American Journal of Epidemiology

Vol. 192, No. 1
https://doi.org/10.1093/aje/kwac156
Advance Access publication:
August 25, 2022

Original Contribution

Racial/Ethnic and Sex/Gender Differences in Sleep Duration Trajectories From Adolescence to Adulthood in a US National Sample

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Initially submitted November 15, 2021; accepted for publication August 23, 2022.

Racial/ethnic and sex/gender disparities in sleep duration have been documented in adolescence and adulthood. Identifying racial/ethnic and sex/gender differences in sleep duration trajectories from adolescence to adulthood can inform interventions on the developmental periods individuals are most at risk for short sleep duration. We examined racial/ethnic and sex/gender differences in self-reported sleep duration trajectories from adolescence to adulthood using data from waves I, III, IV, and V of the National Longitudinal Study of Adolescent to Adult Health (1994–2018; $n = 12{,}593$). Multigroup growth mixture modeling was used to enumerate sleep duration trajectories from adolescence to adulthood. There were 3 common trajectory types across race/ethnicity and sex/gender groups: 1) consistent increasing short sleepers (i.e., increasing probability of short sleep into adulthood) (67.3%); 2) late-onset short sleepers (i.e., no probability of short sleep duration in adolescence until adulthood) (20.2%); and 3) early-onset short sleepers (i.e., declining probability of short sleep duration from adolescence into adulthood) (12.5%). The prevalence of the consistent-increasing trajectory was highest among Black male respondents, while late onset was highest among White female respondents and early onset greatest among Latinx male respondents. Findings underscore the need to intervene in early adolescence to prevent short sleep duration in adulthood.

ethnicity; gender; health status disparities; life span; race; sex; sleep

Abbreviations: Add Health, National Longitudinal Study of Adolescent to Adult Health; GMM, growth mixture model; SD, standard deviation.

Sleep is vital for physical and cognitive development across the life span (1, 2). Short sleep duration (<8 hours at ages 13–18 years and <7 hours for adults over age 18) (3, 4) has been linked to negative health outcomes, such as obesity, diabetes, hypertension, and depression, among both adolescents and adults (5–9). Approximately 70% of adolescents and 35% of adults reported short sleep duration (10, 11). The transition from adolescence to adulthood is a critical period with various biological and sociocontextual changes that converge, leading to declining sleep duration into adulthood (12). Possible biological processes include a circadian phase delay during pubertal development that favors an evening chronotype and the development of a sleep-wake homeostatic system that allows for more wakefulness during the daytime; both processes result in a progressively later bedtime from early adolescence into young adulthood (13). In combination with a later bedtime, sociocontextual pressures such as early school start times during adolescence, academic and work demands, increasing responsibilities as young adults become independent from their parents, and family formation present additional barriers to sleep (14–16). However, minoritized racial/ethnic groups and women have unique sociocontextual experiences from adolescence to adulthood that may have different impacts on their sleep duration patterns across the life course that warrant further research.

Significant racial/ethnic disparities in sleep duration have been documented. Asian, Black, and Hispanic/Latino adolescents generally report shorter sleep duration than non-Hispanic White adolescents, with similar disparities found

among adults (17, 18). These racial/ethnic disparities in sleep duration may be attributed to the persistent racially discriminatory policies and practices that subject minoritized racial/ethnic groups to greater social disadvantage and restrict them from accessing opportunities and resources beneficial to health (19). In turn, minoritized racial/ethnic groups may have greater exposure to factors detrimental to sleep, such as psychosocial stressors, shift work, lower socioeconomic status, acculturative stress, and adverse physical (e.g., air and noise pollution) and social (e.g., lower social cohesion and safety) neighborhood environments (20–26). These unique harmful sociocontextual experiences among racial/ethnic minoritized groups could result in different sleep duration trajectories from adolescence to adulthood, compared with their White peers.

Findings from research examining sex (i.e., biological characteristics such as chromosomes and reproductive/sexual anatomy) and gender (i.e., social construct to describe norms and behaviors that society associates with being male and female) differences have been mixed among both adolescents and adults, demonstrating shorter (11, 27, 28) and longer (29–33) sleep duration among female participants. Shorter sleep duration among female participants could be attributed to earlier pubertal onset during adolescence or hormonal changes (e.g., estrogen and progesterone) that occur during pregnancy and menopause, coupled with gendered expectations (e.g., childcare and housework) (34, 35). Although women tend to experience greater psychosocial stressors (e.g., gender discrimination, occupational stress, and financial strain) (36–40) that are detrimental to sleep, they may be more likely to seek and receive social support than men (41–43), which could help buffer the impact of these stressors on sleep (44, 45). Research, although sparse, suggests that shorter sleep duration among men may be due to poorer sleep hygiene (e.g., greater caffeine intake and screen time) and less positive attitudes towards healthy sleep behaviors than those held by women (46, 47). The interaction of these various biological and sociocultural factors may play a role in shaping sleep duration from adolescence to adulthood for women that may differ from men.

Studies have generally examined sleep disparities in relation to one social identity (e.g., race/ethnicity or gender), with few attempting to explore the impact of multiple identities (e.g., race/ethnicity and gender) on sleep. In the context of public health, intersectionality is a theoretical framework that seeks to understand how the interplay of multiple social identities (e.g., race, gender, social class, sexual orientation, and disability) grants individuals advantages/disadvantages that will influence their health and create health inequities (48). There is growing recognition of the need for intersectional approaches to address health disparities, especially sleep disparities (17). Evidence suggests that sleep duration differs jointly by race/ethnicity and sex/gender in adolescent and adult populations, with Black male and female participants generally reporting the shortest sleep duration and non-Hispanic White women reporting the longest (30, 49–52). However, these studies have focused primarily on documenting racial/ethnic and sex/gender differences in sleep duration in one developmental period.

Assessing sleep duration across multiple developmental periods is important, given that research suggests that sleep duration from earlier developmental periods can influence health later in life (53, 54). Rather than focusing on the impact of sleep at one point in time, research examining the impact of sleep duration across multiple developmental periods may be more informative in predicting health outcomes. For instance, studies among a national US cohort found that cumulative short sleep duration (<6 hours/day) from adolescence to adulthood was associated with increased risk of obesity and asthma (55, 56).

An important approach to examining sleep duration across developmental periods is through characterizing sleep duration trajectories. Sleep duration trajectories could help determine critical periods of inadequate sleep duration, which may be useful for informing sleep interventions. Yet studies describing sleep duration trajectories across the life course remain limited (56–58). These studies have not applied an intersectionality framework to examine sleep duration trajectories from adolescence to adulthood by race/ethnicity and sex/gender. This information could be used to develop interventions targeting specific developmental periods to reduce sleep disparities and ultimately health disparities.

To expand upon prior literature, the primary purpose of this study was to utilize an intersectionality approach to describe race/ethnicity and sex/gender differences in sleep duration trajectories from adolescence to adulthood.

METHODS

Sample

Participants were from the National Longitudinal Study of Adolescent to Adult Health (Add Health) which is a nationally representative, school-based sample with the purpose of investigating adolescent behaviors and their health in adulthood (59). There were 80 high schools and 52 middle schools selected with respect to region of country, urbanicity, school size, school type, and ethnicity to ensure representativeness of US schools. In 1994–1995, an in-home interview was conducted among 20,745 adolescents from these participating schools, with an additional 4 follow-up interviews: wave II in 1996 (n = 14,738; mean age = 16.2 years), wave III from 2001–2002 (n = 15,197; mean age = 22.0 years), wave IV in 2008 (n = 15,701; mean age = 28.5 years), and wave V from 2016–2018 (n = 12,300; mean age = 37.0 years). A more in-depth description of the study design has been published elsewhere (59). In these analyses, those who identified as Black male, Black female, Hispanic male, Hispanic female, White male, or White female from wave I were included (n = 18,649). Other race and sex groups were excluded due to inadequate sample size for analysis. Those with missing sleep duration data in waves I, III, IV, and V were excluded (n = 51). Long sleepers (defined as >12 hours for ages 6–12 years, >10 hours for ages 13–18 years, >9 hours for ages >18 years) in any of the waves (wave I: n = 556, wave III: n = 3,331, wave IV: n = 2,931, and wave V: n = 480) were excluded (total n = 6,020) instead of being grouped with short sleepers or those

with the recommended amount of sleep. The reasons for this exclusion were that mechanisms linking long sleep to health may differ from those linking short sleep to health (60) and the sample size for long sleepers in waves I and V was small. The final analytical sample was 12,593 participants (Web Figure 1, available at https://doi.org/10.1093/aje/kwac156).

Compared with those included in this study, excluded participants were more likely to be female, have higher parental education and educational level, report greater depressive symptoms, and report fair or poor health across all waves (Web Table 1). Supplemental analyses including long sleepers were conducted, with results shown in Web Figure 2. The original Add Health study was approved by the institutional review board of the University of North Carolina, Chapel Hill, and written consent forms were obtained from adolescents and their parents. This present analysis was approved by the institutional review board of Emory University.

Study measures

Sleep duration. Measurements of sleep duration varied by waves. In waves I and V, participants were asked to respond in whole hours to the question, "How many hours of sleep do you usually get?" In waves III and IV, sleep duration was assessed by asking participants for their sleep and wake times for the weekday and weekend. Total sleep hours per day was calculated by a weighted average based on prior studies conducted on sleep using the Add Health data set, in which sleep hours during the weekday (multiplied by 5/7) was summed with weekend sleep hours (multiplied by 2/7) (28, 55). The recommended nightly amount of sleep by age from the American Academy of Sleep Medicine (AASM) is 9–12 hours for ages 6–12 years, 8–10 hours for ages 13–17 years, and 7–9 hours for ages 18 or older (3, 4) and was categorized in analyses as short sleep duration (less than recommended by AASM) vs. healthy sleep duration (within recommended by AASM).

Race/ethnicity and sex/gender. Race/ethnicity categories were constructed based on recommendations by the Add Health research team (61). Respondents were first asked whether they were of Hispanic or Latino origin. A separate question asked respondents to indicate their race, with White, Black or African American, American Indian or Native American, Asian or Pacific Islander, or "other" as possible answers and the ability to select multiple racial groups. Those that indicated being of Hispanic or Latino origin were categorized as "Hispanic" for their race/ethnicity. If participants did not indicate they were of Hispanic or Latino origin and selected "Black or African American" as one of their racial identities, they were categorized as Black for their race/ethnicity, and their other selected racial categories were omitted. This was repeated for the remaining racial groups in the following order: Asian, Native American, other, and non-Hispanic White. Hereafter, Hispanic will be referred to as Latinx and non-Hispanic White will be referred to as White. Sex/gender was assessed by asking whether respondents identified as male or female. The combined race/ethnicity and sex/gender categories for the analyses included: Black male, Black female, Latinx male, Latinx female, White male, and White female.

Statistical analysis. The distributions of participant characteristics were examined by race/ethnicity and sex/gender using χ^2 tests and analysis of variance. Given our interest in applying an intersectionality framework, multigroup growth mixture models (GMMs) were fitted to enumerate the sleep duration trajectory classes across the developmental periods for each race/ethnicity and sex/gender group. In the GMMs, the grouping variable was the race and sex groups; the latent trajectory classes represented the changes in probability of short sleep duration across developmental periods. Covariates were not included in the GMMs given that most factors may be potential mediators in the pathway between race/ethnicity, sex, and sleep duration (See Web Figure 3 for conceptual model) (17, 34). Developmental periods included early adolescence (11–14 years), adolescence (15–19 years), emerging adulthood (20–24 years), young adulthood (25–34 years), and adulthood (35–44 years), based on prior literature (62–64). Once the classes were identified, participants were assigned exclusively to one class based on their highest estimated posterior probabilities. Two to four class models were estimated and compared using the Akaike information criterion (AIC), Bayesian information criterion (BIC), and entropy. The 3-class model had the best fit because of the lower AIC and BIC, higher entropy, and interpretability of classes (65). GMMs were fitted using Mplus, version 8.4 (Muthén & Muthén, Los Angeles, California), with a maximum likelihood estimator and expectation maximization algorithm to estimate parameters (66). Missing data was addressed with full information maximum likelihood, a method to calculate unbiased parameter estimates in the presence of missing data using each case's available data (67). Descriptive analyses were conducted in SAS, version 9.4 (SAS Institute, Inc., Cary, North Carolina).

Since waves I and II data were collected only a year apart, some participants had 2 sleep duration data points in the early adolescence or adolescence developmental periods. Data in GMMs need to be time-structured, and to date no options are available to account for clustering within a time frame (L. K. Muthén, Mplus Support, personal communication, 2020). Thus, we could not include both data points in the analyses. To address this issue, GMMs including data from waves I, III, IV, and V were fitted and compared with models including data from waves II, III, IV, and V. Models including data from wave I had better model fit and interpretability of classes than those with data from wave II. Therefore, results from analyses including wave I are discussed below.

RESULTS

Descriptive analyses

The mean age was 13.4 (standard deviation (SD), 0.7) years in early adolescence, 16.7 (SD, 1.3) years in adolescence, 22.1 (SD, 1.3) years in emerging adulthood, 28.7 (SD, 1.9) years in young adulthood, and 38.2 (SD, 1.8) years in adulthood (Table 1). The prevalence of short sleep

Table 1. Mean (Standard Deviation) Age and Sleep Duration Across Developmental Periods[a] According to Race/Ethnicity and Sex/Gender From Waves I, III, IV, and V of the National Longitudinal Study of Adolescent to Adult Health, United States, 1994–2018

Age, Sleep Duration, and Developmental Period	Total (*n* = 12,593)	Race/Ethnicity and Sex/Gender					
		Black Female (*n* = 1,525)	Black Male (*n* = 1,573)	Latinx Female (*n* = 1,126)	Latinx Male (*n* = 1,302)	White Female (n = 3,236)	White Male (n = 3,831)
Age in years							
Early adolescence	13.4 (0.7)	13.3 (0.7)	13.4 (0.7)	13.4 (0.7)	13.4 (0.7)	13.4 (0.7)	13.4 (0.7)
Adolescence	16.7 (1.3)	16.7 (1.3)	16.7 (1.3)	16.7 (1.2)	16.8 (1.2)	16.7 (1.3)	16.6 (1.3)
Emerging adulthood	22.1 (1.3)	22.1 (1.3)	22.1 (1.3)	22.2 (1.3)	22.4 (1.3)	22.1 (1.4)	22.1 (1.3)
Young adulthood	28.7 (1.9)	28.6 (1.9)	28.7 (1.9)	29.0 (1.8)	29.1 (1.8)	28.6 (1.9)	28.7 (1.8)
Adulthood	38.2 (1.8)	38.1 (1.8)	38.3 (1.8)	38.5 (1.7)	38.6 (1.8)	37.9 (1.8)	38.2 (1.8)
Sleep duration in hours							
Early adolescence	8.1 (1.1)	7.8 (1.3)	7.9 (1.2)	8.1 (1.1)	8.0 (1.2)	8.1 (1.1)	8.3 (1.0)
Adolescence	7.4 (1.2)	7.2 (1.3)	7.3 (1.3)	7.5 (1.3)	7.3 (1.2)	7.4 (1.2)	7.5 (1.2)
Emerging adulthood	7.3 (1.0)	7.3 (1.1)	7.1 (1.2)	7.2 (1.1)	7.4 (1.0)	7.4 (0.9)	7.2 (1.0)
Young adulthood	7.2 (1.0)	7.2 (1.1)	6.8 (1.2)	7.2 (1.0)	7.4 (1.0)	7.5 (0.9)	7.2 (1.0)
Adulthood	6.6 (1.1)	6.3 (1.1)	6.2 (1.1)	6.5 (1.0)	6.5 (1.1)	6.7 (1.0)	6.6 (1.0)

[a] Developmental periods include early adolescence (11–14 years), adolescence (15–19 years), emerging adulthood (20–24 years), young adulthood (25–34 years), and adulthood (35–44 years).

duration varied by developmental periods with 29.7% in early adolescence, 46.8% in adolescence, 31.4% emerging adulthood, 30.5% in young adulthood, and 46.1% in adulthood (Table 2). Short sleep duration was most prevalent among Black male participants across all developmental periods, except early adolescence, when Black female participants were more likely to have short sleep duration. The average sleep duration declined from adolescence into adulthood, with the lowest average sleep duration across developmental periods among Black participants irrespective of sex.

Multigroup GMMs by race/ethnicity and sex/gender

The 3-class model was the best-performing model, with the lowest Akaike and Bayesian information criteria and the highest entropy (Web Table 2). This resulted in 18 trajectories (i.e., 3 trajectories for each of the 6 race/ethnicity and sex/gender intersectionality groups) (Figure 1, Figure 2, and Web Table 3). Through visual inspection, the 18 trajectories were grouped into 3 common sleep duration trajectory types as the 3 trajectories for each intersectionality group varied but were qualitatively comparable. The most prevalent trajectory (67.3%) type was labeled "consistent increasing short sleepers," as the sleep pattern began in early adolescence at a mid-level probability (ranging from 0.44–0.46) of short sleep duration and consistently increased into adulthood (probability ranging from 0.47–0.67). The second most prevalent trajectory type was labeled "late-onset short sleepers," as this group represented those who had zero probability of short sleep duration from adolescence to young adulthood but had a probability of short sleep duration in adulthood (20.2%). The least common trajectory type was labeled as "early-onset short sleepers" (12.5%) and included those with a high probability for short sleep duration during early adolescence only as short sleep declines to a low probability in the adult developmental periods.

Although these 18 trajectories could be grouped into 3 common trajectory types, there were notable differences between the race/ethnicity and sex/gender groups across and within each of these trajectory types (Figures 1 and 2). First, the distribution of the trajectory types varied by racial/ethnic and sex/gender groups (Table 3). Latinx male participants were the most likely to have an early-onset short sleeper trajectory. The consistent increasing short sleeper trajectory was the most prevalent among Black male participants, while the prevalence of late-onset short sleeper trajectory was the highest among White female participants. Second, the trajectories themselves varied across intersectionality groups, with the greatest variation observed among Latinx male participants. Latinx male participants who were early-onset short sleepers began at a mid-level probability (0.41) of short sleep duration and gradually declined to a low probability (0.11) into adulthood, whereas the other race/ethnicity and sex/gender groups had a high probability (1.0) of short sleep duration that sharply declined to a zero probability in adulthood. Latinx male respondents who were late-onset short sleepers had a drastically higher probability (0.88) in adulthood than the other race/ethnicity and sex/gender groups (ranging from 0.17 to 0.50).

In the supplemental analyses categorizing long sleepers as those who received at least the recommended amount of sleep, results were similar. There was one notable difference for Latinx male respondents in which the early-onset short sleepers with long sleepers included had a sharper decline in the probability of short sleep duration from early adolescence to adulthood, whereas there was a more gradual decline in this group with long sleepers excluded.

DISCUSSION

Our study found 3 common sleep duration trajectory types from adolescence to adulthood across 6 race/ethnicity and sex/gender groups. These 3 duration trajectory types included early-onset short sleepers, who had declining probability of short sleep from adolescence to adulthood; consistent increasing short sleepers, with increasing probability of short sleep duration from adolescence to adulthood; and late-onset short sleepers, with no probability of short sleep duration until adulthood. The distribution of these trajectory types differed across race/ethnicity and sex/gender groups, with some differences across race/ethnicity and sex/gender groups within each of these trajectory types.

The most prevalent sleep trajectory type in the overall sample was that of consistent increasing short sleepers. This suggests that for many individuals, the continual increase would eventually lead to consistent high risk for short sleep in older adulthood. Within each racial/ethnic group, the trajectory was more prevalent among male participants than female participants except among Latinx participants. The higher prevalence among male participants in general may be explained by the poorer sleep hygiene (e.g., greater screen time and caffeine intake) among male participants observed in adolescent and adult studies (46, 47, 68–70). Between racial/ethnic groups, this trajectory was the most prevalent among Black participants, with the highest prevalence particularly among Black male respondents. This is in line with studies that have shown Black male participants were the most likely to have the shortest average sleep duration in both adolescent and adult populations (28, 30, 50, 52). This may be due to stress related to the persistent discrimination in Black male experience (e.g., police brutality and criminal profiling) throughout the life course (71–73). In addition, various sociocultural factors (e.g., masculine socialization, stigma, and lack of access to health care and economic resources) may prevent Black males from seeking and receiving support to help mitigate the harmful psychological effects of discrimination (74–76). The high prevalence of this sleep trajectory among Black male participants may contribute to the significant health disparities (77) among this group across the life span.

The second most common trajectory was late-onset short sleepers. A potential explanation for the healthy sleep duration from early adolescence to young adulthood is that these individuals may be in environments (e.g., higher household socioeconomic status, greater neighborhood safety, and social cohesion) that are more optimal for sleep (20, 78, 79). In adulthood, the increase in probability of short sleep duration may be explained by the growing responsibilities and demands, such as work and starting a family, that reduce

Table 2. Distribution of Short Sleep Duration[a] Across Developmental Periods[b] According to Race/Ethnicity and Sex/Gender From Waves I, III, IV, and V of the National Longitudinal Study of Adolescent to Adult Health, United States, 1994–2018

Short Sleep Duration and Developmental Period	Total (n = 12,593)		Race/Ethnicity and Sex/Gender											
			Black Female (n = 1,525)		Black Male (n = 1,573)		Latinx Female (n = 1,126)		Latinx Male (n = 1,302)		White Female (n = 3,236)		White Male (n = 3,831)	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Developmental period														
Early adolescence	3,283	26.1	443	29.0	432	27.5	236	21.0	253	19.4	955	29.5	964	25.1
Adolescence	10,111	80.3	1,201	78.8	1,221	77.6	934	82.9	1,112	85.4	2,561	79.1	3,073	80.2
Emerging adulthood	7,018	55.7	852	55.7	780	49.6	578	51.3	670	51.5	1,951	60.3	2,187	57.1
Young adulthood	8,911	70.8	1,132	74.2	934	59.4	762	67.7	806	61.9	2,476	76.5	2,741	71.5
Adulthood	6,938	55.1	880	57.7	613	39.0	614	54.5	533	40.9	2,142	66.2	2,146	56.0
Short sleep duration														
Early adolescence	975	29.7	174	39.3	158	36.6	72	30.5	76	30.0	278	29.1	217	22.5
Adolescence	4,728	46.8	612	51.0	625	51.2	476	50.5	485	43.6	1,222	47.7	1,308	42.6
Emerging adulthood	2,202	31.4	270	31.7	309	39.6	159	27.5	231	34.5	501	25.7	732	33.5
Young adulthood	2,721	30.5	380	33.6	471	47.4	190	24.9	275	34.1	548	22.1	857	31.3
Adulthood	3,197	46.1	522	59.3	387	63.1	286	46.6	256	48.0	844	39.2	902	42.0

[a] Defined as <9 hours for ages 6–12 years, <8 hours for ages 13–17 years, and <7 for ages 18 years or older based on the American Academy of Sleep Medicine recommendation for amount of sleep according to age.

[b] Developmental periods include early adolescence (11–14 years), adolescence (15–19 years), emerging adulthood (20–24 years), young adulthood (25–34 years), and adulthood (35–44 years).

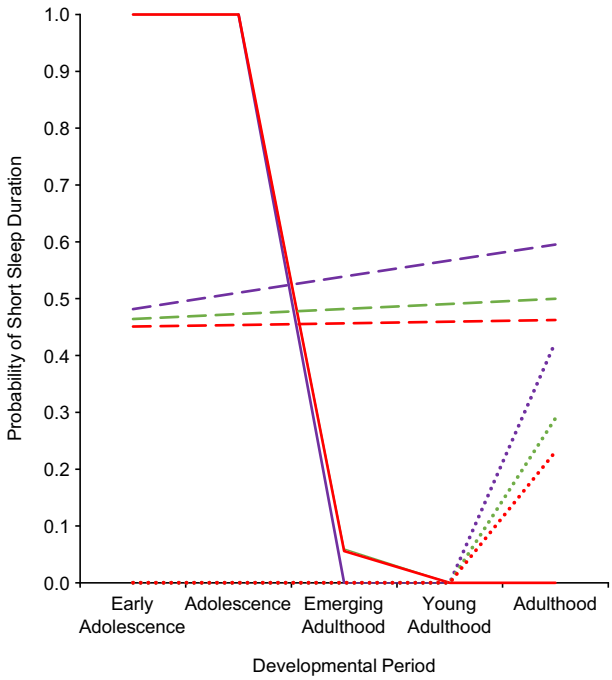

Figure 1. Multigroup growth mixture model short sleep duration trajectories according to race/ethnicity among female respondents, National Longitudinal Study of Adolescent to Adult Health, United States, 1994–2018. Developmental periods include early adolescence (11–14 years), adolescence (15–19 years), emerging adulthood (20–24 years), young adulthood (25–34 years), and adulthood (35–44 years). Trajectories include consistent increasing short sleepers (i.e., increasing probability of short sleep into adulthood), late-onset short sleepers (i.e., no probability of short sleep duration in adolescence until adulthood), early-onset short sleepers (i.e., declining probability of short sleep duration from adolescence into adulthood). Key: Black respondents, purple; Latinx respondents, green; white respondents, red. Early-onset short sleepers, solid lines; consistent increasing short sleepers, dashed lines; and late-onset short sleepers, dotted lines. The early-onset trajectories for Latinx and White respondents are overlapping. The late-onset trajectories are overlapping at zero probability from early adolescence to young adulthood for all racial/ethnic groups.

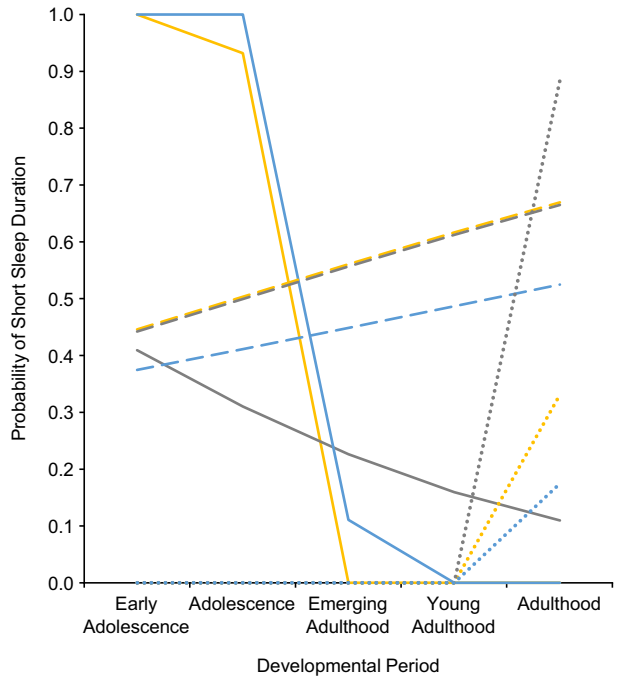

Figure 2. Multigroup growth mixture model short sleep duration trajectories according to race/ethnicity among male respondents, National Longitudinal Study of Adolescent to Adult Health, United States, United States, 1994–2018. Developmental periods include early adolescence (11–14 years), adolescence (15–19 years), emerging adulthood (20–24 years), young adulthood (25–34 years), and adulthood (35–44 years). Trajectories include consistent increasing short sleepers (i.e., increasing probability of short sleep into adulthood), late-onset short sleepers (i.e., no probability of short sleep duration in adolescence until adulthood), early-onset short sleepers (i.e., declining probability of short sleep duration from adolescence into adulthood). Key: Black respondents, yellow; Latinx respondents, gray; and White respondents, blue. Early-onset short sleepers, solid lines; consistent increasing short sleepers, dashed lines; and late-onset short sleepers, dotted lines. The early-onset trajectories for Black and White respondents overlap at zero probability from young adulthood to adulthood. The late-onset trajectories are overlapping at zero probability from early adolescence to young adulthood for all racial/ethnic groups.

the amount of time for sleep (15). Across all racial/ethnic groups, female respondents were more likely to have a late-onset short sleeper trajectory, with the greatest prevalence being among White female respondents. This may be attributed to family formation and gendered expectations that pressure them into being the primary caretaker of the family, allocating less time for sleep (33).

The early-onset short sleepers had the least common trajectory overall. The existence of this trajectory could be due to the sociocontextual changes that occur as people transition from early adolescence into later adolescence. These changes may include earlier school start times, academic pressure, and greater social commitments due to an expanding social network, all of which could prevent adolescents from obtaining a longer sleep duration (14, 80). As these individuals transition into adulthood and become free from early school start times, they may enter the workforce or attend college where there may have greater flexibility in tailoring their sleep schedule (81–83). Across race/ethnicity, this trajectory was generally more prevalent among female participants, except among Latinx individuals. The higher occurrence of this trajectory among female participants may be due to being pressured into more responsibilities than male youth during early adolescence (e.g., caretaking and chores) that reduce the amount of time for sleep (84). However, as these individuals transition into adulthood and seek greater independence, they often enter the workforce or attend postsecondary education, allowing them to relinquish some of these responsibilities (15, 85).

Within the trajectory types, Latinx male respondents had the most distinctive trajectories for early- and late-onset short sleepers. These findings for Latinx respondents could be due to the aggregating of Latinx subgroups—including

Table 3. Distribution of Short Sleep Duration Trajectories, in a Growth Mixture Model Analysis, According to Race/Ethnicity and Sex/Gender, National Longitudinal Study of Adolescent to Adult Health, United States, 1994–2018

Race/Ethnicity and Sex/Gender	Sleep Duration Trajectory					
	Consistent Increasing[a] (*n* = 8,475; 67.3%)		Late Onset[b] (*n* = 2,542; 20.2%)		Early Onset[c] (*n* = 1,576; 12.5%)	
	n	%	*n*	%	*n*	%
Black						
Female	1,047	68.7	346	22.7	132	8.7
Male	1,363	86.7	164	10.4	46	2.9
Latinx						
Female	731	64.9	277	24.6	118	10.5
Male	630	48.4	36	2.8	636	48.9
White						
Female	1,787	55.2	1,039	32.1	410	12.7
Male	2,917	76.1	680	17.8	234	6.1

[a] Increasing probability of short sleep into adulthood.
[b] No probability of short sleep duration in adolescence until adulthood.
[c] Declining probability of short sleep duration from adolescence into adulthood.

Mexican Americans, Puerto Ricans, Central/South Americans, and Cubans—into a single classification. By doing so, the diverse sociocultural context of Hispanic subgroups (e.g., levels of acculturation and nativity) was not accounted for, and that could potentially have influenced their sleep duration throughout adolescence and adulthood (24, 86–89).

There are at least 3 strengths to this study. First, this is one of few studies to examine sleep duration trajectories from adolescence to adulthood, including an older adult assessment time point compared with prior trajectory studies (56, 57). Second, to our knowledge, this is one of the first studies to use an intersectionality approach to examine race/ethnicity and sex differences of sleep trajectories. Finally, this study included a large, diverse cohort, which increases the generalizability of the results.

These findings should be interpreted within the context of the limitations in this study. Intersectionality was limited to participants' racial/ethnic and sex/gender identities and may not have captured the complex underlying social processes that produce these sleep disparities. While we acknowledge that there are more comprehensive approaches for intersectionality, the results from this study were intended to be the foundation for future intersectionality-driven research on sleep disparities (90). Another limitation is the potential measurement error of self-reported sleep duration. Studies have found that participants tend to overestimate their sleep duration when compared with objective measures (e.g., actigraphy), among both adolescents and adults (30, 91–96). Among adults, studies show that measurement error of sleep duration may vary by race/ethnicity and sex/gender (94–96). For instance, in a study with data from the Multi-Ethnic Study of Atherosclerosis comparing self-reported with actigraphy-assessed weekend sleep duration, White participants were more likely to overestimate their sleep duration than Black participants, and Black women were more likely to overestimate their sleep than Black men (95). It is currently unclear whether these differences in measurement error exists among adolescents. Racial/ethnic and sex/gender differences in the overestimation of sleep in both adolescence and adulthood may have led to racial/ethnic and sex/gender variations in the underestimation of the consistent increasing short sleeper trajectory type. Furthermore, sleep duration was assessed differently in waves I and V, which asked "How many hours of sleep do you usually get?" compared with waves III and IV, which asked for weekday and weekend sleep duration. The variation in measurement prevented this study from examining whether the results would have differed by weekend and weekday sleep duration. This may be important since adolescents and adults generally sleep less during the weekdays and more during the weekend (13, 97, 98). Since weekday sleep duration is weighted higher than weekend sleep duration in calculating average sleep duration per day, any changes in weekday sleep duration would more likely influence the trajectories than weekend sleep duration. Moreover, there was a higher proportion of long sleepers in waves III and IV, which could be due to the assessment capturing participants' amount of time in bed instead of actual time asleep. This study was unable to assess changes in sleep duration trajectories among long sleepers, which is important since long sleep duration has been associated with poorer health outcomes. Finally, Add Health did not assess individual sleep need or sleep quality, precluding us from assessing how racial/ethnic and sex/gender differences may influence these important sleep characteristics.

In conclusion, our findings underscore the need to examine sleep within an intersectionality framework to advance sleep disparities research. The consequences of examining a single social identity may result in inaccurate documentation of sleep disparities and subsequently ineffective strategies to reduce these disparities. The findings further suggest that intervening as early as adolescence to prevent short sleep in adulthood would be particularly important given that a high proportion of the sample had an increasing likelihood of short sleep duration from early adolescence to adulthood. Given that the primary focus of this study was to describe racial/ethnic and sex/gender differences in sleep duration trajectories from adolescence to adulthood, future research should apply an intersectionality framework to examine pathways (e.g., health status, socioeconomic status, and discrimination) driving these differences and whether these trajectories are associated with health outcomes. These future studies will be important in developing more informed strategies to mitigate racial/ethnic and sex/gender sleep disparities and subsequently health disparities.

ACKNOWLEDGMENTS

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This work was supported by the National Institutes of Health (grants T32HL130025, R01HL125761, and F31HL151126-01A1).

This research uses data from Add Health, a program project directed by Kathleen Mullan Harris and designed by J. Richard Udry, Peter S. Bearman, and Kathleen Mullan Harris at the University of North Carolina at Chapel Hill, and funded by the *Eunice Kennedy Shriver* National Institute of Child Health and Human Development (grant P01-HD31921), with cooperative funding from 23 other federal agencies and foundations. No direct support was received from grant P01-HD31921 for this analysis. Information on how to obtain the Add Health data files is available on the Add Health website (https://addhealth.cpc.unc.edu/).

The views expressed in this article are those of the authors and do not reflect those of the National Institutes of Health.

Conflict of interest: none declared.

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