CHAPTER 22

Sleep Disorders

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Although the term "sleeping like a baby" conventionally implies certain characteristics, such as sleeping deeply and for long, uninterrupted bouts, developmental sleep researchers—and anyone who has ever lived with an infant—have long understood that "typical" infant sleep is characterized by a variety of different behaviors and patterns, as well as a number of structural features ("sleep architecture") unique to sleep in early life. Furthermore, the regulation of sleep, which involves the interaction between the homeostatic "sleep drive" and circadian-based timing, undergoes substantial developmental changes across the first 3 years of life, and infants often experience either transitory or longer-lasting disturbances in their sleep during this period. In this chapter, we review the typical course of sleep–wake state development across the first 3 years of life, discuss the most common sleep disturbances seen during this period, describe sleep problems in the context of other disorders, and provide an overview of common interventions used to treat infant–toddler sleep problems.

Ontogenetic Course of Sleep Across the First 3 Years

Although the focus of this chapter is on postnatal development, it should be noted that researchers generally agree that sleep states are evident in the last trimester of the prenatal period. Mirmiran, Maas, and Ariagno (2003), in a review of this work, reported that both active and quiet sleep can be differentiated as early as 32 weeks' gestation, and that quiet sleep increases from 32 to 40 weeks' gestation, with a concomitant decrease in indeterminate sleep. Active sleep (AS), however, appears to remain relatively constant during the last weeks of gestation. Similar results are found in preterm infants of the same postconceptional age. The high proportion of AS during late gestation parallels rapid brain maturation that is occurring at this time, implicating AS as potentially playing a role in brain development (Mirmiran et al., 2003). In addition to these changes in sleep architecture during the prenatal period of life, circadian rhythms also are evident in the last trimester of gestation. Mirmiran and Lunshof (1996) and Lunshof and colleagues (1998) have reported a circadian fetal heart rate rhythm that is entrained to maternal rest–activity, cortisol, melatonin, body temperature, and heart rate rhythms. Thus, even during prenatal life, the circadian clock appears to be functional.

Following the prenatal period, dramatic changes in sleep occur during the first 3 years of life, including average sleep duration, sleep architecture, and timing of sleep and wakefulness across the 24-hour day. At birth, the typi-

cal infant spends significantly more time asleep than awake, has a disproportionately higher percentage of active versus quiet sleep, and sleeps about the same amount during the day and night (Kleitman & Englemann, 1953; Roffwarg, Dement, & Fisher, 1964). By age 3, all of this has changed, such that the average 3-year-old has consolidated sleep into one lengthy nighttime bout and one daytime nap, is starting to exhibit adult proportions of active and quiet sleep, and sleeps for an average of about 12 hours per 24-hour day (Galland, Taylor, Elder, & Herbison, 2012; Jacklin, Snow, Gahart, & Maccoby, 1980). We discuss in turn each of these transformations.

Detailed studies of infant sleep in the midportion of the previous century served to inform some general misperceptions that existed at the time. For example, it was discovered that during the newborn period, the average child sleeps approximately 16–17 hours per day, in sharp contrast to the 20–22 hours reported in pediatric textbooks prior to the 1950s (Kleitman & Englemann, 1953; Parmelee, Schulz, & Disbrow, 1961). Also, it had been generally accepted that the total amount of sleep declines early in infancy. The seminal longitudinal work of Kleitman and Engelmann (1953), however, indicated that the total duration of sleep did not differ over the first 3 months of life; rather, it is the distribution of sleep across the 24-hour day that changes, so that more sleep becomes prominent (or "consolidated") during the nighttime hours. This finding has been substantiated in subsequent investigations (e.g., Anders & Keener, 1985; Coons & Guilleminault, 1984). Total sleep time across 24 hours does decline somewhat beyond the 3-month mark, but most infants continue to sleep between 12 and 14 hours per day through the age of 2 years. The longest uninterrupted sleep period at night continues to increase until it levels off sometime between ages 3 and 6 months for the remainder of the first year of life (Anders & Keener, 1985; Burnham, Goodlin-Jones, Gaylor, & Anders, 2002; Galland et al., 2012). Notwithstanding these changes, it should be noted that "sleeping through the night" is a misnomer for most infants and toddlers across the first 3 years of life. Most young children continue to wake up during the night; a substantial proportion, however, learn to self-soothe ("regulate" sleep) and put themselves back to sleep independently upon such awakenings (e.g., Burnham et al., 2002; Keener, Zeanah, & Anders, 1988).

In addition to changes in the total amount of sleep, substantial changes occur in the nighttime architecture of sleep as well. For instance, although the typical adult enters sleep at the beginning of the night through non-REM (nonrapid eye movement) sleep stages (then progressing through Stages 1–4), very young infants enter sleep in an active (or "REM-like") sleep state. AS onset occurs prenatally and generally declines during the early months of life. Coons and Guilleminault (1984) report a significant decrease in AS-onset sleep periods between ages 3 and 6 weeks, and again between ages 4 and 6 months. In addition to the entry into AS, young infants also experience much higher proportions of total sleep time in AS compared to adults and older children (Ficca, Fagioli, & Salzarulo, 2000; Jenni, Borbély, & Achermann, 2004; Kurth, Olini, Huber, & LeBourgeois, 2015). The decline in the percentage of the night spent in AS across the first year of life is accompanied by a concomitant increase in quiet (or "slow wave-like") sleep (Anders et al., 1985; Burnham et al., 2002; Dittrichová, 1966; Kurth et al., 2015; Louis, Cannard, Bastuji, & Challamel, 1997). For instance, Jenni and colleagues (2004) reported that 2-week-olds spend approximately 51% of the night in AS and 39% of the night in quiet sleep; these percentages gradually change to 30 and 70%, respectively, by 9 months of age. As mentioned in the section on prenatal development, the proclivity for AS during early development is thought to play a role in healthy brain development (Kurth et al., 2015; Peirano, Algarín, & Uauy, 2003). The cycle length of each AS–quiet sleep bout is also shorter in infancy and early childhood compared to the 90-minute cycle characteristic of adult sleep architecture. This so-called "ultradian cycle" is closer to 60 minutes in infancy (Aserinsky & Kleitman, 1955; Dittrichová, 1966; Harper et al., 1981), with the adult cycle pattern thought to emerge sometime during middle childhood (Roffwarg et al., 1964).

Perhaps the most striking developmental sleep change that occurs during early infancy is the maturation of the circadian system and the infant's gradual synchronization (or "entrainment") to the 24-hour light–dark cycle. The bulk of research to date suggests that in newborns, there is no clear relationship between sleep and wakefulness and time of day. Rather, sleep patterns are largely dependent on hunger and satiety, and feeding schedules. Thus, sleep

is distributed for the young infant almost equally between night and day. Young infants typically sleep for 3- to 4-hour periods (which may be shorter in breastfed infants) separated by 1–2 hours of wakefulness. Remarkably, by about 3 months of age, most infants have established consolidated sleep periods that occur during the nighttime hours (Bamford et al., 1990; Burnham, 2007; McMillen, Kok, Adamson, Deayton, & Nowak, 1991; St. James-Roberts, Roberts, Hovish, & Owen, 2015).

Although often ignored in discussions of "average" or "typical" sleep, there is a great deal of individual variability in total sleep amount, in the timing of sleep–wake rhythmicity, in the proportion of time spent in each sleep state during sleep itself, and in the longest period of consolidated sleep, among other sleep–wake variables (e.g., Anders, Halpern, & Hua, 1992; Emde & Walker, 1976; Fazzi et al., 2006; Galland et al., 2012; Louis et al., 1997; Navelet, Benoit, & Bouard, 1982; Sadeh, Hauri, Kripke, & Lavie, 1995; St. James-Roberts & Plewis, 1996). For example, an epidemiological study of 493 children ages 1 month to 16 years in Switzerland revealed significant variability in total sleep duration, nighttime sleep duration, and daytime sleep duration (Iglowstein, Jenni, Molinari, & Largo, 2003). In a longitudinal study of almost 3,000 children from birth to 6–7 years, Magee, Gordon, and Caputi (2014) found four different developmental trajectories in regards to sleep duration: typical sleepers (40.6%), initially short sleepers (45.2%), poor sleepers (2.5%), and persistent short sleepers (11.6%). Some of the differences were associated with environmental, parental, and child factors. A more recent study of over 700 parent–child pairs showed a higher interindividual variability in sleep patterns until age 6 months, then little variability in bedtime, sleep latency, and sleep duration from 6–12 months (Bruni et al., 2014). Although researchers are beginning to recognize and examine these individual differences and possible etiological factors in older children (e.g., Buckhalt, El-Sheikh, & Keller, 2007) and adults (Tucker, Dinges, & Von Dongen, 2007), more research into individual differences at earlier ages is needed. These interindividual differences are important partly because they illuminate the complexity involved in clearly defining the boundary between normal and pathological sleep in young children, and in recognizing and evaluating sleep disturbance in this population.

Sleep Disturbances

Definition

As described earlier, the definition of a sleep "problem" in infants and toddlers is complicated by the existence of considerable variability in individuals' "normal" sleep. There are additional complicating factors as well. Factors such as inter- and intracultural variation in what is considered "normal," extreme developmental changes that are occurring during this age period, the fact that sleep disturbances occur in the context of parent–child relationships, and the existence of various systems for clinically classifying sleep "disorders" are all involved in complicating the definition of sleep problems in this age group. For example, culturally based values and beliefs regarding the meaning, importance, and role of sleep in daily life, as well as culturally based differences in sleep practices (e.g., sleeping space and environment, solitary sleep vs. cosleeping, use of transitional objects) have a profound effect on not only how a parent defines a sleep "problem" but also the relative acceptability of various treatment strategies.

Thus, parental concerns and subjective observations regarding their child's sleep patterns and behaviors often define what constitutes a sleep "disturbance" in the clinical context. Certainly, the two are intertwined. For example, in a recent study, parental sleeping problems were associated with more frequent reporting of children's sleeping problems in 2- to 6-year-olds (Rönnlund, Elovainio, Virtanen, Matomäki, & Lapinleimu, 2016). Of course, when an infant wakes up, parents' sleep may be disrupted. Thus, the definition of a sleep problem in an infant is at least partly characterized by parental sleep disruption. Parental recognition and reporting of sleep problems in children also varies across childhood, with parents of infants and toddlers more likely to be aware of sleep concerns than those of school-age children, for example. Medical concerns in an infant, such a prematurity, or congenital conditions, such as Down syndrome (Bassell, Phan, Leu, Kronk, & Visootsak, 2015) may predispose to both parental and subsequent child insomnia (Blomqvist, Nygvist, Rubertsson, & Funkquist, 2017). Finally, the daytime sequelae of inadequate or disrupted sleep may also be less easily recognized in infants, as excessive daytime sleepiness in children is frequently manifested as behavioral and/or mood dysregulation or neu-

rocognitive dysfunction. Interestingly, Kocevska and colleagues (2017) reported that parent-identified sleep problems prior to age 2 years was not associated with later adverse impacts on brain morphology. Sleep problems reported by parents after the age of 2, however, were associated with smaller gray-matter volume at age 7. Clinicians, then, need to exercise caution in diagnosing and treating sleep problems in very young children and must consider the many contextual and developmental factors that may be contributing to what is perceived as a "sleep disturbance."

Prevalence

Despite the difficulty in delineating a clear, universally accepted definition of "problem sleep" in the infant–toddler population, concerns with sleep are among the most common complaints of parents during well-baby visits (Thiedke, 2001). For example, in a study of over 700 parent–child dyads including infants from birth to age 12 months, almost 10% of infants had parent-reported sleep problems, defined as difficulty settling and problematic night wakings (Bruni et al., 2014). In a large-scale study of over 2,000 children from birth to age 36 months in Australia and New Zealand, over 30% of parents reported their infants' sleep to be problematic (Teng, Bartle, Sadeh, & Mindell, 2012). During infancy and toddlerhood, the most frequent caregiver complaints were excessive night waking and settling problems at bedtime, with the former being more prevalent earlier in life and the latter in toddlerhood and beyond (Mindell, 1993). Prevalence rates are largely determined by parental report, although some studies have shown similar rates using objective measures of sleep and a priori established research criteria (e.g., sleep onset ≥ 30 minutes, occurring ≥ 5 nights/week for ≥ 3 weeks; Gaylor, Goodlin-Jones, & Anders, 2001). The most commonly reported overall prevalence rate of any type of sleep problem in the infant–toddler population is around 25% (Lozoff, Wolf, & Davis, 1985; Richman, 1981; Teng et al., 2012). However, in a poll, the National Sleep Foundation (2004) found that only 6% of parents of infants and 11% of parents of toddlers reported a sleep problem in their child. Thus, it is important to conduct more population-based studies and to use consistent definitions, in order to determine clear and accurate prevalence rates.

Clinicians often rely exclusively on parent report of a problem in order to diagnose and treat a sleep disturbance in an infant or toddler. Indeed, sleep problems in infants and toddlers have been found to be correlated with maternal postpartum depression (Hairston, Solnik-Menilo, Deviri, & Handelzalts, 2016), paternal depression, increased anger and stress (Cook et al., 2017; Millikovsky-Ayalon, Atzaba-Poria, & Meiri, 2015), parental fatigue, lower levels of tolerance to crying (Sadeh et al., 2016), lower parental health literacy (Bathory et al., 2016), general disruptions to family life, poor maternal mental and physical health, and lower levels of parental well-being (e.g., Bayer, Hiscock, Hampton, & Wake, 2007). Many parents clearly do find disruptions in their child's sleep to be problematic, but individual tolerance levels and expectations differ greatly; furthermore, the threshold for seeking "professional help" from a variety of health care providers (e.g., primary care pediatricians, mental health specialists, and behavioral sleep medicine specialists, as well as other sources, such as "sleep coaches") likely varies greatly and is influenced by myriad factors ranging from culturally based values to the presence of social support networks, to insurance coverage and access to health care in a given community. Not only does this complex relationship likely profoundly reduce prevalence rates (which are frequently based on diagnostic coding and billing in the health care system), but it also very probably underestimates the impact on sleep problems on both young children and families.

Problematic Night Waking

As discussed earlier, the most common sleep complaint in the infant–toddler population is night waking. Despite research evidence suggesting that sleep problems may be different in very young children compared to how they present in adults, the most recent version of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5; American Psychiatric Association, 2013) and the third edition of the *International Classification of Sleep Disorders* (ICSD-3; American Academy of Sleep Medicine, 2014) do not distinguish between childhood and adulthood sleep disorders. Night-waking problems are classified under the broad term "dysomnia," or difficulty initiating or maintaining sleep. The DSM-5 classification has limited

usefulness in the infancy period because specific criteria for young children are not distinguished, and young children rarely meet the impairment and/or severity criteria for the adult diagnosis. Most night waking during infancy is thought to occur because the infant has learned to depend on or need specific circumstances or objects ("sleep-onset associations") introduced by a caregiver (e.g., rocking, nursing, or a pacifier) in order to fall asleep. These are typically available to the child at bedtime; however, these same sleep-onset associations are also often needed by the child in order to fall *back to sleep* after normal arousals or awakenings during the night. Thus, when the child wakes at night and these circumstances or objects are not present, the parent must reintroduce them in order for the child to reinitiate sleep. As infants and children typically arouse briefly on average four to six times throughout the night as a result of the normal ultradian rhythm of sleep cycles, these night wakings (or, more accurately, these failures to fall back to sleep) may occur as often as every 90–120 minutes.

Night waking is only considered a disorder in the presence of "a specific constellation of symptoms of a defined severity level to be present for a specified time and to result in some significant impairment in functioning either in the child or in the parent(s) or family" (Mindell et al., 2006, p. 1264). In the absence of these criteria, presenting complaints that do not meet the definition of "a disorder" are not diagnosed. As noted earlier, not all parents find it disturbing that their infants or toddlers need their assistance to fall asleep. Thus, two children may present with the exact same symptoms, but only the child whose parents find the pattern problematic, or who is experiencing impairment in daytime functioning, can be formally diagnosed with a "sleep disorder."

Problematic night waking is thought to result largely from parents' providing bedtime environment conditions (i.e., sleep-onset associations such as nursing, rocking) that cannot be reliably reproduced by the infant after waking up in the middle of the night and require parental intervention. Fehlings, Weiss, and Stephens (2001) found that 6-month-old to 4-year-old children who had been referred from a sleep clinic and who experienced these types of "nonadaptive sleep associations" had significantly higher odds of night waking compared to a matched control group. In particular, the ability to self-soothe has been clearly shown to be associated with the practice of putting the infant to bed while drowsy but still awake (i.e., avoiding associating sleep onset with parental intervention). In addition, parental responses to night wakings in and of themselves may be reinforcing (e.g., feeding, prolonged interactions).

While sleep-onset associations are certainly an important contributor to night waking, there are apparently other reasons that nighttime waking develops. For example, in one study, active physical comforting at bedtime only explained 3% of the variance in infant sleep problems at 1 year when examined with other variables such as maternal cognitions, temperament, and maternal anxiety/depression, but it did explain more variance in the continuity of problematic sleep from the first to the second year of life (Morrell & Steele, 2003). Clearly, more research is needed to fully explain the reasons behind night waking in the infant–toddler period.

Settling Difficulties

The second most common sleep disorder found in the infant–toddler population is also considered a "dyssomnia" in DSM-5 (American Psychiatric Association, 2013). "Settling difficulties" are defined as delaying or resisting bedtime. Although it was referred to as "behavioral insomnia of childhood, limit setting subtype" in ICSD-2, ICSD-3 eliminated this classification. However, because it is important to distinguish between night waking and settling difficulties in the infancy period, in this chapter we refer to the limit-setting subtype despite its official (but lamented) demise. Bedtime resistance generally develops in children ages 2 years and older, as children gain more independence and experience more developmentally normal fears, and is manifested by prolonged bedtime routines and strong resistance to going to bed (Crowell, Keener, Ginsburg, & Anders, 1987; Jenkins, Owen, Bax, & Hart, 1984; Salzarulo & Chevalier, 1983). Settling difficulties are thought to be exacerbated by parents' inadequately enforcing bedtimes and/or responding to (and thus reinforcing) children's "curtain calls" (requests, after bedtime, for one more story, one more drink of water, one more hug, 5 more minutes, and the like). The most robust research in this area comes from older children, but it demonstrates a significant correlation between bed-

time resistance and overall daytime resistance to parental behaviors (Bates, Viken, Alexander, Beyers, & Stockton, 2002). Both daytime and bedtime resistance are considered the result of parents' inability to set clear limits.

Nevertheless, these problems also may reflect a mismatch between the parents' expectations and the child's predisposed sleep patterns (Mindell et al., 2006). In particular, prolonged sleep onset and/or night waking may indicate that caregiver expectations regarding "time in bed" may exceed the child's sleep needs, resulting in delayed sleep onset, prolonged night waking or early morning awakening, or some combination of these.

Many children, of course, have symptoms of both night waking and sleep-onset difficulties; thus, a clear distinction is not always feasible. From a practical standpoint, the appropriate diagnosis should be based on the predominant symptom pattern for the previous 3 months whenever possible.

There are also a number of precipitating and perpetuating factors associated with night-waking and settling difficulties in infants and toddlers, which include both extrinsic (e.g., environmental situations, parental issues) and intrinsic (e.g., temperament, medical issues) factors, and often represent a combination of these issues. Bedtime problems are often associated with child temperament (Carey, 1974; Keener et al., 1988; Sadeh, Lavie, & Scher, 1994; Sorondo & Reeb-Sutherland, 2015; Van Tassel, 1985). For example, "fussy" or temperamentally challenging children may require a particular type of soothing/sleep-inducing technique, resisting any alternative that is less dependent on the caregiver. Sleep problems in typically developing infants and toddlers have also been linked to sensory processing issues (Vasak, Williamson, Garden, & Zwicker, 2015). Some caregivers may have their own intrinsic and extrinsic issues (e.g., depression, anxiety, long work hours) that interfere with their ability to set clear limits both during the day and at bedtime. In other cases, there is a "mismatch" between parental expectations regarding sleep behaviors and the normal developmental trajectory of sleep patterns. Finally, environmental factors, such as living accommodations that require a child to share a bedroom with a sibling, parent, or additional family members (e.g., grandparents) residing in the home, may also contribute to poor limit setting or negative sleep onset associations.

Sleep Problems and Bed Sharing

It should be noted that in a number of studies (e.g., Hysing, Harvey, et al., 2014) bed sharing has been associated with increased sleep problems in infants and toddlers. This is a highly controversial topic for a number of reasons, ranging from cultural and socioeconomic differences in typical sleeping practices to potential issues regarding infant attachment to safety concerns (Burnham, 2013; Sadeh, Mindell, & Owens, 2011). In a recent review of the literature, Mileva-Seitz, Bakermans-Kranenburg, Battaini, and Luijk (2017) found general design limitations in studies and a lack of convincing empirical evidence that precluded making strong generalizations either for or against bed sharing. Distinctions should also be made regarding bed sharing, sharing of other sleeping spaces (e.g., a couch), room sharing, and proximate sleeping of caregivers and infants. For example, the American Academy of Pediatrics (2016) has recently revised their guidelines on safe infant sleeping environments, which include room sharing but not bed-sharing, ideally for the first 12 months, as a means of reducing risk of sudden unexpected infant death syndrome.

Other Sleep Disorders

Other sleep disorders that disrupt sleep, such as obstructive sleep apnea and restless legs syndrome/periodic limb movement disorder, may also delay sleep onset and trigger night wakings, and should also be considered in the differential diagnosis if symptoms and risk factors are present (e.g., snoring, adenotonsillar hypertrophy, positive family history). Primary sleep disorders may also coexist with the more behaviorally based insomnias, potentially exacerbating daytime sequelae. For example, sleep terrors may be a cause of nocturnal awakenings characterized by agitation and high levels of arousal in young children, but they are much less common (prevalence of about 1–3%) than problematic sleep-onset associations. They typically first present in the preschool age range, and there is frequently a family history of sleep terrors or sleepwalking. Sleep terrors are characterized by extreme levels of agitation, a high arousal threshold, resistance to comforting, lack of recognition of caregivers, incoherent and/or nonsense verbalizations, and a rapid return to quiet sleep; they generally occur in the

first third of the night, when slow-wave sleep predominates. The child has no memory of the event, and daytime sequelae are extremely rare. "Transient sleep disturbances," also called "adjustment sleep disorders," usually occur in a child with prior normal sleep. Transient night wakings can be the result of a stressful life event, disruption of sleep schedule (e.g., a trip, jet lag), or an illness. Short-term sleep disturbances, however, can become chronic if parents respond in a way (e.g., reinforcement of the night wakings) that fosters poor sleep habits.

Impairments

It is clear that two main sleep problems exist during the infant–toddler period, that some parents find these problems disturbing while others do not, and that sleep problems occur within a complex context of factors that affect their definition, diagnosis, and outcomes. There is also evidence that the aforementioned sleep problems may have a significant impact on some families, and there is research to suggest that they may have an impact on the children who experience them, as well. However, due to the fact that research in this area is relatively new and generally has not used experimental designs or sophisticated data-analytic techniques, we use the term "correlate" to discuss purported impacts of sleep problems on children and families. Thus, the issues we discuss below are clearly bidirectional, in that they both increase the risk (including heightened parental perception) of sleep problems in infants and may be consequences of sleep problems in infants.

Family

As we noted earlier, some of the correlates of infant–toddler sleep problems in families include maternal depression, anxiety, parental fatigue, general disruptions to family life, poor maternal mental and physical health, and less parental well-being (Bayer et al., 2007; Eckerberg, 2004; Hall, Clauson, Carty, Janssen, & Saunders, 2006; Lam, Hiscock, & Wake, 2003; Meijer & van den Wittenboer, 2007; Meltzer & Mindell, 2007; Petzoldt, Wittchen, Einsle, & Martini, 2016; Wake et al., 2006). Hall and colleagues (2006) reported that resolving the sleep problems of 6- to 12-month-old infants resulted in significant improvement in parents' sleep quality, cognitions about infant sleep, depression, and marital harmony. It is important to keep in mind that it is difficult to tease apart the potential direction of effect in these investigations. It is entirely possible that some of these correlates either precede the child's sleep disruption or the two are related to a completely different, unstudied factor. One prospective study did find that persistent sleep disruptions across the first 2 to 24 months of life were uncommon (6%) but were associated with maternal depression and parenting stress at 24 months (Wake et al., 2006). In contrast, in at least one investigation, Bayer and colleagues (2007) indicated that once they controlled for maternal sleep quality, the relationship between infant sleep problems and maternal mental health was eliminated. In most of these investigations, both child sleep and parental well-being were measured by parent report, which potentially confounds any reported relationships.

Child

As discussed earlier, infant–toddler sleep disruptions are correlated with, and indeed may cause, several negative family outcomes. Less clear is whether there is a negative impact on the child him- or herself. While studies of older children and adolescents have indicated relationships between sleep problems and daytime behavior (e.g., Owens-Stively et al., 1997; Smedje, Broman, & Hetta, 2001; Wolfson & Carskadon, 1998), fewer data are available on the infant–toddler population.

A clear elucidation of the potential impact of sleep problems on infants and toddlers is particularly challenging because these children take regular naps during the day. Daytime behavioral effects of a nighttime sleep problem may be diminished by the child's use of daytime sleep to "make up for" a restless or short night. More recent studies have suggested that there may be an association between sleep problems such as settling difficulties and social–emotional problems in toddlers (Hysing, Sivertsen, Garthus-Niegel, & Eberhard-Gran, 2016); sleep problems in infants and later deficits in self-regulation (Williams, Berthelsen, Walker, & Nicholson, 2017) and social–emotional adjustment to school (Williams, Nicholson, Walker, & Berthelsen, 2016; Williams & Sciberras, 2016), infant sleep problems, and parental ratings of infant mood (Mindell & Lee, 2015); infant sleep problems and attentional dysregulation and behavior problems at ages 3–4 years (Sadeh et al., 2015); infant sleep duration and efficiency and

both externalizing and autism spectrum behaviors, which may be gender-specific (Saenz, Yaugher, & Alexander, 2015); and sleep problems at 18 months and social–emotional problems at 5 years (Sivertsen et al., 2015).

Although there is growing evidence to support objective daytime behavioral sequelae for infants and toddlers who experience sleep problems, animal research has confirmed a compelling relationship between sleep and development of the brain. For example, there is some evidence that REM sleep helps consolidate memory and promotes advanced cognitive functioning (Stickgold, 2005); in addition, REM sleep may provide an "endogenous source of activation" with implications for neural development (Kurth et al., 2015, p. 65). Sleep also may be involved in promoting brain plasticity (Frank, Issa, & Stryker, 2001; Kurth et al., 2015). Indeed, the same patterns of development are seen among slow-wave activity, synaptic density, and energy consumption in both humans and rats from birth through adolescence (Kurth et al., 2015). These lines of evidence point to the possibility that sleep provides the foundation for neurocognitive development and growth (Cheour et al., 2002; Gómez & Edgin, 2015; Kurth et al., 2015; Stickgold, Whidbee, Schirmer, Patel, & Hobson, 2000). Thus, it would follow that any problem that results in significant sleep loss during development may impact cognitive functioning.

A robust body of research indicates associations between the quality of older children's sleep and their cognitive and emotional functioning and physical well-being. Sleep loss and sleep fragmentation are known to directly impact mood (increased irritability, decreased positive mood, poor affect modulation). Behavioral manifestations of sleepiness in children are varied, and range from externalizing behaviors, such as increased impulsivity, hyperactivity, and aggressiveness, to mood lability and inattentiveness (Smedje et al., 2001). For instance, sleep loss has been related to maladjustment in preschoolers (Bates et al., 2002) and in impaired daytime cognitive and behavioral functioning in school-age children (Sadeh, Gruber, & Raviv, 2003). Sleepiness may also result in observable neurocognitive performance deficits, including decreased cognitive flexibility and verbal creativity, poor abstract reasoning, impaired motor skills, decreased attention and vigilance, and memory impairments (Dahl, 1996; Randazzo, Muehlbach, Schweitzer, & Walsh, 1998). Although some of the above studies were confounded by the fact that parents provided information on both sleep and behavior, others (e.g., Randazzo et al., 1998) used objective measures. Most evidence for a link between poor sleep and daytime behavioral impairment, however, comes from studies with older children. Finally, it should be emphasized that other postulated health outcomes of inadequate sleep in children include potential deleterious effects on the cardiovascular, immune, and various metabolic systems, including glucose metabolism and endocrine function, and an increase in accidental injuries. For example, shorter periods of nighttime sleep at 3 years have been linked to obesity during middle childhood (Reilly et al., 2005).

Some studies have indicated modest relationships between disturbed sleep and later behavior problems in very young children (e.g., Dearing, McCartney, Marshall, & Warner, 2001; Gregory, Eley, O'Connor, & Plomin, 2004), although factors other than disturbed sleep clearly contribute to the appearance of later behavior problems as well. Scher, Zukerman, and Epstein (2005), for example, found that night waking in infancy predicted only 3% of the variance in behavioral scores at 42 months. Persistent night waking and/or settling problems were better predictors of later negative behavior than was night waking during the infancy period. Wake and colleagues (2006) also found that persistent, rather than transient, problems during the infant–toddler period related to subsequent child behavior problems. Recent work has supported this relationship between persistent sleep problems in early life and later behavioral and academic problems (e.g., Williams, Nicholson, Walker, & Berthelsen, 2016). Thus, it appears likely that severe, persistent sleep problems during the infant–toddler period can impact daytime behavior; less clear is the potential impact of less severe or transient sleep problems.

Sleep Disturbances in the Context of Other Disorders

The high prevalence rates for sleep problems found in children with neurodevelopmental disorders, ranging from 13 to 85%, may be related to any number of factors, including intrinsic abnormalities in sleep regulation and circadian rhythms, sensory deficits, and medications used to treat associated symptoms (Johnson, 1996;

Wiggs, 2001). In children with special needs, sleep problems are often chronic and unlikely to resolve without aggressive treatment. In addition, sleep disturbances in these children often have a profound effect on the quality of life of the entire family. These children also frequently have multiple sleep disorders occurring simultaneously or in succession. Higher degrees of cognitive impairment tend to be associated with more frequent and severe sleep problems.

It has been estimated that significant sleep problems occur in 30–80% of children with severe mental retardation and in at least half of children with less severe cognitive impairment. Estimates of sleep problems in children with autism and pervasive developmental disorder are similarly in the 50–70% range (Owens, 2007). The types of sleep disorders that occur in these children are generally not unique; rather, they are more frequent and more severe than those in the general population, and typically reflect the child's developmental level rather than chronological age. Significant problems with initiation and maintenance of sleep, shortened sleep duration, irregular sleeping patterns, and early morning waking, for example, have been reported in a variety of different neurodevelopmental disorders, including autism spectrum disorders, Angelman syndrome, Rett syndrome, Smith–Magenis syndrome, and Williams syndrome.

Basic principles of sleep hygiene are particularly important to consider in preventing and treating sleep problems in children with developmental delays (Didden, Curfs, van Driel, & de Moor, 2002). Ensuring the safety of these children, especially if night waking is a problem or there is a history of self-injurious behavior, also needs to be a key consideration in management. A range of behavioral management strategies used in typically developing children for night wakings and bedtime resistance, such as graduated extinction procedures and positive reinforcement, may also be applied effectively in children with developmental delays. Collaboration with a behavioral therapist may be needed if there are complex, chronic, or multiple sleep problems, or if initial behavioral strategies have failed. Finally, the use of pharmacological intervention, including melatonin, in conjunction with behavioral techniques, also has been shown to be effective in selected cases; however, few randomized controlled trials of melatonin in children with neurodevelopmental disorders such as autism have included children younger than 2 years old, and none, to our knowledge, has been conducted in infants less than 12 months old.

Parents of young children with attention-deficit/hyperactivity disorder (ADHD) frequently report sleep disturbances, especially difficulty initiating sleep and restless and disturbed sleep (Sung, Hiscock, Sciberras, & Efron, 2008; Tsai, Hsu, & Huang, 2016; Yoon, Jain, & Shapiro, 2012). Surveys of parents and children with ADHD compared to typically developing children consistently report an increased prevalence of sleep problems, including delayed sleep onset, poor sleep quality, frequent night wakings, and shortened sleep duration that includes infants later diagnosed with ADHD (Williams & Sciberras, 2016). Although there are no studies of sleep in very young children with ADHD using more objective methods (e.g., polysomnography, actigraphy), studies in preschool children, for example, have demonstrated increased levels of nocturnal activity and more night-to-night variability in sleep parameters (Melegari et al., 2016). Sleep problems in children with ADHD are likely to be multifactorial in nature, and potential etiologies range from psychostimulant-mediated sleep-onset delay in some children to bedtime resistance related to a comorbid anxiety in some or oppositional defiant disorder in others. In some children, settling difficulties at bedtime may be related to deficits in sensory integration associated with ADHD, while in others, a circadian phase delay may be the primary etiological factor in bedtime resistance (Tsai et al., 2016).

Underlying medical conditions may also account for difficulties falling asleep and staying asleep, including gastroesophageal reflux, allergies and atopic dermatitis, asthma, milk intolerance, chronic gastrointestinal disorders, seizures, and pain (e.g., otitis media). In addition, in those conditions that typically require nighttime parental intervention (e.g., colic), it may be difficult for parents to differentiate between night wakings due to ongoing physical symptoms and those related to learned behaviors (e.g., parental attention to crying). Parents of children with a current or past history of medical problems may also have difficulty setting limits, whether because of guilt, a sense that the child is "vulnerable," or concerns about doing psychological harm. Medication effects may also lead to disrupted sleep and night wakings. A number of patient and environmental factors such as the impact of repeated hospitalization,

family dynamics, underlying disease processes, comorbid mood and anxiety disorders, and concurrent medications are clearly important to consider in assessing the bidirectional relationship of sleep problems and chronic illness in children.

Interventions for Sleep-Related Disturbances

Behavioral interventions are the mainstay treatment of bedtime struggles and night wakings in infants and toddlers. Consistent with the conclusions of two previous reviews (Kuhn & Elliott, 2003; Mindell, 1999), more recent reviews indicate that behavioral therapies produce reliable and durable changes for both bedtime resistance and night wakings in young children (Crichton & Symon, 2016; Meltzer & Mindell, 2014; Mindell et al., 2006). The bulk of the evidence supports the efficacy of behavioral therapies in reducing sleep latency and the number and duration of awakenings (Meltzer & Mindell, 2014), including one review that found efficacy in infants under age 6 months (Crichton & Symon, 2016). However, Douglas and Hill's (2013) review concluded that behavioral interventions in the first 6 months do not decrease crying or reduce later sleep problems, and they may have unintended consequences (increased crying, worsened maternal mood). Given the inconsistent evidence in very young infants, clinicians should use caution in recommending aggressive forms of sleep training in this age group.

Studies of behavioral interventions demonstrate that treatment-related changes across most types of interventions were maintained at short (< 6 months), intermediate (6–12 months) and long-range follow-up (> 12 months). A number of studies also found positive effects of sleep interventions on secondary child-related outcome variables, such as parent-reported daytime behavior (e.g., crying, irritability, detachment, self-esteem, or emotional well-being). Sleep-related behavioral intervention also led to improvement in the well-being of the parents (e.g., related to fatigue, sleep, mood, stress, marital satisfaction) in a number of studies (e.g., Hall et al., 2015; Symon & Crichton, 2017).

Most of the interventions described in behavioral treatment studies may be placed in the following categories: extinction and its variants (see below), positive bedtime routines, scheduled awakenings, bedtime fading with response cost, positive reinforcement, and parent education–prevention programs. Some of the interventions described below are tailored more specifically toward either bedtime problems or night wakings, but since these two issues often coexist, all treatment modalities are included. Unmodified extinction and parent education–prevention programs are the two behavioral interventions that have the strongest empirical support. See Table 22.1 for a detailed list of the pros and cons of each intervention strategy, from a clinical perspective.

Extinction Procedures

"Extinction" procedures in general involve the elimination of parental attention as a reinforcer for undesired behaviors (e.g., crying, screaming). The goal of extinction in the case of problematic night wakings is to enable a child to develop "self-soothing" skills in order to fall asleep independently, without continued need for parental presence.

Unmodified Extinction

The "cry it out" approach involves having the parents put the child to bed at a designated bedtime, then ignore the child's protest behaviors such as crying, tantrums, and calling for the parents (with the exception of illness, injury, etc.), until a preset time the next morning. The biggest obstacles associated with extinction are the requirement for strict parental consistency with the intervention, since inconsistent caregiver response provides intermittent reinforcement and maintains the awakenings and the likelihood of postextinction "response bursts" (temporary intensification of protest behavior immediately after the intervention is instituted). From a clinical standpoint, the major drawbacks of unmodified extinction procedures are that they are stressful for parents and infants, and many parents are unable to ignore crying long enough for the procedure to be effective.

Extinction with Parental Presence

A modification of the extinction approach that is similar to the previous procedure involves having the parents stay in the child's room at bedtime but ignore the child and his or her protest behavior. It is often recommended that parents gradually withdraw from the room each night until the child is able to fall asleep alone.

TABLE 22.1. Pros and Cons of Four Behavioral Interventions

Intervention	Pros	Cons
Unmodified extinction	• Solid empirical evidence for efficacy • Generally effective within 1–2 weeks in uncomplicated cases • Time frame may be appropriate for some families (i.e., imminent birth of another child) • Instructions to caregivers simple and straightforward	• May be less effective or developmentally appropriate if implemented prior to 6 months of age • Unacceptable to many families • Significant cultural barriers • May be challenging for other family members, neighbors • Requires high level of consistency and parental cooperation to avoid intermittent reinforcement • Typically involves "extinction burst" • Most feasible before child is able to climb out of crib
Modified or graduated extinction	• Solid empirical evidence for efficacy • Generally effective within 1–2 weeks in uncomplicated cases • More acceptable to families • Treatment protocol can be individualized • Allows parents to provide reassurance to child	• Typically takes longer than unmodified extinction • Requires high level of consistency and parental cooperation to avoid intermittent reinforcement • Typically involves "extinction burst" • Most feasible before child is able to climb out of crib • "Check-ins" must not be reinforcing • Intermittent parental presence may be activating/upsetting for some children
Positive routines/bedtime fading	• Good empirical support for both • Bedtime routines generally easy to implement and reinforcing for both caregivers and child • Bedtime fading matches bedtime with child's natural fall-asleep time and reduces sleep onset and protest behavior • Generally less stressful for parents than extinction	• Bedtime routines may be challenging to coordinate with parent work schedules, multiple caregivers • Bedtime routines should not involve electronic media, which may be difficult for some families • Bedtime fading involves a temporary later bedtime and thus a longer period of parental involvement in the evening
Scheduled awakenings	• Some empirical support • Focuses on increasing duration of consolidated sleep • Based on child's spontaneous night waking times	• Requires parents to "preemptively" awaken a sleeping child • Difficult to convince caregivers of rationale • Limited utility in clinical practice

Graduated Extinction

"Sleep training" refers to a variety of techniques. Typically, parents are instructed to ignore bedtime crying and tantrums for specified periods of time, tailored to the child's age and temperament, as well as the parents' judgment of how long they can tolerate the child's crying. Parents employ a fixed schedule (e.g., 5 minutes) or one that involves progressively longer intervals (e.g., 5 minutes, 10 minutes, then 15 minutes) of waiting before checking on their child. With incremental graduated extinction, the intervals increase across successive checks within the same night or across successive nights. The checking procedure itself involves the parents comforting their child for a brief period, usually 15 seconds to 1 minute. The parents are instructed to minimize any interactions during check-ins that may reinforce their child's attention-seeking behavior.

Positive Routines and Bedtime Fading with Response Cost

Similar to extinction techniques, these approaches match the child's bedtime with his or her natural sleep-onset time and rely heavily on stimulus control techniques as the primary agent of behavior change. In contrast to extinction strategies, both of these treatments aim to

increase appropriate behaviors and control of affective and physiological arousal, rather than focusing on reduction of inappropriate behaviors. Positive routines involve the parents developing a set bedtime routine characterized by quiet and calming activities that the child enjoys. Bedtime fading with response cost involves taking the child out of bed for prescribed periods of time when the child does not fall asleep. Bedtime is also temporarily delayed to ensure rapid sleep initiation. Once the behavioral chain is well established and the child is falling asleep quickly, the bedtime is moved earlier by 15–30 minutes over successive nights ("fading") until a preestablished bedtime goal is achieved.

Scheduled Awakenings Technique

This approach focuses on increasing the duration of consolidated sleep. The intervention involves parents awakening and consoling their child approximately 15–30 minutes before a typical spontaneous awakening. Caregivers must first establish a baseline of the usual number and timing of spontaneous nighttime awakenings, then schedule preemptive awakenings. Scheduled awakenings are then gradually faded out, by systematically increasing the time span between awakenings.

Of course, all of the behavioral interventions described earlier, especially in children preschool age and older, may be combined with *positive reinforcement* strategies (e.g., sticker charts) to increase the likelihood of desired behaviors (e.g., staying in bed).

Parent Education Programs

These approaches generally focus on early establishment of positive sleep habits, and are often preventive rather than intervention strategies per se. Parent sleep education programs have been shown to be effective not only in treating but also in *preventing* infant sleep problems (Hiscock et al., 2014). Strategies typically target bedtime routines, developing a consistent sleep schedule, parental behavior during sleep initiation, and parental response to nighttime awakenings. Almost all programs include the recommendation that infants be put to bed "drowsy but awake" starting at around 3–4 months of age to help them develop independent sleep initiation skills at bedtime. Other features of parent sleep education programs often include the following:

- Institution of a set bedtime and regular sleep schedule that ensures adequate sleep, as sleep deprivation will result in increased nighttime arousals. A bedtime should be set that is appropriate for the child's age and provides adequate sleep at night. A consistent nightly bedtime will also help to set the circadian clock and enable the child to fall asleep more easily.
- Establishment of a consistent bedtime routine that lasts approximately 20–45 minutes and includes three to four soothing activities (e.g., bath, pajamas, stories) that does not include stimulating activities such as television viewing. Regular nightly bedtime routines have been found to be associated with improved sleep in children ages 1–5 years (Mindell, Li, Sadeh, Kwon, & Goh, 2015).
- Maintenance of daytime sleep (naps) at least through the age of 3–3½ years, to avoid sleep deprivation.
- Use of transitional objects, such as a blanket, doll, or stuffed animal, that will be readily available to the child during the night.

For all of these behavioral strategies, it is critical that parents are consistent in applying behavioral programs to avoid inadvertent intermittent reinforcement of night wakings. They also should be forewarned that frequently protest behavior temporarily escalates at the beginning of treatment ("postextinction burst").

While behavioral interventions for sleep problems in infants and toddlers have considerable empirical support, concerns have been raised both by professional and public groups regarding possible negative impact on children's social and emotional development, and attachment (Etherton, Blunden, & Hauck, 2016; Hiscock & Fisher, 2015). However, recent reviews (Symon & Crichton, 2017) and several randomized controlled trials of behavioral interventions (graduated extinction, bedtime fading) in infants showed no adverse long-term stress responses or long-term effects on parent–child attachment or child emotions and behavior at 12 months (Gradisar et al., 2016) or on outcomes related to child mental health, psychosocial functioning, stress regulation, and child–parent relationship assessed 5 years after the intervention (Price, Wake, Ukoumunne, & Hiscock, 2012).

Pharmacological Interventions

Sedatives/hypnotics should *not* be considered the first line in the management of sleep onset or sleep maintenance insomnia in young children. If recommended in very selected clinical circumstances (e.g., inpatient hospitalization, special needs populations), these drugs should always be combined with behavioral therapy. Only a handful of studies has examined the effect of pharmacological treatment of bedtime problems and night wakings in infants and young children, and with mixed results; one randomized controlled trial of diphenhydramine in six 15-month-olds, for example, showed no advantage with regard to efficacy over placebo (Merenstein, Diener-West, Halbower, Krist, & Rubin, 2006). Despite this, pharmacological interventions such as nonprescription sedating antihistamines are commonly used in clinical practice for sleep problems, even in young children (Owens, Rosen, & Mindell, 2003). In addition, pharmacological strategies are not necessarily specifically targeted toward improving parental adherence to a concurrent behavioral treatment, and thus may not have long-lasting effects. Overall, the evidence suggests that behavioral strategies are equally or more effective, are more acceptable to both parents and practitioners, and avoid potential harmful side effects associated with medication use. Behavioral sleep management strategies have the further advantage of potentially generalizing to the management of daytime issues.

For clinicians, an important treatment goal in managing individual children with special needs, such as ADHD, or other neuropsychiatric conditions, such as autism, should be evaluation of any comorbid sleep problems, followed by appropriate diagnostically driven behavioral and/or pharmacological intervention. For example, difficulty falling asleep in children with ADHD related to psychostimulant use may respond to adjustments in the dosing schedule; in some children, the sleep-onset delay is due to a "rebound" effect of the medication wearing off coincident with bedtime, rather than a direct stimulatory effect of the medication itself. Melatonin has demonstrated reductions in sleep latency when given at bedtime both in typically developing children and in children with ADHD and other neurodevelopmental disorders (Smits et al., 2003; van Maanen, Meijer, Smits, van der Heijden, & Oort, 2017; Weiss, Wasdell, Bomben, Rea, & Freeman, 2006), is generally well tolerated and appears to be an acceptable choice for caregivers (Waldron, Spark, & Dennis, 2016); however, the risk of long-term side effects, especially when melatonin is administered to infants and young children, is unknown. Alpha agonists such as clonidine at bedtime are commonly used in clinical practice to manage prolonged sleep-onset delay in children with ADHD (Klein-Schwartz, 2002; Prince, Wilens, Biederman, Spencer, & Wozniak, 1996); however, it should be pointed out that there is little empirical evidence regarding efficacy and safety, particularly in younger children.

Other Approaches

Alternative treatments, such as infant massage, may be safe and simple adjuncts in the treatment of infant sleep problems. Infant massage is commonly used in many areas of the world, especially Africa, India, and Asia. Although the effects of infant massage on pediatric sleep have not been extensively studied, some studies have shown that massage in the newborn period may have a long-term effect on melatonin synthesis and the development of normal circadian rhythms (Ferber, Laudon, Kuint, Weller, & Zisapel, 2002). The positive effects of massage may also target many of the problems associated with prolonged bedtime struggles, including high infant arousal, parent tension, and negative parent–child interactions. The few studies that have looked at massage as an intervention for pediatric sleep problems have reported shortened sleep-onset latency, fewer night wakings, and improved daytime alertness/behavior following regular bedtime massage (Field & Hernandez-Reif, 2001; Field, Kilmer, Hernandez-Reif, & Burman, 1996).

Conclusions

In summary, our basic understanding of the normal trajectory of sleep development in the first few years of life, and of the etiology and treatment of disordered sleep in infancy, is evolving rapidly. The recognition that sleep is a fundamental human function that both mirrors and impacts other important areas of maturation (social, emotional, cognitive, etc.) in the young child has led to an increasingly sound body of

research exploring the bidirectional relationship between sleep and development. There is still much to learn about the nature and impact of sleep disorders in young children, particularly because further elucidation of these fundamental questions is likely to contribute significantly to our understanding of the relationship between specific brain functions, neuromodulator systems, sleep, and daytime behavior in the developing human.

Key areas for future research include the neuroanatomical and neurophysiological bases of both normal and abnormal sleep development; elucidation of the scope, magnitude, natural history, and impact on morbidity of sleep disorders in young children in the general population, as well as those children with behavioral and developmental disorders; relative risk and protective factors (e.g., temperament, parenting styles, psychosocial adversity) influencing the development of sleep problems; the efficacy of various prevention strategies and treatment modalities in infants and toddlers, children, and the impact of treatment on the natural history of sleep disorders into later childhood and adulthood; and the potential of identifying sleep problems that predict the eventual emergence of psychiatric comorbid conditions (depression, anxiety, bipolar disorder).

It will be particularly important to develop a more comprehensive nosology to describe and categorize the various types of infant sleep disorders for both clinical and research purposes; these classification systems will need to accurately capture both the similarities and distinctions between adult and pediatric sleep disorders, as well as to differentiate normal developmental variation from "pathology" across the age spectrum. Evidence-based clinical screening and evaluation tools for sleep problems in young children that are easily adapted to primary care and outpatient mental health settings need to be developed, systematically evaluated, and disseminated, coupled with educational interventions for caregivers and providers targeted at raising awareness of the significance of these issues. Finally, the substantial impact of disordered sleep deserves further study, ranging from effects on neuroendocrine systems and metabolic pathways related to the development of obesity to neurocognitive deficits, to functional consequences related to learning, family and social relationships, and the public health care burden related to health care costs and lost productivity of caregivers.

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