Sleep, Learning, and the Developing Brain: Early-to-Bed as a Healthy and Wise Choice for School Aged Children

Comment on Fallone G; Acebo C; Seifer R et al. Experimental restriction of sleep opportunity in children: effects on teacher ratings. SLEEP 2005; 28(12): 1561-1567.

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“Everything possible should be done to favor sleep as deep and sound in quality and usually as long in quantity as possible, and everything that seriously interferes with this end should be sedulously avoided...No one should be allowed to go to school at all without [at least] nine hours of sleep...”—GS Hall 1904.

There is a long history of interest in understanding the importance of sleep for normal health, development, and academic performance in children. In a major work1 published more than a century ago, G. Stanley Hall emphasized the crucial role of sleep for optimal health in youth and warned about the consequences of placing excessive time demands on students in ways that undermined this health priority. Hall—a towering figure in the history of psychology and a pioneer in the modern study of adolescence—devoted a lifetime of work to studying virtually all aspects of development, incorporating work in psychology, anthropology, sociology, neurology, and education among others. Given his truly multi-disciplinary approach, it is perhaps not surprising that he was one of the first to recognize the value of adequate sleep during childhood and throughout adolescence.

The scientific evidence to support this type of advocacy—particularly, the kind of experimental data with sufficient rigor to convince skeptics and influence policy makers about the health and academic priorities of sleep—has been accruing slowly but steadily.

A critical advance was launched more than 25 years ago, as Carskadon and colleagues began a series of studies examining the development of normal sleep, and the effects of sleep loss in children and adolescents.2 Over the past few decades, several different research groups have published observational data, clinical data, and results from some cross-sectional studies that provide strong support for an association between inadequate sleep in children (including insufficient time in bed, as well as disruptions or disturbances of sleep) and higher rates of problems with attention, behavior, emotions, and academic difficulties. For example, children with a wide range of behavioral or emotional problems report higher rates of sleep problems, and children sampled on the basis of sleep problems show elevated rates of behavioral and emotional difficulties. There is also a body of data from clinical samples showing that successful treatment of sleep disorders in children and/or improving the quality or quantity of sleep has been associated with functional improvements in these domains.

Despite the mounting accumulation of evidence for associations that link together inadequate or disrupted sleep with sub-optimal daytime functioning in children (especially in the domain of learning, attention, self-control and academic goals), there has been less evidence regarding the causal relationship between sleep and behavioral, emotional, and academic domains in normal children.

At least five previously published controlled studies2-6 have examined daytime function under experimental conditions of sleep restriction, but only one attempted to change sleep for more than one night. That study, an experimental study in normal children by Sadeh, Gruber, and Raviv (2003),7 found evidence that restricting or extending sleep for multiple nights in non-clinical samples of children had a direct impact on specific domains of neurobehavioral functioning in children.

The paper by Fallone, Acebo, Seifer, and Carskadon7 in this issue of SLEEP, provides new experimental data showing that restricting sleep times in healthy normal school children for one week resulted in increased teacher ratings of academic problems in the classroom and increased severity ratings of school-related attention problems.

Several interesting aspects of this paper warrant some consideration. First, these results were obtained in children who were healthy, mostly middle to upper-middle class, and were screened for sleep problems as well as behavioral and emotional problems. Second, the level of sleep restriction was modest, and compliance and time asleep were quantified by use of actigraphy as well as sleep logs. Third, and perhaps most importantly, the study utilized ecologically-valid measures of academic functioning by obtaining teacher ratings to assess behavior and academic performance in real classroom settings.

The study also raises provocative questions about similarities and differences in sleep restriction effects in less optimal samples. For example, what would the pattern of effects look like in youth who are already coping with some degree of behavioral, emotional, or academic difficulties? Or children who were already dealing with other sources of stress, low levels of structure and social support, or other forms of adversity?

One of the most provocative ways to consider the implications of this work becomes evident when placed within a larger body of research underscoring the role of sleep in learning and memory consolidation (see review by Stickgold8). Most of this work has

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been done in adult humans and animals. However, the developing brain appears to be specialized for learning, and sleep appears to be particularly important during periods of brain maturation. And, accordingly, there is emerging evidence from animal studies that suggests sleep may play a crucial role in brain plasticity.\cite{9,10}

Clearly, a great deal more developmental sleep research is needed in both animals and human studies. However, one could hypothesize that sleep may be particularly important for learning and academic function in children because it is involved in fundamental aspects of brain plasticity—and the processes of embedding new knowledge, memories, and skills, into developing neural systems. The implication here is that the long-term effects of insufficient or disturbed sleep in children may have important long term effects on learning—particularly if these occur chronically and during key times in development.

More generally, society places a high premium on the importance of learning and acquiring new skills during childhood—this is the basis of investing in schools and education for youth. If sleep is essential for some aspects of learning, then it would follow that we should place a premium on sleep during corresponding periods.

Given the explosion of advances in developmental neuroscience and in both animal and human studies of sleep during development, it seems likely that new mechanistic discoveries about sleep, learning, and brain development will provide compelling insights relevant to these ideas. Advances in these basic areas may provide further support for the role of adequate sleep during key periods of development. Perhaps, in the future, we will be able to look back on the current work by Carskadon and colleagues, and it will appear as pioneering and prescient as Hall’s work appears today.

In the meantime, the scientific evidence continues to accrue in support of advocating for the importance of sleep for children in order that they have the greatest opportunity for healthy development and academic success.

REFERENCES