brain's ability to modify its function and even its structure in response to external experiential cues (Dang-Vu et al. 2006, Bertelle et al. 2007). A lack of sleep can lead to impairments in behavioural, cognitive and emotional functioning, as well as decreased ability to concentrate (Davis, Parker & Montgomery 2004, Bertelle et al. 2007).

Cultural Influence over Sleep

Although sleep is a biological necessity that is a human universal, the way we sleep is strongly influenced by wider cultural values, practices and assumptions (Worthman 2011).

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What is considered “normal” with regard to adult and infant sleep varies from culture to culture (Glaskin, Chenhall 2013), as well as through time (Ekirch 2001). In response to particular cultural and political-economic pressures related to employment, the Western ideal for sleep is a single unbroken 8-hour period that occurs during the night. While many people within Western cultures have sleep patterns that do not adhere to this norm (i.e. shift workers, elderly people), the cultural assumption that it is the correct way to sleep is strong (Worthman 2011). However, infants are not influenced by this assumption. Infant sleep is driven by biological necessity and is shaped by our evolutionary history (Jones, Ball 2012). Mismatches between infants’ biologically-based requirements for sleep and adult cultural expectations play an important role in shaping parental perceptions of infant sleep as problematic (Ball 2003, Jenni, O’Connor 2005, Gettler, McKenna 2011). Some experts on infant sleep have been led to wonder “whether at least some sleep-related problems of children are not in fact created by cultural practices that may be incongruent with aspects of sleep biology or with stages of a child’s emotional development” (Jenni, O’Connor 2005).

Evolutionary background to infant sleep

Infant sleep biology has evolved over millennia, shaped by the nature of human mother-infant interactions. Human infants have a set of biological “expectations” that evolved based on what was normal during the course of human evolution (McKenna, Ball & Gettler 2007). Human infants are born developmentally immature as a trade-off between our large human brains and the necessity for the infant to pass through the birth canal (Trevathan 1996). As a consequence, they are not able to care for themselves or to be left alone for many months after birth. Therefore, infants “expect” to be in nearly constant contact with their mothers, to sleep in proximity with them and to be breastfed frequently throughout the day and night, since adequate replacement foods did not exist (Ball, Klingaman 2008). In this context, human milk has evolved to provide quick energy supply, through high levels of milk sugars, and to be easily digestible due to lower levels of fat and protein (Riordan 2005). In the early weeks and months

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of life infants biologically “expect” a feeding every few hours or less, and, accordingly, their sleep patterns reflect a need to awaken frequently.

Infant Sleep Architecture

Infant sleep cycles are considerably shorter than adult sleep cycles, lasting about 60 minutes, compared with adult sleep cycles of between 90 and 100 minutes (Jenni, Borbely & Achermann 2004). Infants spend much more time than adults in “active sleep,” the equivalent of Rapid Eye Movement (REM), or dreaming sleep. In early infancy over 50% of sleep time is spent in active sleep, dropping to about 30% at 8 months of age (Sheldon 2006). This compares with about 20% REM in adult sleep (Siegel 2005). The other half of the infant sleep cycle is “quiet sleep,” the equivalent of adult Non-Rapid Eye Movement (NREM), or deep sleep. In infants, active sleep occurs first in each 60-minute cycle, followed by quiet sleep. In adult sleep, deep sleep occurs first, followed by increased periods of dreaming sleep towards the end of the sleep episode (Bertelle et al. 2007). Infants are more easily woken during periods of active sleep than quiet sleep and are more likely to awaken during the transition between states (Parslow et al. 2003). However, while it may seem appealing to parents to promote longer periods of deep sleep for the infant (and therefore minimise awakenings), the high percentage of active sleep seen in infants is thought to play an important role in infant brain development.

Brain growth and development occurs more rapidly during infancy than at any other period of development. Neural connections in the brain peak between two and four months of life at double the adult number (Goldman-Rakic 1987). Researchers have suggested, therefore, that since infants spend a great deal of their time asleep, the neurological activation that occurs in the brain during active sleep is essential for the development and maintenance of the brain’s neural network (Bertelle et al. 2007, Siegel 2005). Quiet sleep provides the opportunity for consolidation of the changes in neural pathways brought about in response to periods of wakefulness or brain activation (Bertelle et al. 2007).

Infant Sleep Duration

Just as infant sleep architecture differs from that of adults, so too do infant sleep patterns and duration. In adults, the instinct to sleep at night and be awake during the day is driven by the circadian rhythm, which ties biological functions to the light/dark cycle of the 24-hour day (Bertelle et al. 2007). When infants are born, they are not attuned to this cycle (Ardura et al. 2003); as a result, in the early months of the infant's life, sleep occurs in short blocks that are distributed throughout the day and night (Henderson, France & Blampied 2011). A comprehensive review of studies on infant sleep duration from around the world has identified norms for infants up to one year of age (Galland et al. 2012). Drawing on the results from 34 studies, the review found that between birth and two months of age infants sleep an average of 14.6 hours distributed throughout the 24-hour day. A great deal of variation in sleep duration exists between infants, with some sleeping as little as 8 hours in 24 and others as much as 22 hours (Galland et al. 2012). Between birth and two months infants wake on average 1.7 times overnight (range: 0-3.4) (Galland et al. 2012). As the circadian rhythm emerges in response to daylight and social cues during the first four months, infants begin to consolidate their sleeping time into a longer overnight period (Henderson, France & Blampied 2011). In the period between three and six months, infants wake on average 0.8 times overnight (range: 0-3.0) (Galland et al. 2012). By six months of age, the average number of hours of sleep has dropped to 12.9 hours and stays at roughly that level through to two years of age. The range of variation among infants narrows from 8.8 to 17 hours at six months, to about 10 to 15 hours from 12 months to two years (Galland et al. 2012). Sharing these well-evidenced norms with parents may help to reassure them that their infant's sleep patterns and duration are appropriate for their stage of development.

Sleeping Through the Night

One of most frequent questions that parents are asked by friends and family, and that they in turn inquire about with health care providers, is when their infant will begin to sleep through the night. Colloquially, an infant who "sleeps through the night" is understood to fall asleep and sleep without waking until a time that is considered appropriate to wake for the rest

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of the family. Scientifically, however, sleeping through the night, or “settling” has been defined more narrowly (Henderson, Motoi & Blampied 2013). One of the most influential early studies on infant sleep defined “sleeping through the night” as sleeping for a five hour stretch between midnight and 5am (Moore, Ucko 1957). The researchers followed 104 infants in order to ascertain when they began to sleep through the night. Using the midnight to 5am definition, they found that 70% of infants began sleeping through by three months of age (Moore, Ucko 1957). However, of the infants who began to sleep through by three months, half—about 35% of the total—subsequently reverted to waking at night between six and 12 months of age. An additional 10% of the infants did not sleep through the night at all during their first year. Together, these findings indicate that about 45% of the infants, or *nearly half*, did not consistently sleep through the night by one year of age, even using the narrow definition of midnight to 5am. Unfortunately, whereas the three month finding has become a guideline that is widely quoted (Jones, Ball 2012), this latter finding is not well known to parents and practitioners.

A recent study has extended this work on infant settling, by looking at differences in the age when infants “sleep through the night” using three definitions: a narrow definition (midnight to 5am); a broader definition (any unbroken 8-hour stretch overnight); and a “family congruent” definition (10pm-6am) (Henderson et al. 2010). The third definition comes closest to reflecting what is colloquially meant by “sleeping through the night” (Henderson, Motoi & Blampied 2013). Following 75 infants, the researchers found that by three months of age 50% of the infants slept without waking between midnight and 5am, and 50% slept without waking for an 8-hour period. However, it was not until five months of age that 50% of infants slept without waking from 10pm to 6am (Henderson et al. 2010). This finding suggests that a more appropriate parental guideline for when an infant might start to sleep through the night would be five months or later. At the same time, more than a quarter of the infants (28%) in the study had not started to sleep without waking between 10pm to 6am by the time they turned one year of age. The global review of infant sleep described above found that night waking continues to be very common through the second half of the first year and the second year,

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with an average of 1.1 and 0.7 awakenings, respectively (Galland et al. 2012). Parents should be reassured that infant night waking is an extremely common occurrence through the first year and second year.

There are several key implications to these studies that new parents should be made aware of with regard to “sleeping through the night.” First, scientific sources may define sleeping through the night differently from common usage, which can lead to inappropriate parental expectations for infant sleep. At the same time, many infants do not sleep through the night during their first 12 months, even when it is defined as a period of five overnight hours. Infant sleep development is not linear; many infants start to sleep through the night at some point, but then revert to night waking as new developmental processes take place. Finally, the point at which an infant sleeps for a period similar to the rest of the family (family congruent “sleeping through the night”) is likely to occur substantially later than the point at which the infant sleeps for a period from midnight to 5am (scientifically-defined “sleeping through the night”).

Strategies

Parents frequently look for strategies to help them deal with infant sleep. The “babymoon” is a strategy that can maximise maternal sleep and rest in the very early postpartum period. Many cultures have traditionally mandated a period of rest and recovery following birth, in which the mother primarily takes care of her new infant’s needs, while family members and friends take care of the mother herself, any older children and contribute to the cooking and cleaning. The names given to this period vary by location, but include *la cuarentena*, *resguardo* and *doing the month* (Piperata 2008, Waugh 2011, Callister 2006). Breastfeeding promoters who encourage a “breastfeeding vacation,” involving extended rest periods, minimal household responsibilities and on-demand breastfeeding echo these long established practices. It must be said that the degree of social and familial support available to the new parents will likely determine whether a “babymoon” period is practicable.

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Another widely discussed intervention for infant sleep is known as “sleep training”, often using an extinction or “Cry It Out” approach. In this process, infants are left to fall asleep alone, in a room separate from caregivers. Parents are instructed to leave the infant to “self-soothe” and not to respond to crying for increasing periods of time (Douglas and Hill 2013). Sleep training of infants younger than six months has not been found to improve infant and maternal outcomes related to sleep (Douglas, Hill 2013) and there is evidence that the process is highly stressful for infants. Australian researchers who looked at infants who were being sleep trained found that on the first day of the process infant crying increased and the infants showed elevated levels of cortisol, a stress hormone at and after bedtime (Middlemiss et al. 2012). By the third day, the infants had stopped crying when left alone to fall asleep, but they continued to show elevated cortisol. Essentially, in the face of a lack of response, the infants had ceased the “signalling behaviour” that should normally alert a caregiver to their distress, but they nevertheless continued to experience high levels of stress (Middlemiss et al. 2012). Parents who inquire about sleep training methods should be informed of the potential negative effects of sleep training, and supported to explore strategies that may improve their own and their infant’s sleep (e.g., bedsharing-see Russell, this volume).

Summary

This article has reviewed the evidence on infant sleep biology and sleeping patterns, and presented normative data for infant sleep duration and the age at which infants may sleep through the night. This data provides a solid evidence base for advising new and expectant parents regarding infant sleep through the first two years of life.

Literature Cited

Ardura, J., Gutierrez, R., Andres, J. & Agapito, T. (2003), Emergence and evolution of the circadian rhythm of melatonin in children, *Hormone Research*, vol. 59, no. 2, pp. 66-72.

Ball, H.L. (2003), Breastfeeding, bed-sharing, and infant sleep, *Birth-Issues in Perinatal Care*, vol. 30, no. 3, pp. 181-188.

- Rudzik, AEF. Normal Infant Sleep and Parental Expectations. *International Journal of Birth and Parental Education*. 2(2): 7-10.
- Ball, H.L. & Klingaman, K. (2008), Breastfeeding and Mother-Infant Sleep Proximity: Implications for Infant Care in *Evolutionary medicine and health : new perspectives*, eds. W. Trevathan, E.O. Smith & J.J. McKenna, Oxford University Press, New York, pp. 226-241.
- Bertelle, V., Sevestre, A., Laou-Hap, K., Nagahapitiye, M.C. & Sizun, J. (2007), Sleep in the neonatal intensive care unit, *Journal of Perinatal & Neonatal Nursing*, vol. 21, no. 2, pp. 140-148.
- Callister, L.C. (2006), Doing the month: Chinese postpartum practices, *Mcn-the American Journal of Maternal-Child Nursing*, vol. 31, no. 6, pp. 390-390.
- Dang-Vu, T.T., Deseilles, M., Peigneux, P. & Maquet, P. (2006), A role for sleep in brain plasticity., *Pediatric Rehabilitation*, vol. 9, no. 2, pp. 98-118.
- Davis, K.F., Parker, K.P. & Montgomery, G.L. (2004), Sleep in infants and young children: Part one: normal sleep., *Journal of pediatric health care : official publication of National Association of Pediatric Nurse Associates & Practitioners*, vol. 18, no. 2, pp. 65-71.
- Douglas, P.S. & Hill, P.S. (2013), Behavioral Sleep Interventions in the First Six Months of Life Do not Improve Outcomes for Mothers or Infants: A Systematic Review., *Journal of Developmental and Behavioral Pediatrics*, vol. 34, no. 7, pp. 497-507.
- Ekirch, A.R. (2001), Sleep we have lost: Pre-industrial slumber in the British isles, *American Historical Review*, vol. 106, no. 2, pp. 343-386.
- Galland, B.C., Taylor, B.J., Elder, D.E. & Herbison, P. (2012), Normal sleep patterns in infants and children: A systematic review of observational studies, *Sleep Medicine Reviews*, vol. 16, no. 3, pp. 213-222.
- Gettler, L.T. & McKenna, J.J. (2011), Evolutionary Perspectives on Mother-Infant Sleep Proximity and Breastfeeding in a Laboratory Setting, *American Journal of Physical Anthropology*, vol. 144, no. 3, pp. 454-462.
- Glaskin, K. & Chenhall, R. (eds) (2013), *Sleep around the world : anthropological perspectives*, Palgrave Macmillan, New York.
- Goldman-Rakic, P.S. (1987), Development of Cortical Circuitry and Cognitive Function, *Child development*, vol. 58, no. 3, pp. 601-622.
- Henderson, J.M.T., France, K.G. & Blampied, N.M. (2011), The consolidation of infants' nocturnal sleep across the first year of life, *Sleep Medicine Reviews*, vol. 15, no. 4, pp. 211-220.

- Rudzik, AEF. Normal Infant Sleep and Parental Expectations. *International Journal of Birth and Parental Education*. 2(2): 7-10.
- Henderson, J.M.T., France, K.G., Owens, J.L. & Blampied, N.M. (2010), Sleeping Through the Night: The Consolidation of Self-regulated Sleep Across the First Year of Life, *Pediatrics*, vol. 126, no. 5, pp. e1081-e1087.
- Henderson, J.M.T., Motoi, G. & Blampied, N.M. (2013), Sleeping through the night: a community survey of parents' opinions about and expectations of infant sleep consolidation., *Journal of Paediatrics and Child Health*, vol. 49, no. 7, pp. 535-40.
- Jenni, O.G., Borbely, A.A. & Achermann, P. (2004), Development of the nocturnal sleep electroencephalogram in human infants, *American Journal of Physiology-Regulatory Integrative and Comparative Physiology*, vol. 286, no. 3, pp. R528-R538.
- Jenni, O.G. & O'Connor, B.B. (2005), Children's sleep: An interplay between culture and biology, *Pediatrics*, vol. 115, no. 1, pp. 204-216.
- Jones, C.H.D. & Ball, H.L. (2012), Medical anthropology and children's sleep: the mismatch between Western lifestyles and sleep physiology in *Sleep: Multidisciplinary Perspectives*, eds. A. Green & A.M. Westcombe, Jessica Kingsley Publishers, London, pp. 86-103.
- McKenna, J.J., Ball, H.L. & Gettler, L.T. (2007), Mother-infant cosleeping, breastfeeding and sudden infant death syndrome: what biological anthropology has discovered about normal infant sleep and pediatric sleep medicine., *American Journal of Physical Anthropology*, vol. Suppl 45, pp. 133-61.
- Middlemiss, W., Granger, D.A., Goldberg, W.A. & Nathans, L. (2012), Asynchrony of mother-infant hypothalamic-pituitary-adrenal axis activity following extinction of infant crying responses induced during the transition to sleep., *Early Human Development*, vol. 88, no. 4, pp. 227-32.
- Moore, T. & Ucko, L.E. (1957), Night Waking in Early Infancy: Part I, *Archives of Disease in Childhood*, vol. 32, no. 164, pp. 333-342.
- Muscat, T., Thorpe, K. & Obst, P. (2012), Disconfirmed expectations of infant behaviours and postnatal depressive symptoms among parents, *Journal of Reproductive and Infant Psychology*, vol. 30, no. 1, pp. 51-61.
- Parslow, P.M., Harding, R., Cranage, S.M., Adamson, T.M. & and Horne, R.S. (2003), Arousal responses to somatosensory and mild hypoxic stimuli are depressed during quiet sleep in healthy term infants, *Sleep*, vol. 26, no. 6, pp. 739-744.
- Piperata, B.A. (2008), Forty days and forty nights: A biocultural perspective on postpartum practices in the Amazon, *Social Science & Medicine*, vol. 67, no. 7, pp. 1094-1103.

Rudzik, AEF. Normal Infant Sleep and Parental Expectations. *International Journal of Birth and Parental Education*. 2(2): 7-10.

Polnay, L., Blair, M., Horn, N. & Nathan, D. (1999), *Manual of Community Paediatrics*, Churchill Livingstone, Edinburgh.

Riordan, J. (2005), *Breastfeeding and Human Lactation (3rd edition)*, .

Sheldon, S.H. (2006), Sleep in infants and children. in *Sleep: a comprehensive handbook* , ed. T.L. Lee-Chiong, Wiley, Hoboken, N.J., pp. 507-510.

Siegel, J.M. (2005), Functional implications of sleep development, *PLoS Biology*, vol. 3, no. 5, pp. 756-758.

Trevathan, W.R. (1996), The evolution of bipedalism and assisted birth, *Medical Anthropology Quarterly*, vol. 10, no. 2, pp. 287-290.

Waugh, L.J. (2011), Beliefs Associated with Mexican Immigrant Families' Practice of La Cuarentena during Postpartum Recovery, *JOGNN-Journal of Obstetric Gynecologic and Neonatal Nursing*, vol. 40, no. 6, pp. 732-741.

Worthman, C.M. (2011), Developmental Cultural Ecology of Sleep in *Sleep and Development: Familial and Socio-Cultural Considerations*, ed. M. El-Sheikh, Oxford University Press, Oxford.