



## Intraindividual Fluctuations in Sleep Predict Subsequent Goal Setting in Adolescents

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**Abstract:** The purpose of this study was to investigate within- and between-person associations between sleep and subsequent goal setting in adolescents. We conducted an intensive repeated measures longitudinal study to assess intra- and inter-individual associations between sleep and goal setting and potential moderators of such associations. Thirty-nine seventh through 12th graders reported on their sleep quality and propensity to set goals in their daily lives several times per week for approximately four months. We used a combination of multilevel modeling with time-varying covariates and centering techniques to partition within- and between-person variance. We found significant and positive associations between sleep and goal setting within individuals, but no such associations between individuals. That is, students were more likely to set goals for their work after getting a good night's sleep relative to their own average sleep quality, but getting good sleep on average relative to other individuals showed no association with average goal setting. These relationships were not moderated by participant age, gender, or sociodemographic status as indexed by maternal education. Differences in average sleep between adolescents matters less for their propensity to set goals than whether they experienced better- or worse-than-usual sleep the previous night given their own average. This finding represents the first evidence documenting effects of sleep on goal setting, which is an important psychological precursor to many youth behavioral and achievement outcomes. Our findings highlight the individuality of sleep needs and point to new directions for sleep-related practice and policy aimed at youth.

**Keywords:** sleep, goal setting, adolescence, intraindividual, fluctuation

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Adolescence is a significant developmental period marked by immense promise and potential. The skills, attitudes, habits, and behaviors developed during adolescence are long-lasting and can either support or hinder young people in their transition to adulthood. Setting specific, high goals for desired outcomes is one such habit that has proven effective in promoting this transition (Carroll et al., 2013; Shulman & Nurmi, 2010).

However, the effectiveness of goal setting for reaching desired outcomes is moderated by many individual and contextual factors. Personality, temperament, and cognitive skills provide the basis for goal construction and strategies (Nurmi,

1991; Salmela-Aro et al., 2007). Feedback, commitment, and workload determine whether goals will affect performance (Locke & Latham, 2006). Without the appropriate conditions to maximize goal setting and attainment, adolescents may struggle to reach their goals, with adverse consequences for subsequent self-efficacy, success, and well-being (e.g., Salmela-Aro et al., 2007). These consequences are particularly pronounced during important life transitions, such as those experienced during the adolescent years.

Sleep is one potential moderating factor that has been relatively neglected in the goal setting literature, despite its importance in the adolescent health literature (e.g., Dahl &

Lewin, 2002). Sleep is implicated in many of the skills and processes underlying goal setting, including cognitive performance, self-regulation, and emotion regulation (Beebe, 2011; Owens et al., 2016; Palmer et al., 2018). Adolescents who experience sleep problems are at risk for many health and behavioral problems that are also associated with goal setting, including academic struggles, obesity, substance abuse, and difficulty regulating cognition and emotions (Beebe, 2001; Dewald et al., 2010; Fatima et al., 2016; Fuligni & Hardway, 2006; Kwon et al., 2020). However, to our knowledge, no studies have examined the importance of sleep for goal setting in adolescence.

Attitudes, practices, and customs around sleep vary widely across individuals and cultures (Jenni & O'Connor, 2005; Jeon et al., 2005), and substantial variation exists in the amount and quality of sleep that one needs for optimal daily functioning (Fuligni et al., 2019). Such evidence is consistent with broader principles of relational developmental systems theory (e.g., Ford & Lerner, 1992; Overton, 2015) and the notion of the individuality of development (Lerner, 2018; Rose et al., 2013; Nesselroade & Molenaar, 2010). Understanding this variation is important for the development of targeted policies and practices to improve sleep and subsequent outcomes in adolescence.

Research is only beginning to explore intraindividual variation in sleep patterns and implications for interventions that target change in sleep behaviors and outcomes affected by sleep (Fuligni & Hardway, 2006, Neubauer et al., 2020). For example, sleepiness, which is likely a function of individual sleep needs and vulnerability to poor sleep, is more strongly related to neurobehavioral functioning and academic performance than sleep duration (Anderson et al., 2009; Dewald et al., 2010). Evidence from an ambulatory assessment study indicates an inverted-U-shaped relationship between time in bed and working memory updating accuracy in elementary schoolers; such relationships were stronger within individuals than between individuals and were also moderated by overall cognitive performance (Könen et al., 2015). Another intraindividual examination with adolescents found that within-person increases in stressful life events predicted concurrent and subsequent increases in sleep duration variability, and that intraindividual variability in sleep duration mediated the within-person association between exposure to stressful life events and increased anxiety symptoms (Bustamante et al., 2020). Furthermore, shorter-term (weekly) inconsistencies in sleep were more strongly associated with internalizing symptoms than longer-term (monthly) changes in sleep, suggesting short-term fluctuation patterns may be more influential than long-term patterns and changes (Bustamante et al., 2020). In a daily diary study, adolescents reported greater levels of daily distress after nights in which they obtained too little or too much sleep, but significant variation was observed in the magnitude of these associations (Fuligni et al., 2019). These studies indicate that associations between sleep and developmental outcomes vary widely both within and between

individuals, but short-term, intraindividual patterns may be more influential than interindividual differences. However, more research is needed to fully understand and address the individualized nature of sleep to inform effective interventions and recommendations.

To address this gap, the present study took an intensive repeated measures approach to examine associations between sleep and subsequent goal setting at both the intraindividual and interindividual levels. We repeatedly measured both sleep and goal setting in a diverse sample of adolescents and tested hypotheses about within- and between-person effects of sleep while avoiding the artificial and short-run nature of typical experimental manipulations that randomly assign participants to sleep deprivation conditions. This design provides a more ecologically valid test of the effects of sleep as they might occur in the real world (e.g., Bolger & Laurenceau, 2013). Moreover, our analytic approach combined hierarchical linear modeling with time-varying covariates and centering techniques in order to fully disentangle within- from between-person effects of sleep. This approach adjusts for overall individual differences while allowing each person to serve as his or her own baseline, thus enabling separate tests of the within- and between-person effects of sleep within a naturalistic testing context.

## Method

### Sample and procedures

The present study focuses on a subset of measures administered as part of the larger Methods and Measures across the Developmental Continuum (MMDC) initiative (for additional information, see Yu et al., 2020 and Yu et al., 2021). The full MMDC project included a sample of participants recruited from elementary, middle, and high school classrooms across the United States, including communities in Boston, MA, Austin, TX, O'Donnell, TX, and Washington, DC. Sampling occurred as a multi-stage process in which the research team first contacted schools and classroom teachers. Once a teacher agreed to participate, all students in their classroom were offered the opportunity to participate. Student assent and parental consent were obtained prior to data collection. Student participants were asked to complete a total of 50 assessments over the course of the school year and were provided with data visualizations to help them track their implementation progress.

We assessed intraindividual variability using an intensive repeated measures longitudinal design (Bolger & Laurenceau, 2013). Participants used an online platform to complete survey measures approximately one to four times per week regarding their sleep and goal setting, along with other variables that are outside the scope of the present analysis. The goal setting measure was administered as part of a 13-item survey on intentional self-regulation that was adapted from existing measures. Surveys were primarily completed during teacher-designated periods of regular school

instruction. Teachers were instructed to assist their students and encouraged to choose an administration schedule (such as Monday-Wednesday-Friday), but students could also “make up” a session if they were out of class during regular administration. Teachers were provided with a script to read to students upon their first administration to help them understand the goals of the study, what they would be doing, and how to log into the testing platform to complete the survey. All procedures were approved by the Institutional Review Board.

The analytic sample for the current study was made up of three classrooms of students who were administered the sleep and goal-setting measures of interest. Of the 60 originally enrolled participants, four (6.7%) completed the target of 50 measurement occasions over the course of the study period; the range of completed assessments was 1 to 50, with a mean of 35 ( $SD = 12.66$ ) and a median of 35. The analytic

sample was restricted to participants who completed at least 10 measurement occasions to meaningfully analyze and interpret intraindividual relations. Accordingly, the final analytic sample included 39 participants and 1256 observations. Observations were separated by 5.9 days on average ( $SD = 9.86$ ).

Participants in the analytic sample were 16.47 years of age on average ( $SD = 1.83$  years, range = 12-19) and were mostly female (see Table 1 for full set of descriptive statistics). Participants were primarily Hispanic/Latinx (58.97%) and many identified with multiple races and ethnicities (10.24%). In regard to maternal education level, 61.54% of the mothers had less than a high school degree, 12.82% had high school degrees or GEDs, 10.25% had some college, associate, or trade school degrees, and 15.37% had a 4-year college degree or higher.

**Table 1.**  
*Sample Characteristics*

Variable	<i>M (SD)</i> or Percent	<i>N</i>
Age	16.47 (1.83)	39
Gender		
Male	46%	18
Female	54%	21
Race		
Asian American & Hispanic/Latinx	2.56%	1
Black/African American	12.82%	5
Black/African American & Hispanic/Latinx	2.56%	1
Hispanic/Latinx	58.97%	23
Hispanic/Latinx & White/European American	5.12%	2
White/European American	15.38%	6
Maternal education		
8 <sup>th</sup> grade or less	41.03%	16
Some high school	20.51%	8
High school diploma or GED	12.82%	5
Some college	7.69%	3
2-year college (Associates Degree)	2.56%	1
4-year college (Bachelors degree)	7.69%	3
Master’s Degree	5.12%	2
Doctoral/Professional Degree	2.56%	1

**Table 2.**  
*Descriptive Statistics for Focal Study Variables*

Variable	<i>M (SD)</i>	<i>N</i>	ICC
Goal Setting	3.58 (2.29)	1248	0.02
Sleep	3.43 (1.04)	1085	0.34
Time since first assessment	86.22 (52.85)	1256	0.13

## Measures

**Goal setting.** Goal setting was measured using a single item drawn from a larger researcher-developed survey measure based on the Children’s Self-Efficacy Scale (Bandura, 2006) and the Freund and Baltes (2002) conceptual model of intentional self-regulation. Participants responded to the statement “Today, I set goals for my work” using a 5-point Likert scale with response options including 1 (False), 2 (More False Than True), 3 (Neither True nor False), 4 (More True Than False) to 5 (True).

**Sleep quality.** Prior night’s sleep was measured using a single item developed by the research team. Participants responded to the question “How well did you sleep last night?” using a 5-point Likert scale with response options including 1 (Terrible), 2 (Poorly) 3 (OK), 4 (Well), and 5 (Very Well). This measurement strategy matches the approach used in similar daily diary and intensive repeated-measures designs (e.g., Åkerstedt et al., 2012; Tracy et al., 2020) and is supported by evidence suggesting sleep quality is more important than sleep duration for psychological outcomes in adolescence (Vermeulen et al., 2021).

**Covariates.** Participant age, gender, and maternal education level were collected in the parental consent form. Age was measured continuously in years, gender was a dummy variable (coded 0 if female and 1 if male), and maternal education was treated as an ordered categorical variable with eight categories (see Table 1). Time, defined as the number of days elapsed since the first measurement occasion, was also measured continuously and included as a covariate in the analytic models.

## Analytic Strategy

Data cleaning and preliminary analyses were conducted using the *Tidyverse* package (Wickham et al., 2019) in R (R Core Team, 2019), and statistical models were estimated in MPlus Version 8 (Muthén & Muthén, 2017). All models used Bayesian analysis with diffuse priors given the lack of available existing evidence to be used for subjective parameter selection. For the purposes of interpretation, the median of the parameter distribution and the 95% credible interval (CrI) are reported in the results. If zero is not included in the 95% CrI, this can be interpreted as a 95% probability that the true estimate does not contain zero and considered “statistically significant” in the conventional frequentist sense.

We used a combination of centering techniques and mixed effects modeling to test our focal questions regarding within- and between-person effects of sleep on subsequent goal setting. Specifically, our analysis approach generated person-mean-centered indicators for sleep by subtracting each person’s overall mean across measurement occasions from each of their daily observed values. The resulting Level-1 variables represent daily sleep quality relative to each individual’s own average. We added these person-mean-centered sleep indicators as time-varying covariates at Level 1 to linear

models with goal setting as the outcome. Time was also included as a time-varying variable at Level 1, measured continuously as the number of days since the first measurement occasion. Grand-mean-centered individual mean sleep was included as a predictor of the slope and intercept at Level 2. This modeling strategy allowed us to estimate the associations between short-term changes in sleep and short-term changes in subsequent goal setting as well as the associations between a student’s average sleep and average goal setting.

Our first model (Model 1) included person-mean-centered sleep and time at Level 1, with grand-mean-centered sleep as a predictor of the slope and intercept at Level 2:

$$GoalSetting_{ti} = \pi_{0i} + \pi_{1i}Sleep_{pmc_{ti}} + \pi_{2i}Time_{ti} + e_{ti} \quad e_{ti} \sim iid, N(0, \sigma^2)$$

Model 1 - Level 2:

$$\begin{aligned} \pi_{0i} &= \beta_{00} + \beta_{01}MeanSleep_{gmc_i} + \beta_{02}Time_i + u_{0i} \quad u_{0i} \sim iid, N(0, \tau_{00}) \\ \pi_{1i} &= \beta_{10} + \beta_{11}MeanSleep_{gmc_i} + \beta_{12}Time_i + u_{1i} \quad u_{1i} \sim iid, N(0, \tau_{11}) \end{aligned}$$

Our second model (Model 2) was identical to Model 1, with the exception of age, gender, and maternal education being included as covariates in the equation for the Level-2 intercept:

Model 2 - Level 1:

$$GoalSetting_{ti} = \pi_{0i} + \pi_{1i}Sleep_{pmc_{ti}} + \pi_{2i}Time_{ti} + e_{ti} \quad e_{ti} \sim iid, N(0, \sigma^2)$$

Model 2 - Level 2:

$$\begin{aligned} \pi_{0i} &= \beta_{00} + \beta_{01}MeanSleep_{gmc_i} + \beta_{02}Age_i + \beta_{03}Gender_i + \beta_{04}MomEd_i + \beta_{05}Time_i + u_{0i} \\ &\quad u_{0i} \sim iid, N(0, \tau_{00}) \\ \pi_{1i} &= \beta_{10} + \beta_{11}MeanSleep_{gmc_i} + \beta_{12}Time_i + u_{1i} \quad u_{1i} \sim iid, N(0, \tau_{11}) \end{aligned}$$

In all models, random effects were estimated for the effects of time and sleep, and covariances among random effects were freely estimated.

## Results

Adolescents in our sample reported sleep quality between “OK” and “Well” on average (mean = 3.43, *SD* = 1.04) and high goal setting on average (mean = 3.58, *SD* = 2.29; see Table 2 for descriptive statistics). Neither variable showed significant relationships with age, gender, or maternal education. Zero-order correlations for continuous variables are displayed in Table 3, with correlation coefficients estimated using Pearson’s product-moment method collapsing across time and individuals.

**Table 3.**  
*Zero-Order Correlations for Continuous Study Variables*

	<i>N</i>	1	2	3
1 Goal Setting	1248	--	--	--
2 Sleep	1085	0.029	--	--
3 Age	1256	-0.087	0.117	--
4 Time	1256	0.116	-0.032	0.039

Preliminary analyses revealed a linear growth model provided adequate fit to the goal setting data. Participants did not demonstrate significant systematic change in goal setting over time, suggesting goal setting remained relatively stable on average during the study period.

**Changes in Sleep Predict Subsequent Goal Setting**

Model 1 results indicated a significant and positive association between getting better-than-usual sleep and goal setting within individuals (see Table 4). All participants showed positive associations between sleep and goal setting (see Figure 1), with no participants demonstrating a reverse effect (i.e., increased goal setting after worse-than-usual sleep).

Interestingly, at Level 2, having better sleep on average relative to other individuals was not associated with higher goal setting on average. That is, students are more likely to

set goals for their work after getting a good night’s rest relative to their own average sleep quality, but getting good sleep in general relative to other students shows no association with average goal setting. No significant interaction was observed in Model 1, meaning individuals who reported better than average sleep were no more or less sensitive to the short-term effects on goal setting of getting better – or worse – than-usual sleep on any given night.

Results from Model 2, which included student-level covariates, were largely consistent with those of Model 1 (see Table 5). Specifically, getting better-than-usual sleep was significantly associated with subsequent goal setting at the within-person level but getting better-than average sleep relative to other individuals was not associated with better-than-average goal setting at the between-person level. Like Model 1, the interaction between person-mean sleep and the random slope in Model 2 was not significant.

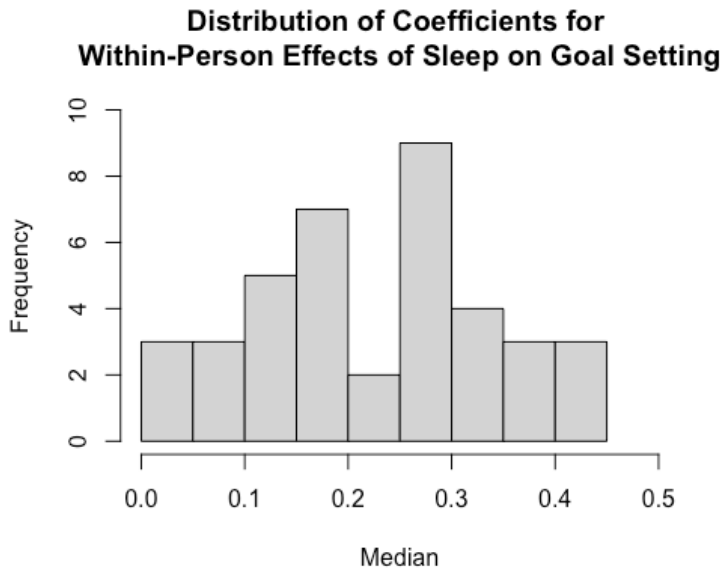
**Table 4.**  
*Model 1 Multilevel Regression Coefficients and Error Terms*

	<i>Beta</i>	<i>B</i>	95% CrI	<i>p</i>
Within				
Sleep (Cluster-centered)	1.290	0.237	[0.155, 0.330]	<.001
Time	0.023	0.001	[-0.001, 0.002]	.320
Goal setting residual variance	0.949	1.094	[1.011, 1.191]	<.001
Between				
Sleep (Cluster mean)	0.267	0.473	[-0.140, 1.079]	.134
Sleep (centered) x Sleep (mean)	-0.524	-0.155	[-0.299, 0.071]	.120
Goal setting residual variance	0.746	0.995	[0.613, 1.822]	<.001
Random slope residual variance	0.708	0.023	[0.003, 0.102]	<.001
Information criterion				
Number of Free Parameters	15			
Deviance (DIC)	19805.937			
Estimated Number of Free Parameters (pD)	118.657			

*Note.* *Beta* = standardized coefficients. *B* = unstandardized coefficients. 95% CrI = 95% Bayesian credibility interval (2.5 and 97.5 percentiles in the posterior distribution). Coefficients represent unstandardized model estimates. P-values for cases in which the credible interval does not include zero appear in bold.

**Figure 1.**

Distribution of coefficients for within-person effects of sleep on goal setting.

**Table 5.**

Model 2 Multilevel Regression Coefficients and Error Terms

	<i>Beta</i>	<i>B</i>	95% CrI	<i>p</i>
<b>Within</b>				
Sleep (Cluster-centered)	1.233	0.241	[0.117, 0.343]	<b>&lt;.001</b>
Time	0.020	0.000	[-0.001, 0.002]	.430
Goal setting residual variance	0.949	1.093	[1.011, 1.207]	<b>&lt;.001</b>
<b>Between</b>				
Sleep (Cluster mean)	0.275	0.554	[-0.139, 1.101]	.120
Sleep (centered) x Sleep (mean)	-0.451	-0.125	[-0.294, 0.071]	.180
Time	0.309	0.020	[-0.001, 0.040]	.070
Age	-0.142	-0.082	[-0.290, 0.122]	.530
Gender	-0.090	-0.223	[-1.061, 0.444]	.650
Maternal education	-0.167	-0.091	[-0.315, 0.088]	.290
Goal setting residual variance	0.649	0.993	[0.636, 1.678]	<b>&lt;.001</b>
Random slope residual variance	0.788	0.027	[0.005, 0.101]	<b>&lt;.001</b>
<b>Information criterion</b>				
Number of Free Parameters	24			
Deviance (DIC)	20216.654			
Estimated Number of Free Parameters (pD)	135.627			

Note. Beta = standardized coefficients. B = unstandardized coefficients. 95% CrI = 95% Bayesian credibility interval (2.5 and 97.5 percentiles in the posterior distribution). P-values for cases in which the credible interval does not include zero appear in bold.

## Discussion

In a series of multilevel models on intensive repeated measures data, getting better-than-usual sleep was positively associated with subsequent goal setting in a diverse sample of adolescents. Specifically, for each unit increase in a student's prior night sleep quality, their propensity to set goals was predicted to increase by 0.24 units. These effects held even after controlling for change in goal setting over time and for sociodemographic characteristics including age, gender, and maternal education. Differences in average sleep between individuals mattered less for goal setting than whether a given individual experienced better- or worse-than-usual sleep the previous night given their own average. The combination of centering and multilevel modeling employed in this study allowed each individual to serve as their own baseline, providing a naturalistic test of the effects of sleep quality on goal-setting while fully partitioning within- and between-person associations.

This study adds to the small but growing body of evidence documenting the dynamic interplay between sleep quality and subsequent psychological functioning in youth. Sleep problems in adolescence have been associated with a substantial list of adverse outcomes, including struggles with academic achievement (Dewald et al., 2010), obesity (Fatima et al., 2016), and substance abuse (Kwon et al., 2020). However, most studies have either employed sparse assessment strategies, focused on specialized clinical populations (e.g., children with chronic insomnia), or used experimental designs (e.g., imposing sleep restrictions) that may not generalize to other contexts. Our study is among the first to utilize an intensive repeated measures design to capture naturalistic variation in sleep patterns during adolescence, representing an important step toward translating the existing knowledge base to practice and policy. Our study is also the first to focus on consequences of sleep for goal setting, which is a crucial psychological precursor for many behavioral and achievement-related outcomes established during adolescence (e.g., Locke & Latham, 2006; Nurmi, 1991; Salmela-Aro et al., 2007; Shulman & Nurmi, 2010).

Contrary to the within-person findings, interindividual differences in sleep in our study were not associated with goal setting. That is, getting better sleep on average relative to other individuals did not predict better or worse goal setting. This finding is consistent with growing evidence that demonstrates the individuality of sleep needs (Bustamante et al., 2020; Fuligni et al., 2019) and points to the need for more personalized approaches to cultivating healthy sleep habits. Although sleep quantity was not specifically measured in the current study, our findings suggest that blanket recommendations such as the call from the American Academy of Sleep Medicine for adolescents to get at least eight to 10 hours of sleep per night (Paruthi et al., 2016) may be less useful than identifying the sleep needs for a specific adolescent and encouraging them to develop consistent sleep patterns. For example, some youth may do well with less than eight hours of

sleep each night so long as their sleep is restful and restorative, whereas others may require more. Overall sleep quality and duration relative to one's peers or classmates is less important than ensuring each adolescent meets his or her personal sleep needs.

These findings point to new opportunities to intervene on sleep to improve and maintain goal setting, particularly during the high school years. Insufficient sleep is a universal and modifiable risk factor that offers promise for prevention and intervention strategies focused on improving outcomes for at-risk populations (Smaldone et al., 2007). Some examples of effective sleep interventions exist, including sleep education (Arora & Taheri, 2017) and sleep hygiene improvement (Hall & Nethery, 2019). Furthermore, sleep problems are easily assessed across healthcare settings. Thus, treating and preventing sleep deprivation and poor sleep quality may represent a promising new direction for pro-grams to promote positive youth development and prevent youth problem behaviors. This idea may be especially relevant given epidemiological evidence indicating considerable changes to sleep patterns during adolescence (Dahl & Lewin, 2002; Leger et al., 2012).

Our findings also demonstrate the potential of intensive longitudinal designs to improve the understanding of intraindividual development in adolescence. In our study, within-person associations indicated significant links between sleep quality and subsequent goal setting, whereas a between-person approach implied that sleep quality was not a significant predictor of goal setting. This pattern highlights the importance of examining intraindividual fluctuations, which have been relatively neglected in the existing literature, in addition to interindividual differences.

## Limitations

These results represent promising initial evidence for the significance of within-person fluctuations in sleep for subsequent goal setting. However, our study is not without limitations, and our findings should be regarded as exploratory and hypothesis generating prior to replication and additional confirmatory testing. First, given our small sample of 39 participants, these findings should be replicated with a larger group of participants. Intensive repeated measures designs are time consuming and costly and can be difficult to implement on a large scale. Nevertheless, the small sample of the present study limited our statistical power to detect between-person effects and interactions. Moreover, although our study utilized a sample that was racially and socioeconomically diverse, these results may not generalize to other samples that are more representative of the national population. Therefore, additional research should be conducted before drawing strong conclusions regarding interindividual differences in sleep and goal setting more broadly.

Second, our study was also limited in terms of measurement: both sleep and goal setting were assessed using a single self-report item as opposed to direct assessment and

multiple-item measures. Single-item self-report measures are quick and easy to use and confer many practical benefits in the context of *in situ* intensive repeated assessment studies (e.g., by reducing participant burden and limiting practice effects given the many assessment periods). However, methodologists often advocate for the use of multiple-item measures, particularly when assessing complex, subjective constructs such as goal setting. This recommendation occurs because measurement error tends to average out when individual scores are summed to create a total score. Moreover, single-item measures do not allow for the estimation of internal consistency, which is an important psychometric reliability metric. Although some argue that single-item measures can be just as sensitive and reliable as multi-item instruments for certain constructs (e.g., Gardner et al., 1998), we nonetheless recommend exploring other measures of sleep and goal setting in future work. For example, future studies could use more objective sleep measures (e.g., actigraphy) and explore multiple-item instruments for goal setting.

## Conclusions

Sleep is an essential component of healthy development, and sleep quality represents a promising category of universal risk factors that can be objectively assessed and intervened upon to improve a range of important outcomes in all youth. We used a combination of multilevel modeling and centering techniques in the context of an intensive repeated-measures design to demonstrate within-person effects of sleep on subsequent goal setting in a diverse sample of adolescents. We found that overall sleep quality relative to one's peers or classmates is less important for adolescent goal setting than ensuring that each adolescent meets his or her personal sleep needs. This work represents the first evidence documenting associations between sleep and goal setting, which is an important psychological precursor to many youth behavioral and achievement outcomes. Our findings highlight the individuality of sleep needs and point to new directions for sleep-related policy and practice aimed at adolescents. Given the importance of goal setting for a range of outcomes in adolescence and beyond, our findings also highlight the need for increased attention to the factors that cultivate and promote goal setting, such as sleep.

## Declaration of interests

The authors declare there are no conflicts of interest.

## Author contributions

All authors contributed to the conception and design of the study. MJB, WC, and PAC contributed to study recruitment and/or data collection. LEM carried out the statistical analyses and drafted the first version of the manuscript. LEM, JB, DY, GJG, and PJY were actively involved in the interpretation of the data and LEM, JB, MJB, and WC revised the article. All authors read and approved the submitted version

for publication.

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