Adolescent Sleep Patterns

Recent years have witnessed a growing concern for insufficient sleep, particularly in the United States. In the early 1990s a congressionally mandated commission noted that insufficient sleep is a major contributor to catastrophic events, such as the nuclear disaster at Chernobyl and the grounding of the *Exxon Valdez*, as well as personal tragedies, such as automobile accidents. Adolescents appear to be among the most sleep-deprived populations in our society, although they are rarely included in sleep assessments. This book explores the genesis and development of sleep patterns at this stage of the life-span. It examines biological and cultural factors that influence sleep patterns, presents risks associated with lack of sleep, and reveals the effects of environmental factors such as work and school schedules on sleep. *Adolescent Sleep Patterns* will appeal to psychologists and sociologists of adolescence who have not yet considered the important role of sleep in the lives of our youth and to educators who work regularly with young people.

Mary A. Carskadon is Professor of Psychiatry and Human Behavior at Brown Medical School and Director of Sleep and Chronobiology Research at the E. P. Bradley Hospital. A former president of the Sleep Research Society, Dr. Carskadon is a Fellow of the American Academy of Sleep Medicine, recipient of the Nathaniel Kleitman Award for Distinguished Service, a member of the Sleep Disorders Research Advisory Board of the National Heart, Lung, and Blood Institute and the National Space Biomedical Research Institute Advisory Board, and associate editor of the journals *Sleep* and *Behavioral Sleep Medicine*.

Adolescent Sleep Patterns

Biological, Social, and Psychological Influences

Edited by

MARY A. CARSKADON

Brown Medical School

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Contributors

Christine Acebo, Brown Medical School
Miriam Andrade, University of São Paulo
Mary A. Carskadon, Brown Medical School
Flavia Cortesi, University "La Sapienza," Rome
Ronald E. Dahl, University of Pittsburgh
William C. Dement, Stanford University
Sanford M. Dornbusch, Stanford University
Flavia Giannotti, University "La Sapienza," Rome
Mari S. Golub, University of California, Davis
Reut Gruber, Tel-Aviv University
Tana M. Hoban-Higgins, University of California, Davis
James T. McCracken, UCLA Neuropsychiatric Hospital, Los Angeles
Melissa K. Melby, Emory University
L. Menna-Barreto, University of São Paulo
Gary S. Richardson, Henry Ford Hospital, Detroit
Roger H. Rosa, U.S. Department of Health and Human Services, Cincinnati
Avi Sadeh, Tel-Aviv University
Peter T. Takeuchi, University of California, Davis
Barbara A. Tate, Children's Hospital of Boston
Kyla L. Wahlstrom, University of Minnesota
Amy R. Wolfson, College of the Holy Cross
Carol M. Worthman, Emory University

Foreword

WILLIAM C. DEMENT

Adolescence is the great and terrifying transition from childhood to adulthood. It is in the interest of a civilized society that a mature, responsible, and well-educated young adult emerges from this transition. Along with mental and physical maturation, a triumvirate of preventive health should be inculcated during adolescence as a permanent philosophy of living. The practice of nutritional health will ensure the best possible outcome during the process of growing older. Exercise and physical fitness, likewise, will also foster health and quality of life. Healthy adequate sleep will foster longevity and particularly the optimal use of our waking hours. We are not healthy unless our sleep is healthy. Sadly (perhaps the raison d'être of this volume), the inculcation of this third member of the triumvirate of preventive health is absent. Furthermore, its absence can have many known and as yet unknown deleterious effects on human life.

A recent report of an exhaustive study on adolescence, *Great Transitions: Preparing Adolescents for a New Century* prepared by the Carnegie Corporation of New York (1995), exemplifies the puzzling and frustrating blind spot regarding sleep issues by even the best of the best. While excellent, thorough, and future-oriented in every other area, the report did *not* mention adolescent sleep or biological rhythms.

It has been my great privilege to be associated for many years with the editor and progenitor of this book. I knew her first as a family member (a cousin of my wife), and then I was very lucky that a unique concatenation of events brought her to Stanford University in 1970. She directed a truly pioneering program on the scientific study of daytime sleepiness in the Stanford University Summer Sleep Camp from 1975 to 1985. The studies in this remarkable facility established the scientific basis of our current understanding of the critical dimension of waking

sleepiness-alertness and its nocturnal determinants. In addition, and of great importance to the topic of this book, she directed a longitudinal study of a cohort of children as they went through the great transition of adolescence.

At the beginning of this remarkable decade of research, the gold standard of assessing daytime sleepiness, the multiple sleep latency test (MSLT), was developed and applied. Using this test each summer on the longitudinal cohort, it was established that sleep need does not change or may even increase during the great transition. The MSLT also allowed an assessment of the effect of sleep restriction on daytime alertness; for the first time, it was clear that the impact of lost sleep accumulates from day to day. This accumulation is often referred to as the "sleep debt." Finally, the great disparity between MSLT measures of sleep need in adolescents versus questionnaire data on actual sleep obtained at home during the school year allows us to conclude that many, if not most, adolescents must be severely, chronically sleep deprived. The data bases are very small, but students falling asleep in class are a familiar sight to middle school and, particularly, high school teachers. This situation is further complicated by the biological tendency for phase delay of circadian rhythms and the markedly increased prevalence of students holding extracurricular jobs, usually in the evening, to earn money.

During much of 1990 and 1991, Dr. Carskadon and I served on the National Commission on Sleep Disorders Research, which carried out a congressionally mandated study of the role of sleep deprivation and sleep disorders in American society. One of the areas that we examined was whether the facts about sleep that we have known for more than two decades have actually been integrated into the educational system and the health care system. Unfortunately, crucial education about sleep need and biological rhythms and sleep disorders likely to occur in adolescence was completely absent. It is my very strong opinion that all human beings become victims of the lack of awareness about sleep during the great transition and, to some extent, for the rest of their lives. Although data on sleep disorders in latency-age children are limited, the studies conducted by Dr. Carskadon, particularly for children in middle- and upper-class environments, suggest that sleep needs are generally fulfilled at this age with a resulting optimal daytime alertness and performance.

In terms of developing a society in which healthy sleep is a priority, the optimal target may be the developing adolescent. Crucial material about sleep, sleep deprivation, biological rhythms, and sleep disorders

can be readily taught at this age level. It might also be possible to introduce effective interventions to promote positive schedule strategies that allow more time for sleep. For example, a great deal can be accomplished by using the "bully pulpit" of driver training, a key issue for all adolescents.

Another area pioneered by Dr. Carskadon and to some extent revealed during the early days of the Stanford University Sleep Disorder clinic is what is now called the delayed sleep phase syndrome. In the Stanford studies and more recently in her research at Brown and in the work of others, it has become clear that there is a major biological rhythm problem in adolescence, and this problem clearly exacerbates the sleep loss problem. This knowledge has come onto the radar screen in recent years with sporadically successful efforts to change the starting time in high schools to a later hour. Accomplishing this initiative is uniquely difficult because of the complexity of forces determining the school schedule. Preliminary data where the starting time has been successfully delayed have been promising.

Finally, it is time to address the pervasive adolescent problem of school schedule–biological clock mismatch in some effective manner. There is an urgent need for researchers and clinicians in the area covered by this volume to cooperate, to arrive at a consensus, and to provide leadership both in adding to the necessary scientific data bases to foster change, and to provide leadership in advocating wise public policy in this crucial area. Leadership is needed at every level, including local school boards, county and state organizations, and even at the federal level. Dr. Carskadon is certainly the outstanding leader in this area, and she has assembled a tiny band of other leading researchers to produce a very important and long-overdue book.

Preface

MARY A. CARSKADON

The maturation of sleep patterns in teens has been a focus of my research for 25 years – long enough for the teens I first studied to have teenagers of their own. I often wonder why we don't know it all yet, and then I step into the world and am reminded of the complexity of life and the accelerating rate of change in opportunities, expectations, technology, and social mores. Developing humans are at the center of it all, with sleep's core behavioral role at the mercy of these factors and many more.

I am humbled by the task of attempting to understand the phenomena we observe, and I am inspired by the process of scientific investigation. As in other fields, progress is usually neither linear nor direct; it is affected by the evolution of methodologies and ideas, and the flow of knowledge can be entirely redirected by conceptual breakthroughs. My research in the area of adolescent sleep patterns has benefited from several such major reconstructive conceptual shifts. The first seism occurred in the longitudinal Summer Sleep Camp study at Stanford – inspired by William Dement and Thomas Anders – in which we not only failed to confirm the predicted reduction of sleep need across adolescent development but also showed a restructuring of sleep so that pubertal adolescents sleeping no less than before were actually *sleepier* in the afternoon. The conclusion: teens don't need less sleep.

A second movement of our conceptual tectonic plates fractured the assumption that the delay in the timing of sleep in adolescents, especially later bedtimes, was purely a psychosocial phenomenon. Instead, we now find that the brain's mechanisms controlling the timing of sleep appear to undergo a shift at adolescence that is permissive of and in some may drive the teen phase delay. The conclusion: teens cannot simply decide to fall asleep or wake up.

The major theoretical contribution that allows us to frame a biological context for these investigations began with A. A. Borbély's articulation of the two-process model of sleep (in *Human Neurobiology*, 1982), a model that allows us to predict and examine the principal biological components regulating sleep. Combined with new methods and measures, the theoretical advances in understanding these biological factors provide exciting opportunities. The story of adolescent sleep goes beyond biology, however, and the contributors to this book provide stepping-stones leading to the future development of this ever challenging area of study.

The birthplace of this project was an international symposium on Contemporary Perspectives on Adolescent Sleep held in Marina del Rey, California, in April 1997. The symposium was sponsored by the University of California at Los Angeles, Youth Enhancement Services (YES), under the leadership of Michael Chase, Ph.D., and supported by an unrestricted educational grant from the Anheuser-Busch Foundation. Many of the attendees at the symposium have authored chapters in this book. We are indebted to Dr. Chase and the Anheuser-Busch Foundation for assembling us to begin this project.

I can never thank Bill Dement, M.D., Ph.D., adequately for all of his enthusiastic support and encouragement over many years of mentorship. I am again indebted to him for writing the Foreword to this book and providing such a persuasive reminder of the importance of this work in his usual charismatic style.

One clear gap in understanding the place of sleep in the lives of teens has been its integration with social roles and societal forces that influence teens. I am grateful to Dr. Sanford Dornbusch for his chapter, which discloses so eloquently the blind eye that the field of adolescent sociology has turned toward sleep and acknowledges the likely importance the assessment of sleep may hold for sociologists.

I tried to provide some scaffolding for subsequent chapters in a broad overview of "Factors Influencing Sleep Patterns of Adolescents," Chapter 2. An outline of issues from home, to work, to school, to basic biological concepts precedes the description of our field-lab study in 9th and 10th grade students. This particular study clarifies most strongly for me the enormous burden an early school start time places on adolescents given no support to make appropriate adjustments.

The overview of "Endocrine Changes Associated with Puberty and Adolescence" by Gary Richardson and Barbara Tate adds to the scaffold with a clear explanation of human neuroendocrine system changes during this critical developmental phase and how these changes

influence brain mechanisms that contribute to the control of sleep and wakefulness.

The idea for chapters on comparative biology of adolescent sleep patterns was inspired by an e-mail from Mari Golub in 1996 asking me to help interpret activity pattern findings from her adolescent Rhesus monkeys. I was working at the time with Barbara Tate to develop a rodent model (*Octodon degus*) to examine similar issues. The explorations of adolescent activity patterns in these species in Chapters 4 and 5 offer interesting counterpoints to the human condition and add strength to the hypothesis that biological changes at the adolescent transition assist a phase delay.

In the course of a research career, certain moments in time hold salient places in our intellectual development or scientific yearning. One such moment for me came during the challenge of grant writing while collecting data at the Stanford Sleep Camp in the summer of 1979. This striking image includes an overwhelming sense of urgency to know about sleep patterns from the viewpoint of an anthropologist: what *is* the developmental pattern of sleep in non-Westernized cultures? I remember vividly my desire to know right then and there and my wish that I could do the field work myself. Of course, this urgency dissipated in the throes of ongoing work, but the yearning for this knowledge has remained. Thus, one of my most gratifying experiences was meeting Dr. Carol Worthman at the symposium, and I am thrilled to include her scholarly presentation, "Toward a Comparative Developmental Ecology of Human Sleep," in this book. Carol's chapter is the first comprehensive assessment of human sleep from the perspective of an anthropologist, and it is stunning in its scope and analysis. Worthman and her colleague, Melissa Melby, have embraced this effort with enthusiasm, and I am both grateful for and a bit in awe of their accomplishment. I am also delighted to know that Carol has recently completed the first field study specifically to examine sleep, the first of what I hope are many to follow.

Two views of adolescent sleep patterns from disparate contemporary "Westernized" societies are provided in the chapters by Miriam Andrade and Luiz Menna-Barreto, who examine the sleep of teens in São Paolo, and by Flavia Gianotti and Flavia Cortesi, who probe sleep patterns and sleep problems of Italian teens. These chapters stand in contrast to the anthropological perspective and as introduction to the issues of sleep patterns and school schedules in North American adolescents.

Before considering these concerns, however, our journey through the world of adolescent sleep takes two brief side trips to explore related but more tangential issues. I have wanted to summarize the data from our adolescent driving risk surveys for a number of reasons. First, they hold an inherent message about drowsy driving in teens. In addition, I have wanted to honor the cherished memory of and say farewell to my dear friend, Helen Bearpark, Ph.D., who shared in this research and for whom the issue of drowsy driving was a compelling concern. Thank you, Helen. Roger Rosa takes us next to Finland for an examination of adult workers who experience early-morning shift schedules. His research points out not only difficulties associated with such work shifts but also the challenges of making life-style choices to accommodate sleep under those circumstances. Adolescents with early school start times face similar challenges.

To my knowledge, Kyla Wahlstrom is the first career educator to have embraced a research interest at the interface of school schedules and teen sleep. I marvel at the complexities of school systems that Kyla's chapter charts for us, as she examines step by step the structures that impact decisions about the school schedule. The tantalizing tales of the Edina, Minnesota, experience only whet our appetites for results from Kyla's longitudinal assessments of the Minneapolis "experiment." A preliminary summary of those findings is included as an appendix to her chapter.

Amy Wolfson's chapter takes aim at the challenges that face teenagers as this century progresses and provides useful suggestions that may help reverse societal, family, and life-style trends providing the pressure to shrink adolescent sleep. This insightful presentation gives us fair warning and prescriptive recommendations.

I find Christine Acebo's assessment of adolescent sleep patterns in "Influence of Irregular Sleep Patterns on Waking Behavior" very important in its unique examination of sleep's impact while controlling for other important factors. This chapter acknowledges that such outcomes as grades, depressed mood, injuries associated with alcohol or drugs, and absenteeism are multidetermined. The subsequent analytical models then include sleep predictors in multiple regressions that allow us to identify clearly the significant impact of sleep amount and regularity, even when accounting for age, sex, race, educational expectations, learning disabilities, and substance use. These findings highlight the crucial role of sleep and provide a strong introduction for the final chapters.

The last three chapters of this book provide more clinical perspectives of adolescent sleep patterns. Avi Sadeh and Reut Gruber write of the ways stressful events in adolescents' lives can impinge on sleep. The case vignettes concluding their chapter put real faces to the theoretical models and predictions. James McCracken is a practicing psychiatrist and researcher who has studied depression in adolescence. He summarizes for the clinical scientist the ways in which adolescents' sleep and depressed mood are intertwined and speculates on neural substrates. Ronald Dahl writes compellingly of the challenges an adolescent's brain faces to achieve a successful integration of cognitive and emotional development and how this process is impacted by and has an impact on the sleep patterns of adolescents.

I thank all these authors for their thoughtful contributions to this book and their patience with the process. I believe we have assembled a set of perspectives that will enlighten and inform. I must also especially thank Christine Acebo and Amy Wolfson for helping bring this work to fruition and Marian "Max" Elliott for her many hours of labor and solicitous forbearance of my moods.

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