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Factors associated with probable insomnia at university entry and predictors of recovery, emergence and severity over the first academic year: a longitudinal cohort study at five UK universities

Spyros Spyridonidis ,[1] Anne C Duffy ,[2,3] Katheryn F Morse ,[1] Lucy Dorey,[4] Kate E Saunders,[3,5] Tanya Manchanda,[3] Nicola C Byrom ,[6] Jemima Dooley,[7] Liz Forty,[8] Kevin A Matlock,[3,9] Samuel R Chamberlain,[4] Edward Watkins,[7] Lucy J Robinson [1]

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For numbered affiliations see end of article.

Correspondence to
Dr Lucy J Robinson;
lucy.robinson2@newcastle.ac.uk

ABSTRACT

Objectives To identify factors associated with probable insomnia at university entry, baseline factors associated with insomnia recovery and emergence over the first academic year, and whether changes in modifiable factors were associated with insomnia severity at follow-up.

Design Longitudinal cohort study.

Setting Five universities in the UK.

Participants 5524 first-year undergraduates completed baseline assessments; 1286 (23.3%) completed follow-up and were analysed longitudinally.

Outcome measures Primary outcome was probable insomnia (Sleep Condition Indicator). Secondary outcomes were recovery and emergence of insomnia over the year and follow-up insomnia severity.

Results In adjusted models, insomnia at university entry was associated with depressive symptoms (OR 2.64, 95% CI 2.19 to 3.18), anxiety (OR 1.19, 95% CI 1.01 to 1.42), childhood sexual abuse (OR 1.33, 95% CI 1.09 to 1.62), bullying (OR 1.23, 95% CI 1.05 to 1.44), alcohol use problems (OR 1.18, 95% CI 1.02 to 1.35) and lower resilience (OR 0.92, 95% CI 0.91 to 0.94). Over the first academic year, higher anxiety was associated with lower odds of recovery (OR 0.89, 95% CI 0.82 to 0.96) and higher depression with emergence of probable insomnia (OR 1.10, 95% CI 1.03 to 1.17). Increases in depression (B −0.34, 95% CI −0.44 to −0.23) and anxiety (B −0.25, 95% CI −0.37 to −0.13) were associated with worse follow-up insomnia severity; increases in resilience were associated with less severe insomnia (B 0.16, 95% CI 0.07 to 0.25).

Conclusion Probable insomnia was common at university entry, with different factors associated with recovery, emergence and severity.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ This study drew on data from first-year undergraduate students across a broad range of academic disciplines at five UK universities.
⇒ The longitudinal design allowed us to track recovery, new onset and changes in insomnia severity across the first academic year.
⇒ Insomnia recovery and new onset were defined using a Reliable Change Index, so that observed changes reflected meaningful clinical change rather than normal symptom fluctuation.
⇒ All measures relied on self-report, which may introduce response bias, particularly for sensitive topics such as mental health.
⇒ Follow-up retention rates were relatively low, with evidence of differential attrition (eg, by mental health history and childhood adversity), introducing possible attrition bias, which may affect the generalisability of findings.

INTRODUCTION

The mental health of university students is a growing policy and public health concern in the UK[1] and worldwide.[2 3] It is now well established that the transition to university is associated with unique stressors, including leaving the family home and assuming greater independence,[4 5] which can significantly impact students' well-being.[6] For those who start university at 18 or shortly thereafter, this transition occurs during a key developmental period characterised by increased sensitivity to stress[7] and is close to the peak onset period for many common mental health conditions.[8] Many students present with mental health needs at university entry, with 28% of first-year undergraduates reporting a lifetime mental health diagnosis, 30% screening positive for anxiety, 28% for depression and 18% for sleep problems.[9]

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The most recent global systematic review and meta-analysis on the prevalence of insomnia symptoms among undergraduate university students included 48 studies and reported a pooled prevalence of 46.9% (95% CI 40.1% to 53.6%), although estimates varied across continents and screening instruments.[10] This is broadly consistent with earlier regional reviews, which reported pooled prevalence estimates of 43.3% (95% CI 28.9% to 58.2%) among university students in Saudi Arabia[11] and 52.1% (95% CI 41.1% to 63.1%) in South Asia.[12] Insomnia in undergraduates is associated with lower academic achievement,[13 14] elevated levels of mental health conditions, including anxiety and depression,[15] and increased suicide risk.[16] More broadly, insomnia is common across the lifespan[17] and can persist over time if left untreated.[18] Persistent insomnia is linked to increased risk of cardiovascular disease,[19] obesity[20] and recurrent anxiety and depression.[21]

Factors influencing insomnia in university students may differ from those affecting other demographic groups. A narrative review comparing risk factors across age groups found that anxiety, depression, stress, poor sleep hygiene and internet addiction were most frequently reported among university students, reflecting academic pressures and the unstructured nature of student life, whereas gender, chronic pain and socioeconomic status were most frequently reported among older adults, reflecting physical illness and social circumstances more characteristic of later life.[22] Research focusing specifically on the transition to university has identified a further set of contributing factors. A qualitative study with 15 first-year undergraduates identified lifestyle factors unique to the transition to university that may contribute to poor sleep quality and insomnia, including new living arrangements, environmental noise, social pressure, unstructured academic schedules, increased independence and irregular sleep-wake patterns.[23] Longitudinal data from the U-Flourish cohort study in Canada showed that lower self-esteem, perfectionism and external locus of control predicted the emergence of insomnia symptoms in first-year undergraduates,[15] while a subsequent U-Flourish analysis found that more frequent cannabis use, greater passive screen time and lower exercise were associated with probable insomnia at year end.[24] Large-scale cohort data from China similarly identified female gender, prior sleep difficulties, alcohol use, pre-existing mental health problems and negative coping styles as predictors of insomnia over time.[25] Together, these findings suggest that psychological, psychosocial and lifestyle factors are associated with insomnia among university students. However, existing longitudinal studies have largely focused on baseline predictors of later insomnia, and less is known about how symptoms develop across the first year or whether changes in factors over time independently affect sleep outcomes.

Higher education offers an opportunity for prevention and early intervention,[26] and identifying the factors that contribute to insomnia during the first year is essential for developing targeted and evidence-based support within university settings. In this study, we used data from a large multisite cohort of first-year undergraduate students in the UK to: (a) identify demographic, psychological, lifestyle and psychosocial factors associated with probable insomnia at university entry; (b) examine whether baseline modifiable psychological, lifestyle and psychosocial factors were associated with recovery from insomnia symptoms by the end of the first year among students who screened positive at university entry; (c) investigate whether the same baseline modifiable factors were associated with the emergence of insomnia symptoms by the end of the first year among students who initially screened negative and (d) examine whether longitudinal changes in these factors across the first academic year were associated with insomnia severity at follow-up.

METHODS

Data source

Data from this study were drawn from three consecutive cohorts of the longitudinal Nurture-U survey study described in detail elsewhere.[27] Briefly, students at Cardiff University, University of Exeter, Newcastle University, University of Southampton and University of Oxford were invited to complete an adapted version of the U-Flourish Student Well-Being[28] survey at the start of the academic year (baseline) and end of the term in spring before university examinations (follow-up). Only participants who completed the online baseline survey were invited to take part in the follow-up survey. The survey included validated measures of mental health symptoms, well-being, lifestyle, social factors and access to support. Recruitment lasted over three academic years, from autumn 2022 to spring 2025. Participation incentives and an engagement campaign that included mass communication, on-campus promotion and social media posts were used to encourage student participation. To verify student status and reduce the risk of ineligible or fraudulent responses, the survey was advertised exclusively through university channels and required participants to provide a university email address and student number at registration. Duplicate responses were identified and removed based on matching student numbers. Informed by the U-Flourish Study student engagement campaign,[28] public and patient involvement was incorporated through the Nurture-U Student Advisory Group, comprising 142 student representatives from participating universities, who contributed to all stages of the project.[29]

Participants

Eligible participants were first-year undergraduate students enrolled at one of the five participating universities. Students aged over 24 years (n=191) were excluded due to under-representation relative to the 18–24 age range, as findings for this subgroup would not be generalisable to students entering university at or around the

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typical age of 18. Students were not excluded on the basis of pre-existing mental health diagnoses.

Measures

For a detailed description of the measures, please see the published study protocol.[27] The a priori selection of measures of interest was undertaken based on previously published findings relating to psychological,[15] psychosocial[25] and lifestyle factors[24] linked to insomnia, as well as by their availability in the Nurture-U dataset.

Demographics and family/personal history

Participants self-reported their age (in years), gender and international student status using single-item questions. Students reported their personal and family history of mental health conditions and identified their ethnicity from a standard list. Disability status was assessed with a single yes/no item. In this study, ethnicity was coded using top-level categories derived from the UK 2021 Census list of ethnic groups. Two modifications were applied. First, the Mixed and Other categories were collapsed to minimise the risk of participant identification. Second, students who identified exclusively as Chinese were coded as a separate category within the broader Asian group, as this subgroup was sufficiently large to justify independent analysis. Adverse childhood experiences were measured using three items adapted from the Childhood Experience of Care and Abuse[30] measure, assessing physical abuse, sexual abuse and bullying. Each item was entered as a separate predictor in the analyses.

Psychological variables

Anxiety symptoms were measured using the Generalised Anxiety Disorder 7-item scale (GAD-7), a seven-item measure scored 0–21, with a cut-off of ≥10 indicating clinically significant symptoms.[31] The GAD-7 has been validated in clinical and general population samples[31 32] and showed excellent internal consistency in the present study (α=0.90).

Depressive symptoms were measured using the Patient Health Questionnaire (PHQ-9), a nine-item measure scored 0–27, with a cut-off of ≥10 indicating clinically significant symptoms.[33] The PHQ-9 has been validated in clinical and general population samples[33 34] and showed good internal consistency in the present study (α=0.87).

Well-being was measured using the short version of the Warwick Edinburgh Mental Well-being Scale (WEMWBS-7),[35 36] a seven-item measure scored 7–35, where higher scores indicate better well-being. The WEMWBS has been validated in general and clinical population samples,[37 38] and showed good internal consistency in the present study (α=0.85).

Alcohol use problems were measured using the Alcohol Use Disorders Identification Test for Consumption (AUDIT-C),[39] a three-item screening tool scored 0–12, with a cut-off of ≥5 indicating probable alcohol use problems.[40] The AUDIT-C has demonstrated strong psychometric properties across diverse populations[39 41] and showed good internal consistency in the present study (α=0.87).

Psychosocial variables

Resilience was measured using the Brief Resilience Scale (BRS),[42] a six-item measure scored 6–30, where higher scores indicate greater ability to recover from stress. The BRS has strong psychometric properties[42 43] and showed good internal consistency in the present study (α=0.81).

Loneliness was measured using a modified four-item version of the original eight-item University of California, Los Angeles (UCLA) Loneliness Scale,[44] in which the four reverse-coded items were omitted to reduce questionnaire length.[27] Items were scored 1–4, yielding total scores from 4 to 16, with higher scores indicating greater loneliness. The original eight-item measure has demonstrated strong psychometric properties, including in university samples,[45 46] and a systematic review supports the reliability of abbreviated versions of the UCLA in adults.[47] The four-item scale demonstrated good internal consistency in the present study (α=0.88).

Social support was measured using the Social Resources subscale of the Resilience Scale for Adolescents,[48] a five-item subscale scored 5–25, where higher scores indicate greater perceived social support. The subscale showed acceptable internal consistency in the present study (α=0.79), consistent with previous estimates.[48]

Lifestyle variable

Exercise was measured using a single item assessing the frequency of working out, going to the gym or attending a fitness class in the past month, rated on a 5-point ordinal scale: 1 (‘never’), 2 (‘less than weekly’), 3 (‘once a week’), 4 (‘2–3 times per week’) and 5 (‘4+ times per week’).

Outcome

The primary outcome was probable insomnia as reported using the Sleep Condition Indicator (SCI). The SCI is an eight-item self-report screening tool for probable insomnia based on Diagnostic and Statistical Manual of Mental Disorders, 5th Edition diagnostic criteria.[49] Items are rated on a 5-point Likert scale, yielding a total score ranging from 0 to 32, with higher scores indicating better sleep. The SCI has demonstrated strong psychometric properties, with a cut-off score of ≤16 identified as optimal for detecting probable insomnia disorder.[49] Internal consistency in the present sample was good (α=0.88). For the longitudinal analyses, recovery was defined as meeting three criteria: (a) screening positive for probable insomnia at baseline (SCI ≤16), (b) screening negative at follow-up (SCI >16) and (c) demonstrating an increase in SCI score exceeding the Reliable Change Index (RCI) of 7 scale points.[50] Emergence was defined as the inverse pattern, that is, moving from above to below the symptom threshold while also showing a decrease in SCI score greater than 7 scale points. These definitions were used to account for natural symptom fluctuation that does not reflect meaningful clinical change.[50]

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Ethics and consent

Ethics approval was obtained at each university site: University of Exeter (FHLS Psychology Research Ethics Committee, 519175); Cardiff University (Wales Research Ethics Committee, IRAS reference: 155838, REC reference: 16/WA/0323); Newcastle University (Faculty of Medical Sciences Research Ethics Committee, 24735/2022); University of Oxford (Medical Sciences Interdivisional Research Ethics Committee, Ref. R60998); University of Southampton (Faculty of Medicine Ethics Board, ERGO 73178). All student participants read a letter of information and provided informed consent to access and complete the survey.[27]

Statistical analysis

Baseline characteristics were first described for the full baseline sample (N=5524). Participants who completed baseline only (N=4238) were compared with those who completed both assessments (N=1286) using χ^2 tests for categorical variables and the Wilcoxon rank-sum test for continuous variables, with descriptive statistics reported as percentages and median with IQR, respectively. In the full baseline dataset, 12.1% of values were missing overall (range 5.2%–20.4%; online supplemental table S1), and in the longitudinal dataset, 6.3% were missing (range 0.4%–17.0%; online supplemental table S2). Little's tests rejected the assumption that data were missing completely at random in both datasets (p<0.001). Missing data were handled using multiple imputation by chained equations, performed separately for the baseline-only and longitudinal datasets. 20 imputed datasets were generated using predictive mean matching for continuous variables and logistic regression for binary variables, with ten iterations. The imputation models included all variables used in subsequent analyses. Estimates were pooled using Rubin's rules.[51]

For each analysis, univariable models were first fitted, followed by a fully adjusted model including all predictors simultaneously. To examine factors associated with probable insomnia at baseline, logistic regression models were fitted in the full baseline sample including demographic (gender, international student status and ethnicity), family and personal history (personal and family mental health diagnosis, disability and adverse childhood experiences), psychological (anxiety, depression, wellbeing and alcohol use problems), lifestyle (exercise frequency) and psychosocial variables (resilience, loneliness and social support). To identify modifiable factors associated with insomnia recovery and emergence, separate logistic regressions were fitted among students with (N=469) and without (N=817) probable insomnia at entry, with baseline psychological, psychosocial and lifestyle variables entered as continuous predictors. Longitudinal changes in modifiable factors as predictors of follow-up insomnia severity were examined using linear regression (N=1286), with change scores operationalised as follow-up minus baseline and baseline insomnia severity included as a covariate. To assess robustness of the longitudinal analyses to differential follow-up, a sensitivity analysis used inverse probability weighting, with weights derived from a logistic regression model predicting follow-up completion from baseline characteristics.[52] A post hoc sensitivity analysis assessed whether shared item content between the PHQ-9 and SCI inflated the reported associations, adding the PHQ-9 sleep item as a covariate in the cross-sectional model and excluding it from the PHQ-9 total in the longitudinal models. ORs with 95% CIs are reported for logistic regression models and unstandardised coefficients (B) with 95% CIs for the linear regression model. Variance inflation factors (VIFs) indicated no evidence of problematic multicollinearity across all models (all VIFs<2.5).[53] No formal power calculation was conducted, as the sample was determined by recruitment to the broader Nurture-U cohort study.[27] All statistical analyses were conducted using Stata V.18.

RESULTS

Sample characteristics

The full baseline sample consisted of 5524 first-year undergraduate students (table 1), representing an estimated 5.2% of the approximately 105 000 first-year undergraduates enrolled across the five participating universities during the three recruitment years. The median age of participants was 18 years (IQR=18–19); 62.5% were female and 71.5% were White. International students comprised 15.6% of the sample, 13.1% reported a disability, 29.7% reported a lifetime history of a mental disorder and 43.9% reported a family history of mental disorder. Clinically significant anxiety and depression symptoms were reported by 27.4% and 28.4% of students, respectively, and 32.0% screened positive for probable insomnia.

Participants who completed the baseline survey only (N=4238) were compared with those who completed both baseline and follow-up assessments (N=1286) on baseline characteristics (table 1). Participants with data at both timepoints were more likely to be female (68.4% vs 60.8%, p<0.001), White (75.1% vs 70.5%, p=0.004) and domestic students (86.6% vs 83.7%, p=0.013). They were also more likely to report childhood sexual abuse (17.5% vs 15.0%, p=0.031), bullying (27.9% vs 24.9%, p=0.031), a lifetime personal history of mental disorder (33.9% vs 28.4%, p<0.001), a family history of mental disorder (51.3% vs 42.4%, p<0.001) or a disability (16.6% vs 12.2%, p<0.001). They were more likely to screen positive for anxiety (31.9% vs 26.0%, p<0.001), depression (32.8% vs 27.2%, p<0.001) and insomnia (35.4% vs 30.9%, p=0.003), but less likely to report alcohol use problems (40.1% vs 46.7%, p<0.001). No statistically

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Table 1 Baseline characteristics of the full baseline sample and comparison of participants with baseline-only data and those with both baseline and follow-up data

Characteristic	Full baseline sample	Baseline only	Both time points	Test statistic (df), p value*
	N=5524	N=4238	N=1286	
	n (%)	n (%)	n (%)	
Age in years, median (IQR)	18 (18–19)	18 (18–19)	18 (18–19)	–0.39, 0.695
Gender				47.55(2), <0.001
Male	1882 (34.07)	1539 (36.31)	343 (26.67)	
Female	3455 (62.54)	2575 (60.76)	880 (68.43)	
Gender diverse	187 (3.39)	124 (2.93)	63 (4.90)	
Ethnicity				15.15(4), 0.004
White	3952 (71.54)	2986 (70.46)	966 (75.12)	
Black	122 (2.21)	97 (2.29)	25 (1.94)	
Asian Chinese	394 (7.13)	316 (7.46)	78 (6.07)	
Asian other	577 (10.45)	473 (11.16)	104 (8.09)	
Mixed or other	479 (8.67)	366 (8.64)	113 (8.79)	
International student, yes	862 (15.60)	690 (16.28)	172 (13.37)	6.11(1), 0.013
Childhood physical abuse, yes	449 (8.17)	352 (8.31)	103 (8.04)	0.08(1), 0.779
Childhood sexual abuse, yes	858 (15.54)	634 (14.96)	225 (17.47)	4.64(1), 0.031
Childhood bullying, yes	1408 (25.49)	1054 (24.86)	359 (27.88)	4.65(1), 0.031
Lifetime history of mental disorder, yes	1640 (29.69)	1202 (28.37)	436 (33.88)	14.26(1), <0.001
Family history of mental disorder, yes	2426 (43.91)	1798 (42.42)	659 (51.26)	30.71(1), <0.001
Screen positive for disability, yes	724 (13.11)	515 (12.16)	214 (16.61)	16.96(1), <0.001
Screen positive for anxiety (GAD-7), yes	1516 (27.41)	1102 (26.00)	410 (31.93)	16.86(1), <0.001
Screen positive for depression (PHQ-9), yes	1571 (28.42)	1151 (27.16)	421 (32.78)	14.81(1), <0.001
Screen positive for insomnia (SCI), yes	1767 (32.01)	1308 (30.87)	455 (35.40)	9.06(1), 0.003
Alcohol use problems (AUDIT-C), yes	2483 (44.94)	1977 (46.66)	516 (40.10)	16.70(1), <0.001

*P values compare participants who completed the baseline survey only (N=4238) with those who completed both baseline and follow-up surveys (N=1286); χ^2 tests for categorical variables and Wilcoxon rank-sum test for continuous variables. The full baseline sample column is provided for descriptive purposes and is not included in statistical comparisons.
AUDIT-C, Alcohol Use Disorders Identification Test–Consumption; GAD-7, Generalised Anxiety Disorder 7 item scale; PHQ-9, Patient Health Questionnaire 9 item depression scale; SCI, Sleep Condition Indicator.

significant differences were observed in age or exposure to childhood physical abuse. These differences should be considered when interpreting the longitudinal findings.

Factors associated with probable insomnia at entry to university

In univariable logistic regression models, higher odds of probable insomnia were found among students identifying as female or gender-diverse, those reporting childhood adversity (including physical abuse, bullying and sexual abuse), a personal or family history of mental health diagnosis, disability, alcohol use problems, greater loneliness and those screening positive for anxiety or depression (table 2). In contrast, lower odds of insomnia were observed among international students and Asian Chinese students, and among those reporting more frequent exercise, higher well-being, greater resilience and stronger social support.

The fully adjusted model was a significant improvement over the intercept-only model (model F-test p<0.001). In this model (table 2), students who screened positive for depression had more than twice the odds of probable insomnia at entry to university (OR=2.64, 95% CI 2.19 to 3.18). Anxiety was associated with a smaller increase in odds (OR=1.19, 95% CI 1.01 to 1.42), as were childhood sexual abuse (OR=1.33, 95% CI 1.09 to 1.62), a history of bullying (OR=1.23, 95% CI 1.05 to 1.44) and alcohol use problems (OR=1.18, 95% CI 1.02 to 1.35). Each one-unit increase in resilience was associated with

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Table 2 Associations between demographic, psychological and psychosocial factors and probable insomnia at university entry (N=5524)

	Unadjusted model	Adjusted model*
Characteristic	OR (95% CI)	OR (95% CI)
Gender (ref: Male)		
Female	1.22 (1.07 to 1.39)†	0.85 (0.74 to 1.00)
Gender diverse	2.48 (1.82 to 3.37)†	1.10 (0.77 to 1.50)
Ethnicity (ref: White)		
Black	0.81 (0.52 to 1.28)	0.64 (0.40 to 1.03)
Mixed or other	1.10 (0.88 to 1.37)	1.06 (0.84 to 1.33)
Asian Chinese	0.70 (0.53 to 0.92)‡	0.97 (0.71 to 1.33)
Asian other	0.87 (0.70 to 1.08)	1.00 (0.80 to 1.27)
Student status (ref: Domestic)		
International	0.75 (0.63 to 0.92)‡	1.03 (0.83 to 1.28)
Physical abuse	1.82 (1.47 to 2.27)†	1.26 (0.99 to 1.60)
Sexual abuse	2.22 (1.86 to 2.65)†	1.33 (1.09 to 1.62)‡
Bullying	2.00 (1.74 to 2.31)†	1.23 (1.05 to 1.44)§
Lifetime history of mental disorder	1.97 (1.73 to 2.25)†	1.05 (0.89 to 1.23)
Family history of mental disorder	1.58 (1.39 to 1.80)†	1.08 (0.93 to 1.24)
Disability diagnosis	1.99 (1.65 to 2.39)†	1.16 (0.93 to 1.43)
Anxiety positive screen (GAD-7)	3.03 (2.67 to 3.45)†	1.19 (1.01 to 1.42)§
Depression positive screen (PHQ-9)	4.21 (3.70 to 4.79)†	2.64 (2.19 to 3.18)†
Alcohol use problems (AUDIT-C)	1.24 (1.10 to 1.40)†	1.18 (1.02 to 1.35)§
Exercise	0.78 (0.69 to 0.88)†	1.00 (0.87 to 1.14)
Well-being (WEMWBS), continuous	0.89 (0.88 to 0.91)†	0.99 (0.97 to 1.01)
Loneliness (UCLA), continuous	1.17 (1.14 to 1.19)†	1.03 (0.99 to 1.07)
Resilience (BRS), continuous	0.88 (0.87 to 0.89)†	0.92 (0.91 to 0.94)†
Social support (READ), continuous	0.78 (0.73 to 0.84)†	1.08 (0.99 to 1.19)

Adjusted model fit: F(21, 7374.3)=27.08, p<0.001.
*Adjusted for all other variables in the table.
†p<0.001.
‡p<0.01.
§p<0.05.
AUDIT-C, Alcohol Use Disorders Identification Test–Consumption; BRS, Brief Resilience Scale; GAD-7, Generalised Anxiety Disorder 7-item scale; PHQ-9, Patient Health Questionnaire 9-item depression scale; READ, Resilience Scale for Adolescents–Social Resources subscale; ref, reference category; UCLA, University of California, Los Angeles; WEMWBS, Warwick–Edinburgh Mental Well-being Scale.

an 8% reduction in the odds of insomnia symptoms (OR=0.92, 95% CI 0.91 to 0.94). Associations observed in univariable analyses for demographic characteristics, mental health history, disability, well-being, exercise frequency, loneliness and social resources were attenuated after adjustment.

Factors associated with recovery from insomnia among students with insomnia at university entry

Among the 1286 students with baseline and follow-up data, 469 (36.4%) screened positive for probable insomnia at university entry. By the end of the first academic year, 158 (33.7%) of these students had achieved recovery. Unadjusted and adjusted associations are presented in table 3. The adjusted logistic regression model was statistically significant (p<0.001). In this model, higher anxiety symptoms at university entry were associated with reduced odds of recovery, with each one-point increase corresponding to 11% lower odds of recovery (OR=0.89, 95% CI 0.82 to 0.96). More severe insomnia at baseline was also associated with reduced odds of recovery (OR=0.80, 95% CI 0.75 to 0.85). Baseline depressive symptoms, well-being, loneliness, social resources, resilience, alcohol use problems and exercise frequency were not significantly associated with recovery.

Factors associated with emergence of insomnia among students without insomnia at university entry

Among the 817 students (63.5%) who screened negative for clinically significant insomnia at university entry, 124 (15.2%) showed emergence of insomnia symptoms during the first year of study. The adjusted logistic regression

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Table 3 Baseline factors associated with recovery from and emergence of insomnia during the first academic year

	Recovery (n=469)		Emergence (n=817)	
Baseline factors	Unadjusted model OR (95% CI)	Adjusted model* OR (95% CI)	Unadjusted model OR (95% CI)	Adjusted model* OR (95% CI)
Baseline insomnia severity (SCI)	0.83 (0.79 to 0.88)†	0.80 (0.75 to 0.85)†	0.98 (0.93 to 1.03)	1.03 (0.97 to 1.08)
Anxiety symptoms (GAD-7)	0.87 (0.83 to 0.91)†	0.89 (0.82 to 0.96)‡	1.09 (1.05 to 1.14)†	1.05 (0.99 to 1.11)
Depressive symptoms (PHQ-9)	0.89 (0.85 to 0.92)†	0.93 (0.86 to 1.01)	1.10 (1.06 to 1.14)†	1.10 (1.03 to 1.17)‡
Well-being (WEMWBS)	1.11 (1.06 to 1.17)†	0.96 (0.88 to 1.04)	0.94 (0.90 to 0.99)‡	1.05 (0.98 to 1.13)
Loneliness (UCLA)	0.91 (0.84 to 0.99)§	1.10 (0.97 to 1.25)	1.06 (0.99 to 1.14)	0.95 (0.86 to 1.04)
Social support (READ)	1.55 (1.17 to 2.05)‡	1.31 (0.92 to 1.88)	0.76 (0.59 to 0.98)§	0.83 (0.62 to 1.11)
Resilience (BRS)	1.06 (1.01 to 1.11)‡	1.01 (0.96 to 1.06)	0.99 (0.95 to 1.03)	0.97 (0.92 to 1.02)
Alcohol use problems (AUDIT-C)	1.00 (0.93 to 1.08)	0.99 (0.91 to 1.08)	1.00 (0.92 to 1.08)	0.98 (0.91 to 1.07)
Exercise frequency	1.07 (0.92 to 1.24)	0.99 (0.82 to 1.19)	0.92 (0.78 to 1.07)	0.96 (0.82 to 1.13)

ORs represent the change in odds of the respective outcome (reliable recovery or emergence of insomnia during the first academic year) associated with a one-unit increase in each predictor measured at university entry.
All predictors are entered as continuous variables.
Recovery was examined among students who screened positive for probable insomnia at university entry (SCI ≤16; n=469); emergence was examined among students who screened negative (SCI ≥17; n=817).
Reliable recovery and emergence were defined using the Reliable Change Index on the Sleep Condition Indicator (7-point change threshold).
Recovery model fit: F(9, 4657.7)=7.78, p<0.001.
Emergence model fit: F(9, 4513.0)=3.50, p<0.001.
*Adjusted for all other variables in the table.
†p<0.001
‡p<0.01.
§p<0.05.
AUDIT-C, Alcohol Use Disorders Identification Test–Consumption; BRS, Brief Resilience Scale; GAD-7, Generalised Anxiety Disorder 7-item scale; PHQ-9, Patient Health Questionnaire 9-item depression scale; READ, Resilience Scale for Adolescents–Social Resources subscale; UCLA, University of California, Los Angeles; WEMWBS, Warwick–Edinburgh Mental Well-being Scale.

model was statistically significant (p<0.001; table 3). In this model, higher depressive symptoms at university entry were associated with an increased likelihood of developing insomnia during the first academic year, with each one-point increase corresponding to a 10% increase in the odds of insomnia emergence (OR=1.10, 95% CI 1.03 to 1.17). Baseline insomnia severity, anxiety symptoms, well-being, loneliness, social resources, resilience, alcohol use problems and exercise frequency were not significantly associated with insomnia emergence.

Longitudinal changes in modifiable factors and insomnia severity at follow-up

Results of the unadjusted and adjusted linear regression models are presented in table 4. Baseline insomnia severity was strongly associated with follow-up SCI score (B=0.42, 95% CI 0.37 to 0.47). Greater increases in depressive symptoms over the academic year were associated with worse insomnia severity at follow-up (B=−0.34, 95% CI −0.44 to −0.23), as were greater increases in anxiety symptoms (B=−0.25, 95% CI −0.37 to −0.13). Greater increases in resilience were associated with less severe insomnia at follow-up (B=0.16, 95% CI 0.07 to 0.25). Changes in well-being, loneliness, social support, alcohol use problems and exercise frequency were not significantly associated with insomnia severity at follow-up.

Sensitivity analyses

Analyses using inverse probability weighting produced estimates broadly consistent with the primary analyses across the recovery, emergence (online supplemental table S3) and follow-up severity models (online supplemental table S4), supporting the robustness of the reported associations to differential follow-up. No significant association reversed direction, though well-being became a significant predictor in the adjusted emergence and follow-up severity models (OR=1.08, 95% CI 1.01 to 1.17; B=0.16, 95% CI 0.02 to 0.30, respectively). A second set of analyses assessed whether shared item content between the PHQ-9 and SCI inflated the observed associations. Adjusting for the PHQ-9 sleep item attenuated the cross-sectional association between depression positive screen and probable insomnia, which nonetheless remained significant (OR from 2.64 2.19 to 3.18 to 1.52 1.27 to 1.82; online supplemental table S5). Excluding the sleep item from the PHQ-9 total left the longitudinal associations largely unchanged: recovery remained non-significant (OR=0.93 vs 0.96), emergence remained significant (OR=1.10 vs

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Table 4 Associations between longitudinal changes in modifiable factors and insomnia severity at follow-up (N=1286)

	Unadjusted model	Adjusted model*
Variable	B (95% CI)	B (95% CI)
Baseline insomnia severity (SCI)	0.40 (0.34 to 0.45)†	0.42 (0.37 to 0.47)†
Change in anxiety symptoms (GAD-7)	0.02 (–0.08 to 0.12)	–0.25 (-0.37 to –0.13)†
Change in depressive symptoms (PHQ-9)	–0.27 (–0.36 to –0.18)†	–0.34 (–0.44 to –0.23)†
Change in well-being (WEMWBS)	0.26 (0.16 to 0.36)‡	0.12 (–0.01 to 0.26)
Change in loneliness (UCLA)	–0.23 (–0.41 to –0.05)§	–0.12 (–0.32 to 0.09)
Change in resilience (BRS)	0.15 (0.05 to 0.25)‡	0.16 (0.07 to 0.25)†
Change in social support (READ)	0.50 (–0.17 to 1.17)	0.10 (–0.51 to 0.71)
Change in alcohol use (AUDIT-C)	0.01 (–0.27 to 0.30)	–0.01 (–0.26 to 0.24)
Change in exercise frequency	–0.15 (–0.54 to 0.24)	–0.19 (–0.54 to 0.16)

Change scores are operationalised as follow-up minus baseline.
Adjusted model fit: F(9, 868.0)=32.36, p<0.001; average R^2 across imputed datasets=0.23.
*Adjusted for all other variables in the table.
†p<0.001.
‡p<0.01.
§p<0.05.
AUDIT-C, Alcohol Use Disorders Identification Test–Consumption; B, unstandardised regression coefficient; BRS, Brief Resilience Scale; GAD-7, Generalised Anxiety Disorder 7-item scale; PHQ-9, Patient Health Questionnaire 9-item depression scale; READ, Resilience Scale for Adolescents–Social Resources subscale; SCI, Sleep Condition Indicator (lower scores indicate greater insomnia severity); UCLA, University of California, Los Angeles; WEMWBS, Warwick–Edinburgh Mental Well-being Scale.

1.09; online supplemental table S6) and the change-score coefficient predicting follow-up severity was similar (B=–0.34 vs –0.32; online supplemental table S7).

DISCUSSION

Main findings

This large-scale longitudinal cohort study examined factors associated with probable insomnia at university entry, baseline factors associated with its recovery or emergence over the academic year, and changes in factors associated with insomnia severity at follow-up, among first-year undergraduate students at five UK universities. Almost one-third of students (32.0%) screened positive for probable insomnia at entry. Insomnia at university entry was independently associated with depressive and anxiety symptoms, histories of childhood sexual abuse and bullying, alcohol use problems and lower resilience. Among students with insomnia at entry, one in three (33.7%) achieved recovery by the end of the first academic year, and higher baseline anxiety symptoms were independently associated with lower odds of recovery. Among those without insomnia at entry, 15.2% developed insomnia by the end of the first year, and higher baseline depressive symptoms were the only factor independently associated with emergence. Finally, greater increases in both depressive and anxiety symptoms over the academic year were associated with worse insomnia severity at follow-up, while greater increases in resilience were associated with less severe insomnia.

Findings in context

These findings should be interpreted against the backdrop of the high prevalence of insomnia symptoms observed both in the present sample (32.0%) and in the wider literature,[10] alongside the substantial burden of mental health problems reported among undergraduate students more broadly (eg, pooled depression prevalence of 25%).[54] Poor sleep is also frequently normalised by students as an unavoidable part of university life, which may reduce help-seeking and delay identification of those most at risk.[55] Within this context, the present findings describe which factors were associated with insomnia at university entry and with its recovery, emergence and severity during the first year, and may help identify factors worth examining in future research on sleep-focused support.

The finding that depressive symptoms were independently associated with probable insomnia at university entry is consistent with the bidirectional relationship between depression and insomnia in general adult populations. Meta-analytic evidence indicates that insomnia approximately doubles the risk of later depression,[21 56] and prospective data suggest that depression similarly predicts new-onset insomnia.[57] Among university students, cross-sectional studies have similarly reported associations between depression and insomnia,[58] but longitudinal research has largely examined insomnia as a predictor of later depressive symptoms,[15] rather than depression as a factor associated with insomnia. Our findings add to the literature in two ways. First, depressive symptoms were the only independent factor associated with new-onset

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insomnia by the end of the academic year among students who initially reported no clinically significant sleep difficulties. Second, greater increases in depressive symptoms over the academic year were independently associated with worse insomnia severity at follow-up, even after accounting for baseline insomnia severity and changes in other modifiable factors. These findings are consistent with a relationship between depressive symptoms and sleep during the university transition.

Anxiety symptoms were also independently associated with insomnia at university entry. As with depression, the relationship between anxiety and insomnia is bidirectional in general adult populations,[21 57] and insomnia at university entry has been shown to predict subsequent anxiety symptoms in first-year undergraduates.[15] Notably, the longitudinal analyses revealed two novel anxiety-related findings: anxiety symptoms were associated with lower odds of recovery among students who entered university with probable insomnia, and greater increases in anxiety symptoms over the academic year were independently associated with worse insomnia severity at follow-up. These findings suggest that anxiety was associated with insomnia not only at entry but also with its subsequent course. One possible explanation is that anxiety-driven processes such as worry, selective attention and sleep-related monitoring may perpetuate insomnia,[59] making recovery less likely in students with elevated anxiety at entry. Anxiety was associated with lower odds of recovery but not emergence, while depression was associated with emergence but not recovery, which suggests that the two may relate differently. A similar pattern of distinct predictors for recovery versus emergence has been reported for anxiety and depressive symptoms in first-year undergraduates,[60] suggesting recovery and emergence may not be mirror processes.

Resilience was independently associated with reduced odds of probable insomnia at university entry, in line with evidence that reduced resilience is related to heightened stress-related sleep reactivity, emotional dysregulation, and pre-sleep hyperarousal in individuals with insomnia.[61] Although resilience was not associated with recovery or emergence of insomnia categorically, greater increases in resilience over the academic year were associated with less severe insomnia at follow-up, consistent with evidence that resilience predicts better sleep quality in adolescents[62] and that poorer sleep quality and greater insomnia symptoms are associated with lower resilience in university students.[63] Building resilience during the university transition may therefore help reduce insomnia severity, though this would need to be examined in intervention studies.

In terms of early-life risk factors, childhood sexual abuse and bullying were independently associated with insomnia at entry, consistent with longitudinal evidence that specific adverse childhood experiences predict insomnia symptoms from adolescence through adulthood,[64] and cross-sectional data linking childhood maltreatment to sleep difficulties in university students.[65] Among other modifiable factors, alcohol use problems were associated with higher odds of insomnia at entry, consistent with evidence that alcohol disrupts sleep via multiple pathways, including alterations in sleep architecture and circadian rhythm dysregulation.[66 67] However, alcohol use problems were not associated with recovery, emergence or follow-up severity, suggesting its cross-sectional association with insomnia may reflect confounding with other mental health factors included in the adjusted model. Exercise frequency did not remain independently associated with insomnia after full adjustment, contrasting with findings from the U-Flourish study, in which reduced exercise was associated with probable insomnia in first-year undergraduates.[24] As both studies used the same single-item measure, this discrepancy is more likely due to the more comprehensive covariate adjustment in the present study or pandemic-related lifestyle disruption in the U-Flourish sample (2018–2022). Changes in exercise frequency over the academic year were similarly not associated with follow-up insomnia severity. Although meta-analytic evidence supports a positive association between physical activity and sleep quality in adults,[68] the single-item measure used here does not capture common activities such as walking, cycling and team sports, so these null findings should not be interpreted as evidence that exercise is unimportant for student sleep health.

Neither loneliness nor social support was independently associated with insomnia in any of the fully adjusted models, despite both showing significant univariable associations at entry and despite meta-analytic evidence supporting associations between loneliness and sleep[69] and social support and sleep[70] in adult populations. Across exercise, well-being, loneliness and social support, associations that were evident in univariable analyses attenuated after full adjustment. This pattern suggests that the independent associations of these factors with insomnia may be limited once other psychological variables in the model are accounted for.

Strengths and weaknesses

Strengths of the study include the large-scale, multisite design, drawing on data from undergraduates across a broad range of academic disciplines at five universities in the UK. The longitudinal design enabled examination of recovery, new onset and severity of probable insomnia over the first academic year. The use of validated measures and a RCI to define recovery and emergence was intended to distinguish meaningful change from natural symptom fluctuation.

Several limitations should be noted. First, recruitment relied on open, self-selected participation rather than random or systematic invitation of individual students. Because the survey was not distributed to

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every eligible student, a true response rate cannot be calculated. As an approximate indication of coverage, the baseline sample represented around 5.2% of the eligible first-year undergraduate population across the participating universities (based on Higher Education Statistics Agency enrolment figures). Students who chose to participate may differ systematically from non-participants, raising the possibility of selection bias. Second, only 23.3% of baseline participants completed follow-up. Follow-up completers differed systematically from non-completers on several baseline characteristics (table 1), including sex, ethnicity, student status, childhood adversity, personal and family mental health history, disability, and baseline anxiety, depression, insomnia severity, and alcohol use. Because completers had a greater baseline burden of psychological difficulty than non-completers, the recovery, emergence and follow-up severity estimates come from a higher-risk subgroup of the original cohort. To assess whether this introduced bias, we conducted a sensitivity analysis using inverse probability weighting to account for differential follow-up (see Sensitivity analyses section), which produced results consistent with the primary analyses. Third, women were over-represented in the sample; however, this was unsurprising, as similar patterns have been observed in comparable studies.[24] Given that women report higher levels of sleep problems on average,[71] insomnia rates in this sample may be somewhat overestimated. Fourth, although the fully adjusted models included a broad range of covariates, unobserved or residual confounding remains possible. This may include academic demands, environmental factors, and unmeasured sleep-related characteristics.

Fifth, some measures had limitations. The loneliness measure was a modified 4-item UCLA Loneliness Scale from which reverse-coded items were excluded; this version has not been independently validated. Exercise was defined as gym attendance, working out or fitness classes, excluding common activities such as walking and cycling, which may partly explain the null findings for exercise. Sixth, all data were self-reported, which may be subject to response biases and recall errors, particularly for sensitive constructs such as mental health. Seventh, the PHQ-9 includes a sleep item, which may have partly inflated the association between depressive symptoms and insomnia. Sensitivity analyses adjusting for or excluding this item attenuated the cross-sectional association (OR from 2.64 to 1.52, remaining significant) but left the longitudinal associations largely unchanged (online supplemental tables S5–S7), suggesting item overlap contributed to, but did not fully explain, the cross-sectional finding. Eighth, although recovery and emergence were defined using a RCI designed to distinguish genuine change from measurement fluctuation, both remain based on a validated screening instrument rather than confirmed clinical diagnosis. Diagnostic interviews would be needed to confirm that these screening-defined transitions reflect true changes in insomnia disorder status, and future work should consider incorporating clinical assessment to validate screening-defined outcomes. Finally, as participants were drawn from five UK universities, with a female-student-skewed, White-student-skewed and domestic-student-skewed sample, findings may not generalise to more diverse student populations, other types of institutions, or non-UK settings.

Implications

With nearly one-third of students entering university with probable insomnia, there may be value in broader dissemination of evidence-based sleep guidance through existing university communication channels (eg, student portals, email communications and campus-wide health campaigns). Given the association of insomnia with depressive and anxiety symptoms, sleep may be one aspect worth considering alongside mental health in this population, although these data do not show whether doing so would improve outcomes. Students with higher anxiety symptoms at entry had lower odds of recovery, and those with higher depressive symptoms had higher odds of developing insomnia over the year. These associations suggest that such students may be a group in whom insomnia is more likely to persist or emerge, but this would need confirming in other samples.

The associations between longitudinal increases in depressive and anxiety symptoms and worse insomnia severity, and between increases in resilience and less severe insomnia, suggest that interventions targeting these modifiable factors may be worth evaluating for their effects on student sleep. A recent digital mental health literacy course delivered as an accredited undergraduate elective improved resilience, anxiety and depressive symptoms in undergraduates,[72] suggesting that curriculum-based formats could be one way to evaluate such approaches at scale.

Evidence-based interventions such as Cognitive Behavioural Therapy for Insomnia (CBT-I) are recognised as the first-line treatment for insomnia[73 74] and have been found effective in university populations.[75] The present study did not evaluate any treatment, but its findings raise the question of whether such approaches could be tested for students who screen positive for probable insomnia at entry or who do not recover over the first year. Any such approach would require formal clinical assessment to differentiate insomnia disorder from circadian rhythm disorders and other sleep conditions common in this population, and the limited availability of trained therapists may constrain face-to-face delivery, for which digital adaptations may be an alternative. One large Randomised Controlled Trial of 3755 students across 26 UK universities found significant reductions in insomnia alongside secondary improvements in well-being using a digital CBT-I programme.[76] Given that depressive and anxiety symptoms were associated with insomnia in the present

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study, it may be of interest that meta-analytic evidence suggests digital CBT-I produces modest reductions in both alongside improvements in sleep,[77] although whether this applies to the students identified here remains to be tested.

CONCLUSIONS

This large multisite study found that probable insomnia was common at university entry, affecting nearly one-third of first-year students, and was independently associated with depressive and anxiety symptoms, childhood sexual abuse, bullying, alcohol use problems and lower resilience. Among students with insomnia at entry, higher anxiety symptoms were associated with lower odds of recovery over the first academic year, while among those without insomnia, higher depressive symptoms were associated with new onset. Longitudinal increases in depressive and anxiety symptoms were associated with worse insomnia severity at follow-up, while increases in resilience were associated with less severe insomnia. These findings highlight depressive symptoms, anxiety and resilience as factors associated with insomnia in first-year students, though longitudinal and intervention studies are needed to establish whether addressing them would improve sleep.

Author affiliations
[1]School of Psychology, Newcastle University, Newcastle upon Tyne, UK
[2]Department of Psychiatry, Queen's University, Kingston, Washington, Canada
[3]Department of Psychiatry, University of Oxford, Oxford, UK
[4]Faculty of Medicine, University of Southampton, Southampton, UK
[5]Warneford Hospital, Oxford Health NHS Foundation Trust, Oxford, UK
[6]Department of Psychology, King's College London, London, UK
[7]Centre for Mood Disorders Research, University of Exeter, Exeter, UK
[8]School of Medicine, Cardiff University, Cardiff, UK
[9]Autism Research Centre, University of Cambridge, Cambridge, UK

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ORCID iDs
Spyros Spyridonidis https://orcid.org/0000-0003-4864-3438
Anne C Duffy https://orcid.org/0000-0002-5895-075X
Katheryn F Morse https://orcid.org/0000-0001-5409-0652
Nicola C Byrom https://orcid.org/0000-0003-2104-550X
Lucy J Robinson https://orcid.org/0000-0001-5838-8384

REFERENCES

1 Pereira S, Reay K, Bottell J, *et al*. University student mental health survey 2018: a large scale study into the prevalence of student mental illness within UK universities. London Insight Network and Dig-In; 2019. Available: https://uploads-ssl.webflow.com/5611 10743bc7e45e78292140/5c7d4b5d314d163fecdc3706_Mental%20Health%20Report%202018.pdf
2 Duffy A, Saunders KEA, Malhi GS, *et al*. Mental health care for university students: a way forward? *Lancet Psychiatry* 2019;6:885–7.
3 Byrom N, Pointon-Haas J, Upsher R, *et al*. An Argument for More High-Quality Research Focused on Mental Health in the Post-Secondary Context. *Early Intervention Psych* 2025;19:e70002.
4 Gall TL, Evans DR, Bellerose S. Transition to First-Year University: Patterns of Change in Adjustment Across Life Domains and Time. *J Soc Clin Psychol* 2000;19:544–67.
5 Worsley JD, Harrison P, Corcoran R. Bridging the Gap: Exploring the Unique Transition From Home, School or College Into University. *Front Public Health* 2021;9:634285.
6 Bewick B, Koutsopoulou G, Miles J, *et al*. Changes in undergraduate students' psychological well-being as they progress through university. *Studies in Higher Education* 2010;35:633–45.
7 Chung WW, Hudziak JJ. The Transitional Age Brain: 'The Best of Times and the Worst of Times'. *Child Adolesc Psychiatr Clin N Am* 2017;26:157–75.
8 Solmi M, Radua J, Olivola M, *et al*. Age at onset of mental disorders worldwide: large-scale meta-analysis of 192 epidemiological studies. *Mol Psychiatry* 2022;27:281–95.
9 King N, Pickett W, McNevin SH, *et al*. Mental health need of students at entry to university: Baseline findings from the U-Flourish Student Well-Being and Academic Success Study. *Early Interv Psychiatry* 2021;15:286–95.
10 Spyridonidis S, Lad D, Peters H, *et al*. Global prevalence of insomnia symptoms in undergraduate university students: a systematic review and meta-analysis. *Sleep Adv* 2025;6:zpaf083.
11 Baklola M, Terra M, Al-barqi M, *et al*. Prevalence of insomnia among university students in Saudi Arabia: a systematic review and meta-analysis. *Egypt J Neurol Psychiatry Neurosurg* 2024;60:138.
12 Chowdhury AI, Ghosh S, Hasan MF, *et al*. Prevalence of insomnia among university students in South Asian Region: a systematic review of studies. *J Prev Med Hyg* 2020;61:E525–9.
13 Vedaa Ø, Erevik EK, Hysing M, *et al*. Insomnia, sleep duration and academic performance: a national survey of Norwegian college and university students. *Sleep Medicine: X* 2019;1:100005.
14 Duffy A, Keown-Stoneman C, Goodday S, *et al*. Predictors of mental health and academic outcomes in first-year university students:

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Identifying prevention and early-intervention targets. *BJPsych Open* 2020;6:e46.
15 Lindsay JAB, McGowan NM, King N, *et al*. Psychological predictors of insomnia, anxiety and depression in university students: potential prevention targets. *BJPsych Open* 2022;8:e86.
16 Russell K, Allan S, Beattie L, *et al*. Sleep problem, suicide and self-harm in university students: A systematic review. *Sleep Med Rev* 2019;44:58–69.
17 van Straten A, Weinreich KJ, Fábián B, *et al*. The Prevalence of Insomnia Disorder in the General Population: A Meta-Analysis. *J Sleep Res* 2025;34:e70089.
18 Morin CM, Jarrin DC, Ivers H, *et al*. Incidence, Persistence, and Remission Rates of Insomnia Over 5 Years. *JAMA Netw Open* 2020;3:e2018782.
19 Zhang X, Sun Y, Ye S, *et al*. Associations between insomnia and cardiovascular diseases: a meta-review and meta-analysis of observational and Mendelian randomization studies. *J Clin Sleep Med* 2024;20:1975–84.
20 Chan WS, Levsen MP, McCrae CS. A meta-analysis of associations between obesity and insomnia diagnosis and symptoms. *Sleep Med Rev* 2018;40:170–82.
21 Hertenstein E, Feige B, Gmeiner T, *et al*. Insomnia as a predictor of mental disorders: A systematic review and meta-analysis. *Sleep Med Rev* 2019;43:96–105.
22 Saadatfar H, Khademi S, Behdani B, *et al*. Correction to: Insomnia in university students: a review of etiological factors and the advancement of data analytic techniques. *Sleep Breath* 2026;30:197.
23 Foulkes L, McMillan D, Gregory AM. A bad night's sleep on campus: an interview study of first-year university students with poor sleep quality. *Sleep Health* 2019;5:280–7.
24 King N, Pickett W, Keown-Stoneman CDG, *et al*. Changes in sleep and the prevalence of probable insomnia in undergraduate university students over the course of the COVID-19 pandemic: findings from the U-Flourish cohort study. *BJPsych Open* 2023;9:e210.
25 Wang D, Zhao J, Zhai S, *et al*. Longitudinal trajectories of insomnia symptoms among college students during the COVID-19 lockdown in China. *J Psychosom Res* 2022;157:110795.
26 Duffy A. University Student Mental Health: An Important Window of Opportunity for Prevention and Early Intervention. *Can J Psychiatry* 2023;68:495–8.
27 Marshall E, Duffy AC, Chamberlain SR, *et al*. Nurture-U student mental health longitudinal survey: a study protocol. *BMJ Open* 2025;15:e098413.
28 Goodday SM, Rivera D, Foran H, *et al*. U-Flourish university students well-being and academic success longitudinal study: a study protocol. *BMJ Open* 2019;9:e029854.
29 Dooley J, Ghezal A, Gilpin T, *et al*. Assessing the impact of university students' involvement in the first year of Nurture-U: a national student wellbeing research project. *Res Involv Engagem* 2023;9:95.
30 Bifulco A, Brown GW, Harris TO. Childhood Experience of Care and Abuse (CECA): a retrospective interview measure. *J Child Psychol Psychiatry* 1994;35:1419–35.
31 Spitzer RL, Kroenke K, Williams JBW, *et al*. A brief measure for assessing generalized anxiety disorder: the GAD-7. *Arch Intern Med* 2006;166:1092–7.
32 Löwe B, Decker O, Müller S, *et al*. Validation and standardization of the Generalized Anxiety Disorder Screener (GAD-7) in the general population. *Med Care* 2008;46:266–74.
33 Kroenke K, Spitzer RL, Williams JB. The PHQ-9: validity of a brief depression severity measure. *J Gen Intern Med* 2001;16:606–13.
34 Martin A, Rief W, Klaiberg A, *et al*. Validity of the Brief Patient Health Questionnaire Mood Scale (PHQ-9) in the general population. *Gen Hosp Psychiatry* 2006;28:71–7.
35 Stewart-Brown S, Tennant A, Tennant R, *et al*. Internal construct validity of the Warwick-Edinburgh Mental Well-being Scale (WEMWBS): a Rasch analysis using data from the Scottish Health Education Population Survey. *Health Qual Life Outcomes* 2009;7:15.
36 Tennant R, Hiller L, Fishwick R, *et al*. The Warwick-Edinburgh Mental Well-being Scale (WEMWBS): development and UK validation. *Health Qual Life Outcomes* 2007;5:63.
37 Ng Fat L, Scholes S, Boniface S, *et al*. Evaluating and establishing national norms for mental wellbeing using the short Warwick-Edinburgh Mental Well-being Scale (SWEMWBS): findings from the Health Survey for England. *Qual Life Res* 2017;26:1129–44.
38 Vaingankar JA, Abdin E, Chong SA, *et al*. Psychometric properties of the short Warwick Edinburgh mental well-being scale (SWEMWBS) in service users with schizophrenia, depression and anxiety spectrum disorders. *Health Qual Life Outcomes* 2017;15:153.
39 Bush K, Kivlahan DR, McDonell MB, *et al*. The AUDIT alcohol consumption questions (AUDIT-C): an effective brief screening test for problem drinking. Ambulatory Care Quality Improvement Project (ACQUIP). Alcohol Use Disorders Identification Test. *Arch Intern Med* 1998;158:1789–95.
40 Ingesson-Hammarberg S, Molander O, Hammarberg A. Clinical cutoffs of the Alcohol Use Disorder Identification Test for identification of DSM-5 alcohol use disorder: A psychometric evaluation in treatment-seeking patients. *Drug Alcohol Depend* 2024;256:111115.
41 Reinert DF, Allen JP. The alcohol use disorders identification test: an update of research findings. *Alcohol Clin Exp Res* 2007;31:185–99.
42 Smith BW, Dalen J, Wiggins K, *et al*. The brief resilience scale: assessing the ability to bounce back. *Int J Behav Med* 2008;15:194–200.
43 Zhou Z, Ma Z. Evaluating the Brief Resilience Scale in 21 Countries: Psychometric Properties and Measurement Invariance Across Sex, Age, and Countries. *Assessment* 2026;33:765–83.
44 Roberts RE, Lewinsohn PM, Seeley JR. A brief measure of loneliness suitable for use with adolescents. *Psychol Rep* 1993;72:1379–91.
45 Doğan T, Çötok NA, Tekin EG. Reliability and validity of the Turkish Version of the UCLA Loneliness Scale (ULS-8) among university students. *Procedia - Social and Behavioral Sciences* 2011;15:2058–62.
46 Lasgaard M. Reliability and validity of the Danish version of the UCLA Loneliness Scale. *Pers Individ Dif* 2007;42:1359–66.
47 Alsubheen SA, Oliveira A, Habash R, *et al*. Systematic review of psychometric properties and cross-cultural adaptation of the University of California and Los Angeles loneliness scale in adults. *Curr Psychol* 2023;42:11819–33.
48 von Soest T, Mossige S, Stefansen K, *et al*. A Validation Study of the Resilience Scale for Adolescents (READ). *J Psychopathol Behav Assess* 2010;32:215–25.
49 Espie CA, Kyle SD, Hames P, *et al*. The Sleep Condition Indicator: a clinical screening tool to evaluate insomnia disorder. *BMJ Open* 2014;4:e004183.
50 Espie CA, Farias Machado P, Carl JR, *et al*. The Sleep Condition Indicator: reference values derived from a sample of 200 000 adults. *J Sleep Res* 2018;27:e12643.
51 Rubin DB. Multiple Imputation after 18+ Years. *J Am Stat Assoc* 1996;91:473–89.
52 Seaman SR, White IR, Copas AJ, *et al*. Combining multiple imputation and inverse-probability weighting. *Biometrics* 2012;68:129–37.
53 Hair Jr JF, Black WC, Babin BJ, *et al*. Multivariate data analysis. In: *Multivariate data analysis*. CENGAGE, 2010.
54 Sheldon E, Simmonds-Buckley M, Bone C, *et al*. Prevalence and risk factors for mental health problems in university undergraduate students: A systematic review with meta-analysis. *J Affect Disord* 2021;287:282–92.
55 Tadros M, Li S, Upton E, *et al*. Preferences of University Students for a Psychological Intervention Designed to Improve Sleep: Focus Group Study. *JMIR Hum Factors* 2023;10:e44145.
56 Baglioni C, Battagliese G, Feige B, *et al*. Insomnia as a predictor of depression: a meta-analytic evaluation of longitudinal epidemiological studies. *J Affect Disord* 2011;135:10–9.
57 Jansson-Fröjmark M, Lindblom K. A bidirectional relationship between anxiety and depression, and insomnia? A prospective study in the general population. *J Psychosom Res* 2008;64:443–9.
58 Akram U, Akram A, Gardani M, *et al*. The Relationship between Depression and Insomnia Symptoms Amongst a Sample of UK University Students. *Sleep Med Res* 2019;10:49–53.
59 Harvey AG. A cognitive model of insomnia. *Behav Res Ther* 2002;40:869–93.
60 Adams KL, Saunders KE, Keown-Stoneman CDG, *et al*. Mental health trajectories in undergraduate students over the first year of university: a longitudinal cohort study. *BMJ Open* 2021;11:e047393.
61 Palagini L, Moretto U, Novi M, *et al*. Lack of Resilience Is Related to Stress-Related Sleep Reactivity, Hyperarousal, and Emotion Dysregulation in Insomnia Disorder. *J Clin Sleep Med* 2018;14:759–66.
62 Wang J, Zhang X, Simons SR, *et al*. Exploring the bi-directional relationship between sleep and resilience in adolescence. *Sleep Med* 2020;73:63–9.
63 Zhang Y, Li J, Dong J, *et al*. The relationship between sleep quality and psychological resilience of college students: the examination of insomnia as a mediator and attachment as a moderator. *Front Psychol* 2025;16.
64 Desch J, Bakour C, Mansuri F, *et al*. The association between adverse childhood experiences and insomnia symptoms from adolescence to adulthood: Evidence from the Add Health study. *Sleep Health* 2023;9:646–53.

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65 Albers LD, Grigsby TJ, Benjamin SM, *et al*. Adverse childhood experiences and sleep difficulties among young adult college students. *J Sleep Res* 2022;31:e13595.
66 He S, Hasler BP, Chakravorty S. Alcohol and sleep-related problems. *Curr Opin Psychol* 2019;30:117–22.
67 Van Reen E, Roane BM, Barker DH, *et al*. Current Alcohol Use is Associated with Sleep Patterns in First-Year College Students. *Sleep* 2016;39:1321–6.
68 Xie Y, Liu S, Chen X-J, *et al*. Effects of Exercise on Sleep Quality and Insomnia in Adults: A Systematic Review and Meta-Analysis of Randomised Controlled Trials. *Front Psychiatry* 2021;12:664499.
69 Griffin SC, Williams AB, Ravyts SG, *et al*. Loneliness and sleep: A systematic review and meta-analysis. *Health Psychol Open* 2020;7:2055102920913235.
70 Kent de Grey RG, Uchino BN, Trettevik R, *et al*. Social support and sleep: A meta-analysis. *Health Psychol* 2018;37:787–98.
71 Zeng L-N, Zong Q-Q, Yang Y, *et al*. Gender Difference in the Prevalence of Insomnia: A Meta-Analysis of Observational Studies. *Front Psychiatry* 2020;11:577429.
72 Duffy A, King N, Rivera D, *et al*. A longitudinal quasi-experimental study of a pedagogical approach to supporting undergraduate well-being and mental health: digital interdisciplinary accredited elective mental health literacy university course. *BJPsych open* 2026;12:e64.
73 Qaseem A, Kansagara D, Forciea MA, *et al*. Management of Chronic Insomnia Disorder in Adults: A Clinical Practice Guideline From the American College of Physicians. *Ann Intern Med* 2016;165:125–33.
74 Riemann D, Espie CA, Altena E, *et al*. The European Insomnia Guideline: An update on the diagnosis and treatment of insomnia 2023. *J Sleep Res* 2023;32:e14035.
75 Tadros M, Newby JM, Li S, *et al*. A systematic review and meta-analysis of psychological treatments to improve sleep quality in university students. *PLoS One* 2025;20:e0317125.
76 Freeman D, Sheaves B, Goodwin GM, *et al*. The effects of improving sleep on mental health (OASIS): a randomised controlled trial with mediation analysis. *Lancet Psychiatry* 2017;4:749–58.
77 Lee S, Oh JW, Park KM, *et al*. Digital cognitive behavioural therapy for insomnia on depression and anxiety: a systematic review and meta-analysis. *NPJ Digit Med* 2023;6:52.

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