



Original article

## Developmental Trends in Sleep Duration in Adolescence and Young Adulthood: Evidence From a National United States Sample

Julie Maslowsky, Ph.D.<sup>a,\*</sup>, and Emily J. Ozer, Ph.D.<sup>b</sup><sup>a</sup> Robert Wood Johnson Foundation Health & Society Scholars Program, School of Medicine and Public Health, University of Wisconsin-Madison, Madison, Wisconsin<sup>b</sup> Division of Community Health and Human Development, School of Public Health, University of California-Berkeley, Berkeley, California

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 A B S T R A C T

**Purpose:** To present normative values of mean sleep duration from adolescence through young adulthood (ages 13–32 years), prevalence of short (<6 hours) and long (>10 hours) sleep durations, and differences in each by sex and race/ethnicity.

**Methods:** Mean sleep duration and prevalence of extremely short and long sleep were estimated using data from the United States National Longitudinal Study of Adolescent Health, Waves 1–4 (N = 15,701).

**Results:** Sleep duration showed age-related trends, with decreases across the adolescent period from 8.5 hours per night at age 13 years to 7.3 hours at age 18 years, an increase through the emerging adulthood period to 8.5 hours at age 22, and a gradual decline across early adulthood to 7.7 hours at age 32 years. Prevalence of extremely long and short sleep followed similar developmental trends. Adolescent girls reported lower mean sleep duration than did boys, but women reported longer average sleep duration than did men from age 19 years onward. Short sleep duration was most common among African-Americans at all ages. Long sleep was most common among African-Americans in adolescence and emerging adulthood and among Hispanics in early adulthood.

**Conclusions:** Sleep duration is developmentally patterned from adolescence through early adulthood. Mean and extreme sleep durations vary systematically by sex and race/ethnicity as well as age. These normative data on sleep duration will inform studies of the role of sleep in the etiology of a wide range of health conditions affecting adolescents and young adults.

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 IMPLICATIONS AND  
 CONTRIBUTION

This study reveals normative developmental shifts in sleep duration from adolescence through early adulthood. Sleep duration decreases sharply across adolescence, increases somewhat in emerging adulthood, and decreases again across early adulthood. These normative data provide a developmentally informed foundation for studies of sleep's role in a wide range of health conditions.

Sleep is essential for mental and physical health and well-being [1,2]. Abnormal sleep duration—too much or too little sleep—is implicated in a wide range of physical and mental health conditions, including diabetes, hypertension, hypercholesterolemia, obesity, depression, substance use, and all-cause mortality [1,3–9]. There is reason to expect that sleep duration should vary by developmental period from adolescence through young adulthood. Documented biological mechanisms such as

adolescent sleep phase delay and social and contextual factors such as early school start times during adolescence and transition into adulthood roles during emerging and early adulthood provide reasons to expect that sleep duration is developmentally patterned during these periods [10,11]. However, no nationally representative data spanning adolescence through early adulthood have been reported. Understanding normative developmental shifts in sleep duration will help to further specify the role of sleep in the etiology of the many health conditions in which it has been implicated.

The life period spanning adolescence through early adulthood is marked by numerous biological and social developments. It encompasses three developmental periods: adolescence, emerging

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\* Address correspondence to: Julie Maslowsky, Ph.D., Robert Wood Johnson Foundation Health & Society Scholars Program, School of Medicine and Public Health, University of Wisconsin-Madison, 610 Walnut Street, 707 WARF Building, Madison, WI 53726.

E-mail address: [maslowsky@wisc.edu](mailto:maslowsky@wisc.edu) (J. Maslowsky).

adulthood, and early adulthood, each of which is characterized by a distinct combination of biological, contextual, and social influences. Definitions of the age range covered by each of these developmental periods vary. For purposes of the current study, adolescence refers to participants age 13–18 years, emerging adulthood refers to age 19–22 years, and early adulthood refers to age 23–32 years. There is a well-documented decline in average sleep duration across the adolescent period [12–14], a matter of significant concern given that the biological need for sleep does not decrease in adolescence [15]. Rather, the decline in sleep duration is driven by constraints imposed by competing biological and social factors. With pubertal onset comes phase delay, a biologically driven shift that results in adolescents staying awake later at night [12,15,16]. Coupled with early school start times that require early wake times, this leads to a decline in nightly hours of sleep during adolescence.

It is not clear whether sleep time continues to decline after adolescence, in the emerging adulthood period that begins around age 19 years, after typical graduation from secondary school. Roles and responsibilities in emerging adulthood are varied; some individuals enter college, whereas others enter the working world or move into family formation [17]. Compared with adolescence, emerging adulthood is a time when individuals exercise greater ability to choose their own context and accommodate their own sleep schedule without the constraint of early wake times generally enforced by high schools. This may result in increased sleep duration during emerging adulthood. In contrast, early adulthood is typically characterized by the onset of adulthood roles, such as full-time work, marriage, and parenthood, each of which places time and energy demands and may result in diminished sleep duration.

The aim of the current report was to examine whether the well-established decline in sleep time during adolescence continues or reverses in emerging and early adulthood. This is a crucial area of inquiry. If declines in sleep duration previously noted in adolescence continue for a prolonged period into adulthood, this could lead to the development of physical and mental health conditions known to be associated with abnormal sleep duration. We expected that sleep duration would be patterned according to developmental phase—adolescence, emerging adulthood, and early adulthood. Specifically, we hypothesized that sleep duration would decrease in adolescence, increase in emerging adulthood, and decrease somewhat in early adulthood. Normative data are needed to characterize age-related variation in sleep duration and provide a basis for additional research on the precursors and consequences of normal and abnormal sleep duration during this life period.

In addition to mean sleep duration, it is important to consider developmental trends in the prevalence of extreme long and short sleep duration. In adults, accumulating evidence suggests that short and long sleep duration, generally defined as sleeping <6 or >10 hours per night, is associated with negative health outcomes such as obesity, diabetes, and hypertension [4,6,7] and increased risk of mortality [4]. Short sleep in particular appears to precede disease onset, whereas long sleep may also be a consequence of disease. Several studies report that racial and ethnic minorities, particularly African-Americans, are disproportionately represented among those reporting extremely long and short sleep duration [18,19]. Most research on prevalence of short and long sleep duration has focused on middle-aged and older populations; establishing prevalence of short and long sleep durations earlier in life is necessary for understanding their lifespan distributions.

## Methods

### Study sample

This study presents normative values of self-reported sleep duration from adolescence through young adulthood using nationally representative data from the National Longitudinal Study of Adolescent Health (Add Health) [20]. In the first wave of Add Health data collection, a subsample of 20,745 adolescents in seventh through 12th grades were selected from a larger school-based sample of 90,118 to participate in in-depth home interviews and to be followed longitudinally in three additional waves. Wave 1 occurred in 1994–1995; longitudinal follow-ups occurred in 1996, 2001–2002, and 2007–2008. Across the four waves, participants' ages ranged from 11 to 34 years. The present sample includes data reported at each wave by the 15,701 participants from the Wave 1 home interview subsample who were retained through Wave 4 (49.2% female, 57% white, 16.6% African-American, 18.7% Hispanic, and 7.7% other race/ethnicity).

Data were weighted using Add Health Wave 4 grand sample weights, which account for sample attrition and retain the national representativeness of the original Wave 1 sample. A total of 80.3% of Wave 1 sample participated in Wave 4. Using Wave 1 responses, estimated bias in Wave 4 responses resulting from sample attrition was calculated, and Wave 4 weights were generated to correct for this bias [21]. Restricting the age range to 13–32 years, the ages at which sample sizes were large enough to provide robust estimates, and deleting impossible values <0 or >24 hours of sleep per day resulted in a total of 14,799 individuals. Over the course of the four sample waves, these 14,799 individuals provided a total of 52,080 observations on sleep duration, which comprised the final analysis sample. All study procedures were approved by the Institutional Review Board of the University of Wisconsin, Madison.

### Measures

**Sleep duration.** In Waves 1 and 2, participants were asked, “How many hours of sleep do you usually get?” with responses in whole hours. In Waves 3 and 4, participants were asked about amount of sleep via four items: “On days when you go to work, school, or similar activities, what time do you usually wake up?”; “What time do you usually go to sleep the night (or day) before?”; “On days you don't have to get up at a certain time, what time do you usually get up?”; and “On those days, what time do you usually go to sleep the night or day before?”. The first two items were intended to assess weekdays, and the latter two were intended to assess weekends. Hours of sleep per night on weekdays and weekends were calculated, and a weighted average was computed, weighting the weekday items at five of seven and the weekend items at two of seven. In accordance with previous research and with developmentally appropriate recommendations for optimal sleep duration [12,19,22–26], short and long sleep were defined as sleeping <6 or >10 hours, respectively.

**Demographic characteristics.** Participant age at each interview date was calculated and rounded to the nearest year. Participant sex, race, and ethnicity were self-reported at Wave 1. For purposes of the current report, four mutually exclusive racial/ethnic categories were created: (non-Hispanic) white, (non-Hispanic) African-American, Hispanic, and (non-Hispanic) other race/ethnicity.

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