

XI. SLEEP AND DEVELOPMENT: CONCLUSIONS AND FUTURE DIRECTIONS

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ABSTRACT Literature on sleep and child development is growing in novel directions across several disciplines necessitating guiding conceptual principles and methodological tools. First, this volume presents a summary of discussions from an SRCD-sponsored multidisciplinary forum on sleep and development, which includes presentation of key issues and guiding recommendations for research priorities in this fast developing field. Second, enhancing accessibility to child development researchers, state of the science sleep assessment methodologies are presented with a discussion of their advantages and disadvantages. Third, seven empirical studies conducted with “typically” developing infants and children provide examples of relations between sleep and some of the many individual and familial factors that influence and are influenced by sleep. In the presentation of empirical findings, a developmental ecological systems perspective adapted to sleep was espoused to illustrate some of the multiple levels of influence in the study of child sleep and development. Collectively, studies in this volume build significantly on the literature through: (a) illustrating linkages between various sleep parameters (e.g., quality, sleeping arrangements) and other key developmental domains (e.g., attachment, parenting); (b) demonstration of longitudinal relations connecting sleep with development, which is scarce in this field; and (c) utilization of actigraphy-based assessments of sleep duration and quality, which are underutilized in the literature yet important for a more nuanced understanding of sleep and development.

We proposed an ecological systems perspective adapted to sleep (Sameroff, 2000; Sadeh & Anders, 1993) as an organizing framework for presenting the empirical papers illustrating some of the multiple influences on children’s sleep. Chapter IV in this monograph reflects the “child level” of influence by presenting a study of relations between sensory reactivity in infants and the development of their sleep patterns. In Chapter V, another

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example is presented in an investigation of the impact of infants' crawling on the quality of their sleep. Finally, in Chapter VI, interactions between the variables encompassed within both the "child" and "immediate" contexts are illustrated in a study of interactions among respiratory sinus arrhythmia, prior sleep problems, and marital conflict as longitudinal predictors of older children's sleep.

The majority of the studies in this volume reflect "immediate" context influences, primarily facets of the parent-child relationship and parenting behaviors. The literature linking family functioning and sleep is in its early stages and studies presented in this volume make important contributions. In addition to their consistency with parameters of the ecological systems framework, some of the studies were conducted within a more specific theoretical approach. Building and enhancing connections between developmental theory and sleep research was called for in the Sleep and Development Forum (Chapter II), and some of the studies in this volume illustrate some initial steps in that direction. For example, attachment security theory (Ainsworth, Blehar, Waters, & Wall, 1978) guided the study presented in Chapter VIII, and the biopsychosocial frame adopted in Chapter VI made links with cumulative risk (McEwen, 1998), emotional security (Cummings & Davies, 2010), and Dahl's (1996) sleep regulation models.

Collective Contributions of the Empirical Chapters

The empirical studies presented in this volume move the field forward through their longitudinal designs, demonstrations of linkages between various sleep parameters and key developmental domains, and their use of actigraphy when examining sleep duration and quality.

Sleep and Child Development—Longitudinal Associations

Longitudinal studies are scarce in this field and their incorporation in this volume allow for discerning developmental effects. For example, the study presented in Chapter IV extends prior literature on associations between infant sensory reactivity (a specific aspect of temperament) and their sleep by reporting curvilinear relations between reactivity and sleep quality over time. This nonlinear pattern may explain in part some of the null findings between temperament and sleep that are reported in the literature. Further, building on cross-sectional evidence, and through an intensive longitudinal design with multiple waves of data collection, findings from Chapter V indicate that the sleep of crawling infants was more disrupted than that of the same-age noncrawling infants. Through conducting many observations with short time intervals, this study captured more nuanced

relations between crawling and sleep than is possible with cross-sectional inquiries. In addition, findings reported in Chapter VII break new ground by demonstrating linkages between changes in infant and maternal sleep over time; obviously, questions regarding change cannot be addressed through cross-sectional work. Further, mother-child attachment when infants were 15 months predicted their actigraphy-based sleep quality at 24 months, providing the first such demonstration in the literature (Chapter VIII). Another study in this volume demonstrates that between 30 and 42 months of age, bedtime routines and inconsistent parenting predicted change in sleep duration over time (Chapter IX). Illustrating developmental effects, findings reported in Chapter VI establish 3-way interactions among marital conflict, sleep at age 9 years, and physiological regulation as predictors of sleep at age 10. Finally, clarifying plausible reciprocal effects, original findings presented in Chapter X suggest that co-parenting quality during infants' first month of life was a stronger predictor of change in sleep arrangements over time than the opposite direction of effects. Collectively, these longitudinal studies provide some explication of developmental effects, which is much needed in the field.

Sleep Assessments

Sleep is a complex phenomenon that could be examined across many parameters and advantages and disadvantages of established methods for sleep assessments in infants and children were discussed in Chapter III. The majority of the studies in the field rely on either parents' or children's reports of sleep. Although subjective assessments are useful in some circumstance, there are acknowledged limitations of self or parent reports (see Chapter III). The use of objective measures in the sleep and child development literature will likely enhance understanding of sleep-wake regulation across the life-span.

All of the studies in this volume that examined sleep duration and/or quality utilized actigraphy, and consistent with best practices, incorporated sleep diaries to verify actigraphic measures (e.g., for removal of artifacts). As this area of inquiry develops, the assessment and analysis of multiple sleep parameters is optimal (Chapter III), and all of the studies in this monograph have examined more than a single sleep variable.

Monograph Scope, Limitations, and Future Directions

Although incorporation of actigraphy constitutes a step forward toward a better understanding of sleep and development, other important sleep-wake parameters such as sleep stages or EEG spectral densities were not examined;

polysomnography is needed for such assessments. Incorporating a cognitive neuroscience perspective (Dahl & Jenni, 2012; Jenni & Dahl, 2008) and utilizing fMRI is critical for explicating brain processes associated with sleep-wake parameters (Picchioni, Duyn, & Horowitz, 2013; Yoo, Gujar, Hu, Jolesz, & Walker, 2007), and such studies are scarce with children.

Most of the studies presented were with infants and young children and only one study was conducted with older children. Issues addressed apply to development throughout the life span and inclusion of chapters with adolescents (Dahl & Spear, 2004) could have strengthened the contributions of this volume. Further, several of the studies were conducted with small samples and two waves of data collection, which did not allow for the testing of more sophisticated transactional models. Note, however, that three or more study waves were employed in several investigations (Chapters IV, V, and IX). Another qualifier is that only two studies can be considered “experiments” or have such a component in their designs (Chapter IV and VI). The need for experiments including those with sleep restriction and extension components in the sleep and development literature is key to explicating cause and effect relations and are needed to move the field forward (Chapter II).

In this monograph, we discussed key issues and guiding recommendations for child development and sleep research. Conceptual frameworks have been lacking in the convergence of these two areas, and we presented some emerging frameworks that should be useful for providing more coherence and structure for scholars. Because measurement is foundational for any scientific domain, state of the science sleep assessment methodologies were given emphasis. Advances in knowledge must also be realized through appropriate research designs. A large set of important questions concern how sleep and other domains of development emerge and change over time, yet longitudinal studies have been scarce; we have provided exemplars of such studies. These studies represent only a beginning. We hope this monograph will inspire further advances in interdisciplinary theory and research by current and new sleep scientists. We look forward to the fresh ideas and new discoveries that we are confident are forthcoming.

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