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Sleep-Initiation and Sleep-Maintenance Difficulties in Relation to Depressive Symptoms among UK Adolescents

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Abstract. Data from 10,139 adolescents in the UK Millennium Cohort Study were used to examine whether problems with falling asleep and staying asleep were related to depressive symptoms. The analysis focused on participants who were around 14 years old. Depressive symptoms were assessed with the Short Mood and Feelings Questionnaire, while the two sleep measures were analysed separately. Regression models were built in stages, adding demographic factors first, followed by cyberbullying and parent–adolescent relationship variables. Adolescents who took longer to fall asleep or experienced greater difficulty returning to sleep after waking tended to report higher SMFQ scores. These patterns persisted after demographic, cyberbullying, and family-relationship variables were included in the model. Higher depressive symptom scores were also seen among adolescents reporting more cyberbullying victimisation, weaker parental closeness, and more frequent arguments with parents. The exploratory sex analysis suggested a steeper relationship between sleep latency and depressive symptoms for females, although this added little to the overall variance explained. These findings suggest that sleep-initiation and sleep-maintenance difficulties may provide distinct information about adolescent depressive symptoms and may be useful to assess separately. Studies following participants across a long period of time could show how sleep problems, psychosocial stressors, and depressive symptoms change in relation to one another.

Keywords: Adolescent depression, sleep latency, night awakening, Millennium Cohort Study, sleep difficulties

1. Introduction

Adolescence is a period of substantial biological, psychological, and social change. Depressive symptoms become more common during this stage and may affect academic functioning, social relationships, and longer-term mental health. Sleep problems are also frequent during adolescence, and adolescents with poorer sleep tend to report more depressive symptoms and lower psychological well-being [1]. Examining individual sleep difficulties may help clarify which aspects of disturbed sleep are most closely related to depressive symptoms in adolescence.

Insomnia commonly involves difficulty falling asleep, difficulty staying asleep, early waking, or non-restorative sleep, together with impaired daytime functioning [2]. The present study focused on two insomnia-related dimensions: sleep-initiation difficulty and sleep-maintenance difficulty. Sleep

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latency refers to the time taken to fall asleep, whereas night awakening in this analysis refers to waking during the night and having difficulty returning to sleep.

Falling asleep and staying asleep may not reflect exactly the same underlying difficulties. For example, prolonged sleep onset has been linked with repetitive negative thinking, whereas waking during the night may be more closely related to disrupted sleep continuity and subsequent emotional regulation. Treating these experiences as a single global sleep score may therefore obscure potentially meaningful differences between them [3, 4].

Earlier research has frequently summarised multiple sleep problems using a single overall indicator of sleep quality or disturbance. While such composite scores provide a broad picture of sleep, they can make it difficult to distinguish problems with sleep onset from problems with maintaining sleep. It is therefore uncertain whether each of these sleep dimensions contributes information about depressive symptoms when they are analysed simultaneously.

Using data from the Millennium Cohort Study, previous research found that different sleep problems were associated with different patterns of adolescent mental health difficulties. In that study, frequent night waking showed relatively consistent links across mental health outcomes, whereas longer sleep-onset latency was more specifically related to emotional and behavioural difficulties [5]. However, that study did not examine whether sleep-initiation and sleep-maintenance difficulties remained independently associated with depressive symptoms after cyberbullying and parent-adolescent relationship factors were taken into account.

Sleep difficulties and depressive symptoms may also overlap with adolescents' psychosocial experiences. Longitudinal evidence indicates that young people who experience cyberbullying victimisation are at greater risk of poorer mental health, particularly depressive symptoms [6]. Parent-adolescent relationships are another relevant part of the psychosocial environment. Prospective findings also suggest that lower parental warmth and higher levels of family conflict are linked with subsequent increases in depressive symptoms during early adolescence [7]. These experiences may be related to both sleep difficulties and depressive symptoms and should therefore be considered in the analysis.

Despite the established links between sleep problems, psychosocial adversity, and adolescent mental health, relatively little research has examined sleep-initiation and sleep-maintenance difficulties together while accounting for cyberbullying involvement and parent-adolescent relationships. Modelling the two sleep dimensions together allows their individual relationships with depressive symptoms to be evaluated after considering demographic and psychosocial covariates.

The present study, therefore, examined whether sleep latency and night-awakening difficulty were independently associated with depressive symptoms among adolescents in the UK Millennium Cohort Study. It was hypothesised that longer sleep latency and more frequent night awakenings accompanied by difficulty returning to sleep would be associated with higher depressive symptom scores and that both associations would remain evident after adjustment for demographic characteristics, cyberbullying involvement, and parent-adolescent relationship factors. An exploratory analysis also examined whether the association between sleep latency and depressive symptoms differed by sex.

2. Method

2.1. Study design and participants

This study used data from the sixth sweep of the UK Millennium Cohort Study (MCS) and analysed them cross-sectionally. The MCS has followed a large group of children born in the UK around the

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start of the twenty-first century over time. Participants in the sixth sweep ranged from 13 to 15 years old, although most were aged 14. Further details on sampling and data collection for the sixth sweep are available in the MCS Age 14 User Guide and related technical documentation [8].

The analysis used participants from the main Age 14 MCS sample. To be included, adolescents needed complete information for the outcome, including both sleep measures, age, sex, cyberbullying variables, parental closeness, and arguments with each parent. Anyone missing data for one or more variables in the regression analysis was excluded. The final complete-case analytical sample consisted of 10,139 adolescents. The mean age was 13.77 years (SD = 0.45); 5,049 participants (49.8%) were male and 5,090 (50.2%) were female.

Survey weights were not applied because the main aim was to estimate associations within the complete-case sample rather than nationally representative prevalence. The descriptive statistics and regression estimates should therefore not be interpreted as representative of all UK adolescents.

2.2. Measures

2.2.1. Depressive symptoms

Depressive symptoms were assessed using the 13-item Short Mood and Feelings Questionnaire (SMFQ). For each of the 13 items, adolescents rated their recent symptoms on a 0–2 scale covering the previous two weeks. Adding the item responses produced an overall score between 0 and 26, where larger totals reflected greater depressive symptom severity. The SMFQ was developed for children and adolescents and has shown acceptable reliability and validity in adolescent samples [9].

2.2.2. Sleep characteristics

Sleep latency was assessed by asking participants how long it usually took them to fall asleep during the previous four weeks. Responses were coded from 1 to 5: 0-15 minutes, 16-30 minutes, 31-45 minutes, 46-60 minutes, and more than 60 minutes. Higher scores, therefore, indicated a longer time to fall asleep.

Sleep-maintenance difficulty was assessed by asking participants how often they awoke during sleep and had trouble falling back to sleep during the previous four weeks. Responses were coded from 1 (all of the time) to 6 (none of the time). Higher scores, therefore, indicated less frequent sleep disruption, while lower scores indicated more frequent night awakening and difficulty returning to sleep. Sleep latency and night-awakening score were treated as two separate ordinal variables.

2.2.3. Cyberbullying variables

Cyberbullying victimisation was assessed by asking how often other children had sent the participant unwanted or nasty emails, texts, or messages, or posted something nasty about them on a website. Cyberbullying perpetration was assessed by asking how often the participant had done the same to other children. Both items were coded from 1 (most days) to 6 (never), with higher scores indicating less frequent involvement in cyberbullying.

2.2.4. Parent-adolescent relationship variables

Maternal and paternal closeness were assessed separately by asking participants how close they felt to their mother and father. Responses ranged from 1 (not very close) to 4 (extremely close), with

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higher scores indicating greater perceived closeness. Responses indicating no parent or no contact were not included in the complete-case analytical variables.

The frequency of arguments with the mother and father was assessed using separate items. Responses ranged from 1 (most days) to 5 (never), with higher scores indicating less frequent arguments. Maternal closeness, paternal closeness, frequency of arguments with the mother, and frequency of arguments with the father were treated as separate dimensions of the parent-adolescent relationship.

2.3. Statistical analysis

The sample was first described using summary statistics: numeric variables were reported with means and standard deviations, whereas categorical variables were summarised with counts and percentages.

Multiple linear regression models were used to examine the associations of sleep latency and night-awakening score with SMFQ total score. Both sleep variables were included simultaneously in every model so that the association of each sleep dimension could be estimated while accounting for the other. Model 0 included sleep latency and night-awakening score. Model 1 additionally adjusted for age and sex. Model 2 further adjusted for cyberbullying victimisation and perpetration. Model 3 additionally adjusted for maternal and paternal closeness and frequency of arguments with each parent.

The sleep, cyberbullying, and parent-adolescent relationship variables were measured using ordinal response categories but were entered into the regression models as numeric predictors. This approach assumed that moving between adjacent response categories was associated with approximately equal changes in the SMFQ score.

Unstandardised regression coefficients and 95% confidence intervals were reported for all models. These coefficients represented the expected difference in SMFQ score associated with a one-category increase in a predictor while holding the other variables constant. Standardised coefficients were also calculated for the fully adjusted model to support cautious comparison across predictors measured on different scales.

The statistical significance threshold was set at $p < .01$ to reduce the likelihood of false-positive findings when testing multiple predictors. Interpretation focused on the direction, magnitude, and precision of the estimates rather than statistical significance alone.

For the exploratory analysis, a sleep latency × sex interaction term was added to the fully adjusted model. Sleep latency was centred before the interaction term was created. The interaction was evaluated using its regression coefficient and a partial F-test comparing models with and without the interaction. Adjusted predicted SMFQ scores were estimated across sleep-latency categories separately for males and females.

Regression diagnostics were conducted to assess the assumptions of the linear regression models. Analyses were performed using R version 4.6.0 (R Foundation for Statistical Computing, Vienna, Austria).

3. Results

3.1. Sample characteristics

The analytical sample consisted of 10,139 adolescents. Table 1 presents the sleep, psychosocial, and depressive symptom characteristics of the sample.

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Table 1. Descriptive characteristics of study variables in the analytical sample (N = 10,139)

characteristic	mean (SD)
depressive symptoms (SMFQ total score)	5.39 (5.76)
sleep latency	2.26 (1.26)
night-awakening score	4.65 (1.34)
cyberbullying victimisation	5.57 (0.86)
cyberbullying perpetration	5.80 (0.58)
maternal closeness	3.25 (0.79)
paternal closeness	2.91 (0.95)
frequency of arguments with mother	3.19 (1.03)
frequency of arguments with father	3.54 (1.01)

Note. Values are presented as mean (SD) unless otherwise indicated. SMFQ = Short Mood and Feelings Questionnaire. Higher SMFQ and sleep-latency scores indicate more severe depressive symptoms and longer time to fall asleep, respectively. Higher night-awakening, cyberbullying, and parent-argument scores indicate less frequent occurrence, while higher parental-closeness scores indicate greater perceived closeness.

3.2. Associations between sleep characteristics and depressive symptoms

Across the sequence of models, poorer sleep initiation and greater night-time sleep disruption consistently corresponded to higher depressive symptom scores (Table 2). The positive relationship between sleep latency and SMFQ score persisted as demographic, cyberbullying, and parent-adolescent variables were added to the analysis.

Night-awakening score was negatively associated with depressive symptoms. Because higher scores represented less frequent sleep disruption, the negative coefficient indicated that adolescents who reported more frequent night awakening and greater difficulty returning to sleep also tended to report higher depressive symptom scores. This association remained evident in the fully adjusted model.

Table 2. Associations between sleep characteristics and depressive symptoms across sequentially adjusted linear regression models

sleep characteristic	model 0	model 1	model 2	model 3
sleep latency	0.93 (0.84 to 1.01)	0.89 (0.81 to 0.98)	0.78 (0.71 to 0.86)	0.65 (0.57 to 0.73)
night-awakening score	−1.34 (−1.42 to −1.26)	−1.23 (−1.31 to −1.15)	−1.00 (−1.08 to −0.92)	−0.88 (−0.95 to −0.80)

Note. Values are unstandardised regression coefficients (B) with 95% confidence intervals. Sleep latency and night-awakening score were entered simultaneously in all models. Model 0 included both sleep variables. Model 1 additionally adjusted for age and sex. Model 2 further adjusted for cyberbullying victimisation and perpetration. Model 3 additionally adjusted for maternal and paternal closeness and frequency of arguments with each parent. All displayed sleep-variable associations were statistically significant at $p < .001$.

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3.3. Fully adjusted model

In the fully adjusted model, longer sleep latency, more frequent night-awakening difficulty, older age, female sex, more frequent cyberbullying victimisation, lower maternal and paternal closeness, and more frequent arguments with both parents were associated with higher depressive symptom scores (Table 3). Cyberbullying perpetration was not independently associated with depressive symptoms after adjustment for the other variables. The fully adjusted model accounted for 35.8% of the variance in SMFQ scores.

Table 3. Final adjusted linear regression model predicting depressive symptoms

predictor	b	95% CI	standardised β	p
sleep latency	0.65	0.57 to 0.73	0.14	< .001
night-awakening score	−0.88	−0.95 to −0.80	−0.20	< .001
cyberbullying victimisation	−1.69	−1.81 to −1.57	−0.25	< .001
cyberbullying perpetration	−0.08	−0.26 to 0.10	−0.01	.371
maternal closeness	−0.75	−0.88 to −0.61	−0.10	< .001
paternal closeness	−0.61	−0.72 to −0.50	−0.10	< .001
frequency of arguments with mother	−0.56	−0.66 to −0.45	−0.10	< .001
frequency of arguments with father	−0.31	−0.41 to −0.21	−0.05	< .001
age	0.28	0.08 to 0.49	0.02	.005
female sex	1.76	1.58 to 1.95	0.31	< .001

Note. The outcome variable was the SMFQ total score. B values are unstandardised regression coefficients, and β values are standardised regression coefficients. Male sex was the reference category. Higher night-awakening, cyberbullying, and parent-argument scores indicate less frequent sleep disruption, cyberbullying involvement, and parent-adolescent arguments, respectively. Higher parental-closeness scores indicate greater perceived closeness. Values below .001 are reported as p < .001.

3.4. Exploratory sleep latency × sex interaction

The association between sleep latency and depressive symptoms differed by sex (Table 4). Longer sleep latency was positively associated with depressive symptoms among both males and females, but the estimated increase across sleep-latency categories was greater among females.

Adding the sleep latency × sex interaction improved model fit, although the increase in explained variance was small. The interaction is therefore best interpreted as evidence that the association differed by sex rather than as a substantial improvement in the model's overall predictive performance.

Table 4. Exploratory sleep latency × sex interaction predicting depressive symptoms

predictor	B	95% CI	p
sleep latency, centred	0.36	0.26 to 0.47	< .001
female sex	1.77	1.59 to 1.95	< .001
sleep latency × female sex	0.57	0.43 to 0.72	< .001

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Table 4. (continued)

night-awakening score	−0.86	−0.93 to −0.79	< .001
cyberbullying victimisation	−1.69	−1.81 to −1.56	< .001
cyberbullying perpetration	−0.10	−0.28 to 0.07	.247
maternal closeness	−0.73	−0.87 to −0.60	< .001
paternal closeness	−0.60	−0.71 to −0.49	< .001
frequency of arguments with mother	−0.56	−0.67 to −0.46	< .001
frequency of arguments with father	−0.31	−0.42 to −0.21	< .001
age	0.28	0.08 to 0.48	.006

Note. Sleep latency was centred at the sample mean. Male sex was the reference category. Higher night-awakening, cyberbullying, and parent-argument scores indicate less frequent sleep disruption, cyberbullying involvement, and parent-adolescent arguments, respectively. Higher parental-closeness scores indicate greater perceived closeness. Adding the interaction improved model fit, partial $F(1, 10{,}127) = 61.54$, $p < .001$. The interaction model had an adjusted R^2 of .362, compared with .358 for the model without the interaction.

As illustrated in Figure 1, adjusted predicted depressive symptom scores increased across sleep-latency categories for both sexes, with a steeper increase among females. Predictions were adjusted for night-awakening score, age, cyberbullying victimisation and perpetration, maternal and paternal closeness, and frequency of arguments with each parent.

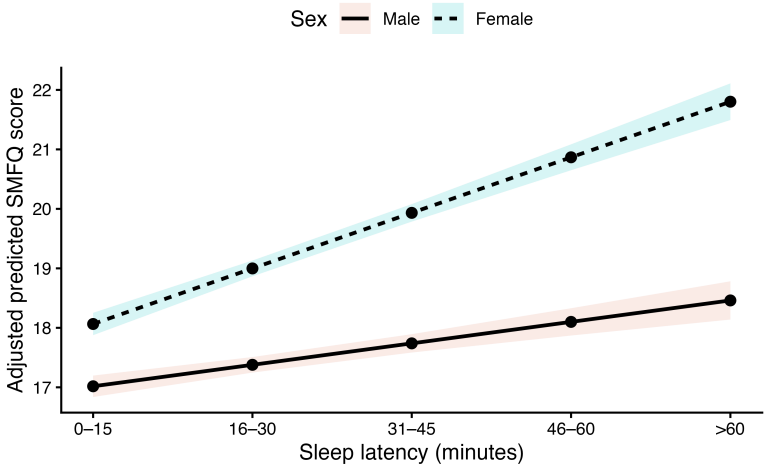

Figure 1. Adjusted association between sleep latency and depressive symptoms by sex. Lines represent model-predicted SMFQ scores, and shaded areas represent 95% confidence intervals

4. Discussion

4.1. Principal findings

Adolescents tended to report higher depressive symptom scores when they took longer to fall asleep or had more difficulty returning to sleep after waking. Importantly, neither sleep indicator was fully accounted for by the other sleep measure or by the demographic and psychosocial covariates included in the analysis. This pattern indicates that sleep onset and night-time sleep disruption capture partly non-redundant information in relation to adolescent depressive symptoms. The

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associations became smaller after cyberbullying and parent–adolescent relationship factors were added to the models. This suggests that sleep difficulties and adverse psychosocial experiences may be partly related to the same variation in depressive symptoms. However, both sleep measures remained associated with depressive symptoms in the fully adjusted model.

The exploratory interaction analysis suggested that the association between sleep latency and depressive symptoms was stronger among females than males. Although the interaction improved model fit, it explained only a small amount of additional variance and should therefore be interpreted cautiously.

The findings suggest that sleep-initiation and sleep-maintenance difficulties are related but may not be interchangeable. Combining several sleep symptoms into a single overall score may conceal whether an adolescent mainly has difficulty falling asleep, difficulty returning to sleep after waking, or both. Considering the two dimensions separately may therefore provide a more detailed description of adolescents' sleep experiences.

As all variables were measured at the same sweep, it is not possible to determine whether sleep difficulties preceded depressive symptoms or vice versa. Sleep difficulties may contribute to depressive symptoms, depressive symptoms may disrupt sleep, or both may be influenced by other factors not included in the analysis.

4.2. Sleep-initiation and sleep-maintenance difficulties

Existing evidence raises the possibility that difficulty initiating sleep and difficulty maintaining sleep relate to depressive symptoms through somewhat different pathways. Difficulty initiating sleep may be related to cognitive processes such as rumination; in adolescents, rumination has been found to partially account for the association between insomnia symptoms and depressive symptoms [3]. By contrast, sleep-maintenance difficulties involve disruptions to sleep continuity, which have been associated with poorer emotional functioning [4].

The present analysis was not designed to identify the biological or psychological pathways underlying these associations. These explanations are based on previous research rather than direct evidence from the current analysis. Repeated assessments over time would be required to establish how these relationships unfold and to investigate possible explanatory pathways.

The present pattern broadly agrees with earlier evidence showing that disturbed sleep accompanies poorer mental health in children and adolescents [1]. This analysis extends that work by including sleep latency and night-awakening score in the same models and by adjusting for cyberbullying involvement and parent-adolescent relationship factors. Importantly, each sleep measure retained an independent statistical relationship with depressive symptoms when the other sleep measure and psychosocial covariates were included.

This pattern does not show that the two sleep dimensions have separate causal effects. Rather, it shows that each contributed statistical information about depressive symptoms when both were included in the same model.

4.3. Cyberbullying and parent-adolescent relationships

Cyberbullying victimisation is longitudinally associated with poorer mental health among children and adolescents, with particularly consistent evidence for depressive symptoms [6]. Similarly, the associations involving parental closeness and parent-adolescent arguments are consistent with longitudinal evidence linking lower parental warmth and greater family conflict to increases in depressive symptoms during adolescence [7]. Together, these psychosocial experiences may be

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related to both sleep difficulties and depressive symptoms and were therefore considered in the present analysis.

Consistent with this possibility, the estimated associations between the sleep variables and depressive symptoms were smaller after the psychosocial variables were included in the models. This pattern suggests some overlap between these experiences, but it does not establish mediation.

The psychosocial variables could act as confounders, mediators, consequences of emotional difficulties, or correlated experiences. A cross-sectional analysis cannot distinguish among these possibilities. Longitudinal analyses would be needed to examine their temporal and explanatory roles.

4.4. Sex-specific association

Increases in sleep latency corresponded to a larger rise in depressive symptom scores among females than among males. The stronger association observed among females may reflect a combination of developmental and psychosocial factors. Recent research suggests that sex differences in adolescent depression may be related to pubertal development, greater exposure or sensitivity to psychosocial stress, and a stronger tendency towards rumination among girls [10, 11]. However, the present cross-sectional analysis could not test whether these factors accounted for the observed interaction.

The interaction should therefore be interpreted as evidence that the estimated association between sleep latency and depressive symptoms differed by sex, not as confirmation of a particular mechanism. Although it statistically improved model fit, the increase in explained variance was small. This pattern should be reproduced in longitudinal datasets before it is used to inform sex-specific assessment or intervention.

4.5. Effect size and practical interpretation

The large analytical sample produced precise estimates, but statistical significance alone does not establish clinical or practical importance. The sleep coefficients represented differences in the SMFQ score associated with moving between adjacent ordinal response categories. Because the distance between categories may not be equal, these estimates should be interpreted with care.

The standardised coefficients indicated that both sleep variables were associated with depressive symptoms after demographic and psychosocial factors were considered. Comparisons across predictors should be made cautiously because the variables were measured on different scales, and sex was represented as a binary variable.

At the individual level, the estimated difference associated with moving between two adjacent sleep categories was modest. At the population level, even modest associations may deserve further investigation when the experiences are common and readily identifiable. The current findings, however, cannot show that changing sleep latency or night-awakening difficulty would lead to changes in depressive symptoms.

4.6. Strengths and limitations

Strengths of the study include the large MCS sample, the simultaneous examination of sleep-initiation and sleep-maintenance difficulties, sequential adjustment for relevant psychosocial factors, and the exploratory analysis of sex differences. Including both sleep dimensions in the same models allowed the association of each with depressive symptoms to be estimated while accounting for the other.

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Several limitations should be considered. Because exposure and outcome variables were measured at the same time point, their temporal ordering and causal direction cannot be established. Because most measures relied on adolescents' own reports, responses may have been affected by memory errors, individual response tendencies, or the use of the same reporting method. Several predictors were measured using single items rather than validated multi-item scales. Treating ordinal response categories as numeric predictors also assumed approximately equal spacing between adjacent categories.

Complete-case analysis may have introduced selection bias if participants with complete data differed systematically from those with missing information. Survey weights were not applied because the analysis focused on associations within the complete-case sample rather than nationally representative prevalence. The estimates may therefore not generalise to all UK adolescents, particularly if sampling probabilities or attrition were related to the study variables.

Residual confounding may also remain because the models did not include socioeconomic circumstances, ethnicity, physical health, substance use, sleep duration, or previous depressive symptoms. Finally, the sleep latency × sex interaction was exploratory and requires replication in independent and longitudinal samples.

4.7. Implications and future directions

Future research could examine whether asking separately about difficulty falling asleep and difficulty returning to sleep after waking provides useful information beyond a general measure of sleep quality.

The steeper sleep-latency pattern observed for females also deserves further investigation. Because this analysis was exploratory and the additional explained variance was small, the finding should not currently be used to support sex-specific clinical thresholds or recommendations.

Following adolescents over time would help establish which changes occur first and whether the relationships are causal. Future studies could include repeated assessments, objective or multi-method sleep measures, a broader range of social and health covariates, and appropriate survey weights when population-representative estimates are intended. Intervention studies would then be needed to determine whether changes in sleep initiation, sleep maintenance, or both lead to changes in adolescent depressive symptoms.

5. Conclusion

Even after demographic, cyberbullying, and family-relationship factors were considered, poorer sleep onset and greater difficulty resuming sleep at night were linked with higher depressive symptom scores. Both sleep measures remained associated with depressive symptoms when they were included in the same model. This suggests that difficulties falling asleep and maintaining sleep may be worth examining separately rather than only as part of a combined sleep score. In practice, assessing these two sleep difficulties separately may provide more specific information about adolescents' sleep experiences and help identify those who may require further mental health assessment or support. The persistence of both associations after adjustment also suggests that sleep difficulties provide information about depressive symptoms beyond the psychosocial factors examined in this study.

The findings also suggest that sleep difficulties should be considered alongside psychosocial experiences, including cyberbullying and parent-adolescent relationships, when evaluating factors associated with depressive symptoms. The associations between the sleep variables and depressive

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symptoms became smaller after these psychosocial factors were added to the models, indicating some overlap between sleep difficulties, adolescents' social experiences, and depressive symptoms. However, the cross-sectional design means that the nature and direction of these relationships cannot be determined.

The association between sleep latency and depressive symptoms was stronger among females, although the exploratory interaction explained only a small amount of additional variance. This finding highlights sex differences as a potentially relevant area for further research, but does not currently support sex-specific screening or intervention. The design, therefore, supports evidence of association rather than causal inference. Longitudinal and intervention research is needed to determine whether the two sleep dimensions play different roles in the development or reduction of adolescent depressive symptoms. Future studies using repeated assessments and more detailed measures of sleep may also help clarify whether sleep-initiation and sleep-maintenance difficulties have different temporal relationships with depressive symptoms. Such evidence could help inform more targeted approaches to early identification and sleep-related support for adolescents experiencing depressive symptoms.

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