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Being out of sync in academia: psychological, sleep-related and chronobiological factors associated with burnout in higher education students

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ABSTRACT

Objectives: Academic burnout is a growing concern in university settings, yet research has mainly focused on internalizing symptoms such as depression and anxiety. Less attention has been devoted to the role of sleep-related variables, including insomnia and chronotype, in explaining burnout levels. This study aimed to assess the relative contribution of internalizing symptoms and sleep-related factors to academic burnout in university students and to test a moderated mediation model in which insomnia mediated the association between internalizing symptoms and burnout, while chronotype was examined as a potential moderator.
Methods: A total of 625 Italian undergraduate students (mean age = 22.55, 59.7% female) completed standardized self-report measures assessing academic burnout, depressive symptoms, anxiety symptoms, insomnia severity, and chronotype. A hierarchical multiple regression analysis was performed, followed by a moderated mediation model to evaluate indirect effects through insomnia across chronotype categories.
Results: The final regression model explained 68% of the variance in burnout symptoms. Depression and anxiety were significantly and positively associated with burnout. Higher insomnia severity was associated with higher levels of burnout, whereas intermediate and morning chronotypes showed lower burnout levels compared with evening types. The moderated mediation analysis revealed significant indirect effects of depressive and anxious symptoms on burnout through insomnia for most chronotype categories, while the indirect effect for depression was non-significant among morning-type students.
Conclusions: These findings underscore the relevance of both psychological and chronobiological factors in academic burnout. Insomnia appears to be a key mechanism linking internalizing symptoms to burnout.

1. Introduction

Over the past few decades, the university environment has become increasingly challenging, competitive, and emotionally taxing, leading to heightened concerns about students' psychological well-being in higher education. Growing attention has been directed toward the construct of burnout [1]. Within the framework of the demand-resource model [2], burnout is conceptualized as a consequence of the prolonged exhaustion of personal and contextual resources necessary to manage persistent work-related stressors. When demands consistently outweigh available coping capacities, individuals become increasingly vulnerable to the development of burnout symptoms. This model, originally developed for occupational burnout, has been recently adapted to the academic context [3]. In this context, burnout can be defined as a syndrome marked by emotional exhaustion, mental disengagement from academic work, reduced cognitive functioning, and decreased emotional functioning [4]. Academic burnout is among the most prevalent and clinically significant presentations of chronic academic stress, with one-fourth to one-third of students experiencing exhaustion [5], and it has been consistently associated with an elevated risk of academic withdrawal [6], and lower academic performance [1], also posing students' mental and physical health at risk [7].

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1.1. The role of internalizing symptoms

The literature consistently conceptualizes internalizing symptoms (i.e., depression and anxiety) as predictors of occupational burnout [8–10]. Specifically, depression is a condition often compared to occupational burnout due to their partially shared manifestation. Indeed, Freudenberger [11] originally noted that individuals experiencing burnout resemble those with depression, exhibiting symptoms of anhedonia, depressed mood, fatigue, and impaired concentration. This symptomatic overlap has led to ongoing debate among scholars regarding whether burnout and depression are overlapping or distinct conditions. However, several scholars claim that burnout and depression are different psychological constructs, with several evidence supporting this statement [12–15].

Depression has consistently been identified as one of the most significant psychological factors related to occupational burnout [15]. Although the evidence is limited, some studies have also been conducted in academic settings. One study implemented a network analysis approach, where academic burnout was strongly interconnected with symptoms of depression and anxiety in medical students [16]. Also, a cross-sectional study conducted among dental students found significant associations between burnout and depression [17].

Although studies have reported an association between workplace burnout and anxiety symptoms [18], research on this relationship in academic contexts remains limited. While fewer in number, studies on students have also begun to highlight this relationship. Two exceptions are provided by Fernández-Castillo [19] who found a significant association between burnout and anxiety in high school students preparing for university entrance exams, and by more recent investigations involving university students [20], and medical students [16]. Another study conducted on adolescents found that academic anxiety mediates the relationship between academic stress and academic burnout [21]. It is therefore important to further examine the occurrence of this relationship in higher education populations.

1.2. The role of sleep-related factors

In recent years, there has been increased attention to sleep-related factors that can contribute to burnout [22]. Indeed, anxiety and depression often adversely affect sleep, leading to challenges in sleep onset and maintenance, disrupted sleep patterns, and increased pre-sleep arousal. Thus, insomnia may function as mediator through which internalizing symptoms might impact on academic burnout. Insomnia, may contribute to the onset of burnout by compromising the restorative function of sleep. Indeed, sleep disturbances impair the recovery of neurophysiological resources, such as executive functioning, emotional regulation, and stress reactivity [23], all of which are crucial for managing the emotional and cognitive demands of an academic setting. Also, insomnia, especially when chronic, may lead to a state of allostatic overload, whereby the body's stress-regulation systems—including the hypothalamic-pituitary-adrenal (HPA) axis—remain activated for a prolonged time, resulting in increased vulnerability to strain, exhaustion, and burnout [24].

In the context of work-related burnout, evidence regarding the association with sleep is extensive [25–27]. However, research in the academic context is scant, while the role of sleep may be especially important for students. University students are frequently required to adapt to significant life changes, including relocating from their family homes, adjusting to new academic environments, and sharing living spaces with roommates. These transitions often involve modifications in daily routines and study schedules, which can disrupt established sleep-wake patterns. Indeed, 7.7% of college students fit all the criteria for an insomnia condition [28] while up to 60% of all students have poor sleep quality [29]. Two studies are available, conducted respectively by Allen et al. and Wolf et al., which found that in students, poor sleep quality and shorter sleep duration are associated with higher levels of burnout in university students [30,31]. However, the study conducted by Allen considered only stress, while the one by Wolf et al. focused exclusively on depression.

In the sleep research field, there is one aspect of great interest that remains poorly investigated– chronotype, defined as the individual's preference for the timing of sleep and activity within the 24-h cycle [32]. Chronotype is typically categorized into three types: *morning types*, who experience peak alertness and performance in the early part of the day; *evening types*, who feel more energetic and function better during the late afternoon or evening hours; and *intermediate types*, who do not exhibit a marked temporal preference and generally adapt well to conventional daily schedules. Evening-type individuals show a heightened vulnerability to a wide spectrum of psychological disorders, such as depression [33]. Although some emerging evidence suggests that evening-type individuals may also be more susceptible to burnout, such as in nursing students [34] and among evening shift workers [35,36], these findings remain limited and highly context-specific as they pertain to narrowly defined populations and occupational settings that may not reflect the broader student population. Interestingly, chronotype may moderate the proposed mediational pathway, such that the indirect effect of internalizing symptoms on burnout through insomnia varies according to individuals' circadian preference.

1.3. Aims

Thus, the present cross-sectional study will investigate the relationship between internalizing symptoms (i.e., depression and anxiety), sleep-related factors (i.e., insomnia and chronotype), and burnout in a sample of Italian University students. In addition, as an exploratory objective, we will implement a moderated mediation model in which anxiety and depressive symptoms will be specified as independent variables, insomnia will be entered as the mediating factor, and academic burnout will be designated as the outcome. Chronotype will be included as a moderator influencing the paths linking predictors to the mediator and the mediator to the outcome in order to determine whether the indirect effects of internalizing symptoms on academic burnout via insomnia vary as a function of chronotype type.

2. Participants and methods

2.1. Participants and procedure

This study was conducted using a cross-sectional design. This data collection took place as part of a larger study registered under the PRISMA project. Participants were recruited through a convenience sampling procedure and were eligible for inclusion if they: (1) were at least 18 years old; (2) were enrolled in an undergraduate program at an Italian university; and (3) had sufficient proficiency in the Italian language to complete the self-report questionnaires. Exclusion criteria included the presence of previously diagnosed physical or psychiatric disorders, as self-reported by participants. Trained researchers visited multiple classrooms and briefly introduced the objectives of the study to students. Those who expressed interest in participating were provided with additional information about the study aims, procedures, and ethical safeguards, and were subsequently asked to provide written informed consent. Questionnaires were completed anonymously in classroom settings, with the presence of trained researchers available to provide clarifications while students accessed the survey via a secure online link. Data collection was anonymous and conducted following the Declaration of Helsinki, and received formal approval from the Research Ethics Committee [edited for blind review] (Prot. no 2024- 234034).

The final sample consisted of 625 university students from 17 undergraduate programs at the University of Modena and Reggio Emilia. These programs spanned different disciplinary areas, including the humanities (e.g., law), science and technology (e.g., engineering), and health sciences (e.g., physiotherapy). The sample included 373 females

and 252 males with a mean age of 22.55 ± 3.82.

2.2. Measures

Burnout symptoms were assessed using the Burnout Assessment Tool-C short-form adapted for students (BAT-C short form) [37,38], a validated 12-item self-report measure comprising four subscales: exhaustion, mental distance, cognitive impairment, and emotional impairment. Each subscale consists of three items rated on a five-point Likert scale. To compute the global burnout score, item responses were first summed to obtain a total raw score. This sum was then divided by the number of items. In this sample, the scale showed excellent reliability, with a Cronbach's alpha of α = .90.

Anxiety was evaluated with the Beck Anxiety Inventory (BAI) [39,40], a 21-item scale measuring the severity of somatic and cognitive anxiety symptoms over the past week. Respondents indicate how much they have been bothered by each symptom during the past week, using a 4-point Likert scale ranging from 0 (not at all) to 3 (severely – it bothered me a lot). The total score ranges from 0 to 63, with higher scores indicating greater levels of anxiety. Cronbach's alpha was computed to assess the internal consistency of the scale in the current sample, yielding a value of α = .95.

Depressive symptoms were assessed using the Beck Depression Inventory-II (BDI-II) [40,41], a widely used 21-item instrument measuring depressive symptomatology. Respondents rate the severity of each symptom over the past two weeks using a 4-point Likert scale ranging from 0 (absence of symptoms) to 3 (severe symptoms), resulting in a total score ranging from 0 to 63. The instrument showed excellent internal consistency in the present sample, as indicated by a Cronbach's alpha coefficient of α = .92.

Insomnia symptoms were measured with the Insomnia Severity Index (ISI) [42,43]. It consists of 7 items evaluating key dimensions of insomnia, including difficulty falling asleep, difficulty maintaining sleep, early morning awakenings, satisfaction with sleep, interference with daytime functioning, noticeability of sleep problems by others, and distress caused by sleep difficulties. Each item is rated on a 5-point Likert scale ranging from 0 (no problem) to 4 (very severe problem), resulting in a total score that can range from 0 to 28. In the present sample, the scale demonstrated good internal consistency, with a Cronbach's alpha of α = .87.

Chronotype was determined using the Morningness–Eveningness Questionnaire (MEQ), which classifies individuals along a morningness-eveningness continuum [32,44]. The MEQ comprises 19 multiple-choice items that explore preferred timing for waking, sleeping, and engaging in mental or physical tasks throughout the day. Each response option is scored on a weighted scale, yielding a total score ranging from 16 to 86. Higher scores indicate a stronger morning preference (i.e., morningness), whereas lower scores reflect a preference for evening activity (i.e., eveningness). Based on normative cutoffs, individuals are typically classified into five categories: definite morning type, moderate morning type, intermediate type, moderate evening type, and definite evening type. However, in our sample, the extreme chronotype categories (i.e., definite morning and definite evening types) included fewer than 10 participants each. Therefore, to ensure sufficient statistical power, these categories were merged with their adjacent groups, resulting in three final categories: morning type (definite + moderate morning), evening type (definite + moderate evening), and intermediate type. Internal consistency reliability was found to be acceptable, with a Cronbach's alpha value of α = .75, in the current sample.

2.3. Statistical analysis

An a priori power analysis was conducted using G*Power (version 3.1.9.7) to determine the required sample size for a multiple linear regression analysis. Assuming a small effect size ($f^2 = 0.02$), an alpha error probability of 0.05, a desired statistical power of 0.80, and specifying 4 tested predictors out of a total of 6 predictors in the model, the analysis indicated that a minimum sample size of 602 participants was required to detect the hypothesized effects. The moderated mediation analyses should be considered exploratory, as no dedicated power analysis for interaction effects was performed.

Pearson's correlation coefficients were computed to examine bivariate correlations among the study variables. To examine the association between psychological and sleep-related factors and academic burnout, a hierarchical multiple linear regression analysis was conducted. Model 0 included sociodemographic covariates: age (in years), sex assigned at birth (male/female). Model 1 included scores on the BDI and BAI. In the Model 2, we added ISI scores and MEQ categories. For the analysis, chronotype was treated as a categorical variable with three levels (morning-type, intermediate-type, evening-type); the evening-type category was used as the reference group in the regression models. Model fit was evaluated using R^2 and adjusted R^2. The contribution of factors in each model was tested via F-change statistics. To examine the mechanisms linking internalizing symptoms to academic burnout, we estimated a moderated mediation model in which depressive (BDI) and anxiety symptoms (BAI) were entered as independent variables (respectively, X_1 and X_2), insomnia symptoms (ISI) were specified as the mediator (M), and academic burnout (BAT) served as the dependent variable (Y). Chronotype was included as a categorical moderator (W), with morning type set as the reference category.

Indirect effects corresponded to the $a \times b$ pathways from BDI and BAI to BAT through ISI. Direct effects (c') represented the association between each predictor and burnout after controlling for the mediator, whereas total effects ($c = c' + a \times b$) represented the overall relation between internalizing symptoms and burnout. Indirect and conditional indirect effects were estimated using bias-corrected bootstrapping with 5000 resamples. Statistical significance was determined by 95% confidence intervals that did not include zero, and conditional indirect effects were evaluated across chronotype categories. All statistical analyses were performed using JASP [45].

3. Results

Descriptive statistics for the main study variables are presented in Table 1.

3.1. Correlation analysis

Since the Shapiro–Wilk tests revealed significant deviations from normality for the majority of variables ($p < .001$), we performed both Pearson's and Spearman's correlation analyses to assess bivariate

Table 1
Results of descriptive statistics (N = 625).

Variable	Mean	SD	Min–Max	Frequency (%)	Theoretical range
Age (in years)	22.55	3.82	18-55		
Sex (0 = M, 1 = F)	—	—	—	F: 59.7%, M: 40.3%	
BDI	11.29	9.33	0–61	—	0-63
ISI	7.54	6.31	0–28	—	0-28
MEQ (1 = Evening_type, 2 = Intermediate-type, 3 = Morning-type)	—	—	—	1: 32.96%, 2: 50.56% 3: 16.48%	18-86
BAI	13.86	13.24	0–63	—	0-63
BAT	2.46	0.80	1–5	—	1-5

Note: BAI = Beck Anxiety Inventory; BDI = Beck Depression Inventory-II; BAT = Burnout Assessment Tool; ISI = Insomnia Severity Index; MEQ = Morningness-Eveningness Questionnaire.

Table 2
Pearson's r and Spearman's rho correlation table.

Variable		BAI		BDI		BAT		ISI		MEQ
1. BAI	Pearson's r	—								
2. BDI	Pearson's r	0.63	***	—						
3. BAT	Pearson's r	0.60	***	0.72	***	—				
4. ISI	Pearson's r	0.56	***	0.62	***	0.70	***	—		
5. MEQ	Pearson's r	−0.32	***	−0.39	***	−0.54	***	−0.45	***	—

Note: BAI = Beck Anxiety Inventory; BDI = Beck Depression Inventory-II; BAT = Burnout Assessment Tool; ISI = Insomnia Severity Index; MEQ = Morningness-Eveningness Questionnaire. *$p < .05$, **$p < .01$, ***$p < .001$.

associations (see Table 2). However, in the table below we report only Pearson's correlations, as both correlation methods yielded comparable results.

3.2. Assumption checks

Assumptions were examined before the hierarchical linear regression was performed. Inspection of the Q-Q plot of standardized residuals indicated that the assumption of normality was met. Autocorrelation of residuals was tested using the Durbin-Watson statistic. All models showed values close to 2 (Model 0 = 1.972; Model 1 = 1.909; Model 2 = 1.956).

The residuals-versus-predicted values plot, which was used to assess the assumption of homoscedasticity, showed a random distribution of residuals devoid of discernible patterns. Multicollinearity was assessed using tolerance and Variance Inflation Factor (VIF) values. Collinearity statistics were within acceptable limits across all models. Tolerance values ranged from 0.584 to 0.997 and VIF values from 1.00 to 1.712, indicating no concerns regarding multicollinearity.

Finally, influential cases and possible outliers were inspected using standardized residuals and Cook's distance. Even though there were five cases with standardized residuals greater than ±3.0, none of them exceeded a Cook's distance of 1.

3.3. Linear regression results

A hierarchical linear regression analysis was conducted to examine the association with depression, anxiety, insomnia and chronotype with academic burnout.

In Model 0, sex assigned at birth (0 = male, 1 = female) and age (in years) were entered as control variables. The model was statistically significant, $F(2, 622) = 3.72$, $p = .02$, though it accounted for only a small proportion of variance in burnout ($R^2 = 0.01$; Adjusted $R^2 = 0.01$). Within this model, sex was marginally significant ($B = 0.13$, $t = 2.01$, $p = .05$). Age was not significantly associated ($B = -0.02$, $\beta = -0.08$, $p = .06$).

In Model 1, depression (BDI) and anxiety (BAI) symptoms were added as independent variables alongside the control variables. The model was statistically significant, $F(4, 620) = 193.82$, $p < .001$, and explained a substantial proportion of the variance in burnout ($R^2 = 0.56$; Adjusted $R^2 = 0.56$), representing a 55% increase in explained variance ($\Delta R^2 = 0.55$). Both depression ($B = 0.05$, $\beta = 0.56$, $p < .001$) and anxiety ($B = 0.02$, $\beta = 0.26$, $p < .001$) were significantly associated with burnout. Age became statistically significant ($B = -0.01$, $\beta = -0.07$, $p = .01$), suggesting that younger students reported higher levels of burnout. The effect of sex was not statistically significant ($B = -0.08$, $p = .08$).

In Model 2, sleep-related variables were introduced: insomnia severity (ISI) and chronotype (MEQ). The model remained statistically significant, $F(7, 617) = 186.06$, $p < .001$, and accounted for a greater proportion of variance ($R^2 = 0.68$; Adjusted $R^2 = 0.68$), with an additional 12% of variance explained ($\Delta R^2 = 0.12$, $p < .001$). Within this model, depression ($B = 0.03$, $\beta = 0.35$, $p < .001$), anxiety ($B = 0.01$, $\beta = 0.14$, $p < .001$), and insomnia severity ($B = 0.04$, $\beta = 0.30$, $p < .001$) remained significantly associated with burnout. Chronotype also showed a significant effect: compared to evening types, students with an intermediate chronotype ($B = -0.36$, $p < .001$) and morning types ($B = -0.49$, $p < .001$) reported significantly lower levels of burnout. Age remained significantly associated ($B = -0.01$, $\beta = -0.06$, $p = .007$), while sex remained non-significant ($B = 0.07$, $p = .085$). Results are reported in Table 3.

3.4. Moderated mediation results

3.4.1. Moderation analyses

To examine whether chronotype moderated the associations linking depressive symptoms, anxiety, insomnia, and academic burnout, all interaction terms concerning morningness–eveningness (MEQ) were included in the models. Chronotype was dummy-coded using morning type as the reference category, resulting in two indicators: MEQ1 (intermediate vs. morning) and MEQ2 (evening vs. morning). Interaction terms were computed by multiplying each predictor by the corresponding dummy variable. As reported in Table 4, none of the interaction resulted statistically significant (all $p > .11$). This indicates that chronotype did not significantly alter the direct associations between depressive symptoms/anxiety and insomnia, nor the associations between insomnia and burnout. To examine whether chronotype moderated the associations among depressive symptoms, anxiety symptoms, insomnia, and burnout, all interaction terms were entered into the regression models. None of the interaction effects reached statistical significance, indicating no evidence of moderation.

3.4.2. Conditional indirect effects

Finally, the indirect effects of internalizing symptoms on academic burnout through insomnia were examined separately for each chronotype category. Given the presence of a categorical moderator—namely, chronotype as defined by MEQ categories—the moderated mediation analysis yielded three distinct indirect effects (internalizing symptoms → insomnia → academic burnout), corresponding to each level of the moderator. The conditional indirect, direct, and total effects for each chronotype level (morning, intermediate, and evening types) are reported in Table 5.

3.5. Conditional indirect effects of insomnia in the association between depressive symptomatology and academic burnout

A significant indirect effect of depressive symptoms on academic burnout through insomnia emerged for intermediate types ($\beta = 0.095$, $p < .001$), and evening types ($\beta = 0.115$, $p < .001$). Importantly, the indirect effect was not significant among morning types ($\beta = 0.067$, $p = .104$).

Among intermediate and evening chronotypes, depressive symptoms exhibited a significant indirect association with academic burnout through insomnia. In these groups, higher depressive symptomatology was related to insomnia, which in turn predicted increased burnout levels, indicating that insomnia functions as a key mechanism linking depression and academic exhaustion. The indirect pathway was stronger among evening types compared with intermediate types, suggesting heightened vulnerability in individuals with delayed circadian

Table 3
Results of hierarchical linear regression predicting academic burnout.

		B	SE	β	t	p	95% CI	
							Lower	Upper
M_0	Sex (1)	0.13	0.06		2.01	0.05	0.00	0.257
	Age	−0.02	0.01	−0.08	−1.87	0.06	−0.03	7.630×10^{-4}
M_1	Age	−0.01	0.01	−0.07	−2.51	0.01	−0.03	−0.01
	Sex (1)	−0.08	0.05		−1.734	0.08	−0.17	0.01
	BDI	0.05	0.01	0.56	16.37	<0.001	0.04	0.05
	BAI	0.02	0.01	0.26	7.29	<0.001	0.01	0.02
M_2	Age	−0.01	0.01	−0.06	−2.72	0.007	−0.02	−0.01
	Sex (1)	0.07	0.04		1.73	0.085	−0.01	0.18
	BDI	0.03	0.01	0.35	10.58	<0.001	0.02	0.04
	BAI	0.01	0.01	0.14	4.58	<0.001	0.01	0.01
	MEQ (Intermediate)	−0.36	0.05		−7.63	<0.001	−0.45	−0.26
	MEQ (Morning-type)	−0.49	0.06		−8.04	<0.001	−0.61	−0.37
	ISI	0.04	0.01	0.30	9.38	<0.001	0.03	0.05

Model statistics

	Model 0	Model 1	Model 2
R [2]	0.01	0.56	0.68
Adjusted R^2	0.01	0.56	0.67
ΔR^2	–	0.55	0.12
F	3.72	193.82	186.06
p	0.02	<0.001	<0.001

Note: BAI = Beck Anxiety Inventory; BDI = Beck Depression Inventory-II; ISI = Insomnia Severity Index; MEQ = Morningness-Eveningness Questionnaire. Sex assigned at birth coded as 0 = male, 1 = female.

Table 4
Moderation effects of chronotype on the associations among depressive symptoms, anxiety, insomnia, and academic burnout.

Interaction Term	Estimate	SE	95% CI	β	z	p
Predicting Insomnia (ISI)						
BDI × MEQ1 → ISI	−0.09745	0.10098	[−0.28446, 0.11104]	−0.05362	−0.965	0.335
BDI × MEQ2 → ISI	−0.01029	0.05492	[−0.13354, 0.10471]	−0.00750	−0.187	0.851
BAI × MEQ1 → ISI	0.09728	0.06237	[−0.03209, 0.20547]	0.07796	1.560	0.119
BAI × MEQ2 → ISI	0.04338	0.03736	[−0.05132, 0.12033]	0.04476	1.161	0.246
Predicting Burnout (BAT)						
BDI × MEQ1 → BAT	0.00905	0.01037	[−0.01457, 0.02775]	0.03959	0.873	0.383
BDI × MEQ2 → BAT	−0.00369	0.00588	[−0.01850, 0.01091]	−0.02138	−0.628	0.530
BAI × MEQ1 → BAT	0.00309	0.00650	[−0.01258, 0.01884]	0.01965	0.475	0.635
BAI × MEQ2 → BAT	−0.00079	0.00387	[−0.00901, 0.00865]	−0.00645	−0.203	0.839
ISI × MEQ1 → BAT	0.00542	0.01182	[−0.03710, 0.04306]	0.02142	0.458	0.647
ISI × MEQ2 → BAT	0.00753	0.00859	[−0.01134, 0.02690]	0.05147	0.877	0.380

Note: MEQ1 represents intermediate chronotype versus morning type, whereas MEQ2 represents evening chronotype versus morning type. BDI: Beck Depression Inventory; BAI: Beck Anxiety Inventory; ISI: Insomnia Severity Index; BAT: Burnout Assessment Tool; MEQ: Morningness–Eveningness Questionnaire.

Table 5
Conditional indirect, direct, and total effects of depressive (BDI) and anxiety (BAI) symptoms on academic burnout through insomnia (ISI) across chronotype levels.

Chronotype	Effect Type	Estimate	SE	95% CI	β	z	p
Intermediate	Indirect (BDI ⇒ ISI ⇒ BAT)	0.00812	0.00165	[0.00489, 0.01136]	0.0954	4.92	<0.001
	Indirect (BAI ⇒ ISI ⇒ BAT)	0.00310	0.00094	[0.00125, 0.00495]	0.0516	3.28	0.001
	Direct (BDI ⇒ BAT)	0.03074	0.00417	[0.02256, 0.03891]	0.3609	7.37	<0.001
	Direct (BAI ⇒ BAT)	0.00795	0.00269	[0.00268, 0.01321]	0.1324	2.96	0.003
	Total (BDI ⇒ BAT)	0.03886	0.00433	[0.03038, 0.04735]	0.4539	8.98	<0.001
	Total (BAI ⇒ BAT)	0.01104	0.00284	[0.00547, 0.01661]	0.1830	3.89	<0.001
Morning	Indirect (BDI ⇒ ISI ⇒ BAT)	0.00577	0.00356	[-0.00120, 0.01274]	0.0674	1.62	0.104
	Indirect (BAI ⇒ ISI ⇒ BAT)	0.00731	0.00227	[0.00286, 0.01176]	0.1210	3.22	0.001
	Direct (BDI ⇒ BAT)	0.03979	0.00927	[0.02163, 0.05795]	0.4644	4.29	<0.001
	Direct (BAI ⇒ BAT)	0.01103	0.00569	[-0.00012, 0.02219]	0.1827	1.94	0.053
	Total (BDI ⇒ BAT)	0.04556	0.00988	[0.02619, 0.06494]	0.5322	4.61	<0.001
	Total (BAI ⇒ BAT)	0.01834	0.00603	[0.00653, 0.03015]	0.3040	3.04	0.002
Evening	Indirect (BDI ⇒ ISI ⇒ BAT)	0.00990	0.00179	[0.00638, 0.01342]	0.1151	5.52	<0.001
	Indirect (BAI ⇒ ISI ⇒ BAT)	0.00527	0.00119	[0.00295, 0.00760]	0.0870	4.45	<0.001
	Direct (BDI ⇒ BAT)	0.02674	0.00383	[0.01922, 0.03425]	0.3109	6.98	<0.001
	Direct (BAI ⇒ BAT)	0.00744	0.00267	[0.00220, 0.01268]	0.1227	2.78	0.005
	Total (BDI ⇒ BAT)	0.03664	0.00396	[0.02887, 0.04440]	0.4279	9.25	<0.001
	Total (BAI ⇒ BAT)	0.01271	0.00280	[0.00722, 0.01821]	0.2107	4.54	<0.001

preference. The conceptual model is depicted in Fig. 1.

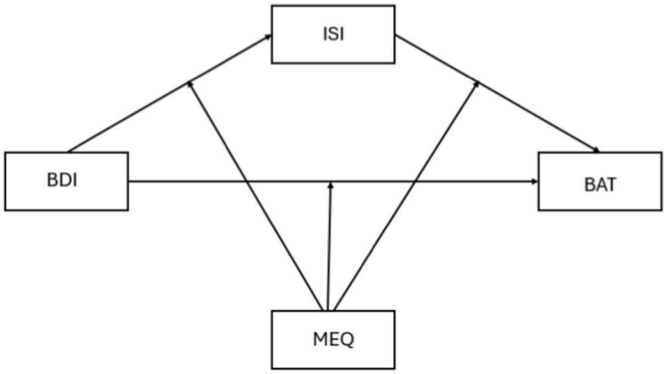

Fig. 1. Moderated mediation model testing the indirect effect of depressive symptoms (BDI) on academic burnout through insomnia (ISI), with chronotype (MEQ) functioning as a categorical moderator.

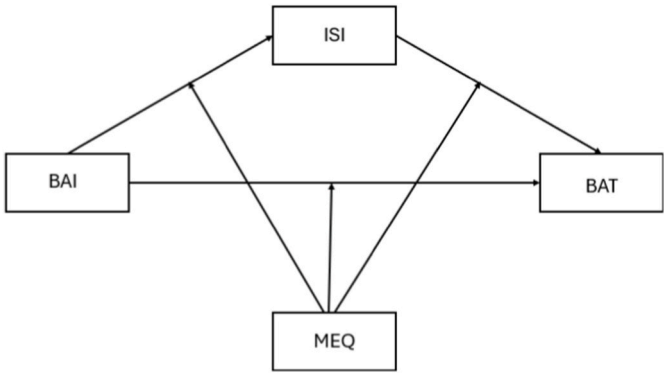

Fig. 2. Moderated mediation model testing the indirect effect of anxiety symptoms (BAI) on academic burnout through insomnia (ISI), with chronotype (MEQ) functioning as a categorical moderator.

3.6. Conditional indirect effects of insomnia in the association between anxiety and academic burnout

A similar configuration was observed for anxiety (see Fig. 2). Significant indirect effects were found for intermediate types ($\beta = 0.052$, $p = .001$), morning types ($\beta = 0.121$, $p = .001$), and evening types ($\beta = 0.087$, $p < .001$). Unlike the depression pathway, the mediation through insomnia for anxiety was significant across all chronotype categories.

3.6.1. Direct and total effects

Both depression and anxiety retained significant direct effects on burnout across all chronotypes. Total effects are significant for both depression and anxiety across all chronotype categories. This pattern indicates that internalizing symptoms are associated with academic burnout and that insomnia only partially explained this relationship.

4. Discussion

The present study aimed i) to examine the association between internalizing symptoms (i.e., depressive and anxiety symptomatology), sleep-related factors (i.e., insomnia symptoms and chronotype), and academic burnout in a large sample of Italian university students, and ii) to test a moderated mediation model in which insomnia mediated the links between internalizing symptoms and burnout while chronotype was evaluated as a potential moderator.

4.1. Internalizing symptoms

Depression and anxiety emerged as significantly associated with burnout, as expected and in line with the previous few evidence available on university students. Specifically, higher levels of anxiety and depressive symptoms are associated with higher levels of academic burnout. Importantly, both anxiety and depressive symptoms remained significant even after the addition of sleep-related factors, indicating the strong association between internalizing symptoms levels and burnout.

This result aligns with a study that implemented a network analysis approach, where academic burnout was strongly interconnected with symptoms of depression and anxiety in medical students [16]. Also, a cross-sectional study conducted among dental students found significant associations between burnout and depression, and between depression and suicidal ideation, whereas burnout was not significantly related to suicidal ideation [17]. It is worth noting, however, that these studies focused on specific student populations (i.e., medical and dental students), which may limit the generalizability of their findings. In contrast, our study encompasses students from a variety of academic fields, providing more broadly applicable insights.

Our findings can be explained within the framework of the Job Demands–Resources Model [2], which posits that burnout results from a chronic imbalance between external demands and the individual's resources. In academic settings, students are exposed to sustained pressures related to examinations, deadlines, workload, and performance expectations. Anxiety and depression might not merely co-occur with burnout but actively contribute to the depletion of the psychological resources required to cope with such demands. Indeed, anxiety might amplify students' perception of academic demands as uncontrollable and threatening, which increases cognitive load and emotional strain. Depressive symptoms such as diminished energy, anhedonia, low motivation, and impaired self-worth might directly reduce engagement with academic tasks.

4.2. Sleep-related factors

Insomnia symptoms showed a significant association with the levels of burnout. In detail, higher levels of insomnia were associated with higher levels of burnout. A study conducted in the academic context highlights a bidirectional relationship between burnout and sleep disturbances in medical students, showing that emotional exhaustion and daytime sleepiness mutually influence each other [46]. Furthermore, daytime sleepiness resulted associated with increased cynicism and reduced academic efficacy (two dimensions of the burnout construct according to the Maslach Burnout Inventory) [46]. Our findings build upon these previous results and contribute to expanding the limited body of evidence available within the academic context.

Evening type resulted a significant factor related to burnout levels. In academic settings, students with an evening chronotype might experience a misalignment between their biological rhythms and institutional schedules (e.g., early morning classes). This leads to “social jetlag,” which is a chronic state of sleep debt and circadian disruption that can result in chronic sleep deprivation, impaired attention, and lower academic performance [47]. In the academic context, nursing students with an evening chronotype, compared to those with a morning chronotype, showed significantly higher academic burnout [48]. In line, Önder et al. identified eveningness as the strongest predictor of burnout in university students, outweighing other sleep-related factors such as average sleep duration and social jetlag [49]. Our findings are in line with these preliminary results and extend them to a sample of university students from various academic fields. Importantly, neither of the two previous studies accounted for internalizing symptoms such as anxiety and depression, whereas our study included these variables. This allows us to hypothesize that sleep-related variables—namely, insomnia and chronotype—seem to be associated with academic burnout, above and beyond the effects of anxiety and depression.

4.3. Moderated mediation analysis and conditional indirect effect

Insomnia emerged as a significant mediating factor through which both depressive and anxious symptoms contribute to burnout. Thus, higher levels of internalizing symptoms were associated with greater insomnia, which in turn was associated with increased academic burnout.

Our results seem to suggest that they exert their effect partially through the disruption of sleep. This is in line with evidence that conceptualize sleep disturbance as a core transdiagnostic mechanism underlying psychological impairment [50,51]. To date, there are very few studies evaluating the role of insomnia as a contributing factor to burnout, and no studies evaluate this aspect in academic burnout. An exception is provided by a recent study conducted by Switaj et al., found that insomnia mediates the longitudinal association between loneliness and occupational burnout among nurses [52].

Although causal inferences cannot be drawn from this design, our findings suggest that targeting insomnia may attenuate the strength of the association between anxiety, depression, and academic burnout, indicating that sleep disturbances represent a potential intervention target. However it should be noted that stablishing a clear causal direction remains challenging, as these domains likely interact in a dynamic and mutually reinforcing manner [50].

A recent study provides support for the potential relevance of sleep-focused interventions in mitigating burnout. In a simple two-week protocol, participants replaced their usual alarm with a sunrise alarm clock and turned off their smartphone and electronic devices at bedtime, without modifying any other behaviors [53]. This intervention led to improved sleep quality and a reduction in burnout symptoms. These findings suggest that even small, feasible adjustments to sleep-related routines may have impact symptoms to burnout.

The moderated mediation analyses did not provide evidence that chronotype significantly moderated the indirect associations between internalizing symptoms and academic burnout through insomnia. Thus, chronotype does not seem to operate as a moderator of the mediational pathways linking depressive and anxious symptoms to burnout. Although no interaction effects emerged, indirect effects through insomnia were estimated separately for each chronotype group. According to our results, for the depression pathway, the indirect effect was not significant among morning types. While chronotype did not significantly moderate the mediational pathways in inferential terms, the pattern of conditional indirect effects indicates that the role of insomnia in linking depressive symptoms to burnout may be less salient among morning-type students. This finding should be interpreted as descriptive heterogeneity rather than evidence of differential mechanisms across chronotypes.

4.4. Future directions

Longitudinal research designs are essential to clarify the directionality of associations among depressive symptoms, anxiety, insomnia, and burnout. Network analytic approaches also represent a promising methodology for investigating how individual symptoms interact within a dynamic system. Such models can identify symptom-level “bridge nodes” that link internalizing distress, sleep disturbances, and burnout. Moreover, future studies should incorporate multimethod assessment strategies, including objective sleep metrics (e.g., actigraphy), ecological momentary assessment of academic stressors, mood and sleep, and more comprehensive covariate sets to account for contextual and lifestyle factors such as academic workload and chronotype–schedule misalignment.

4.5. Limitations

Several limitations of the present study must be acknowledged. The cross-sectional design precludes any causal inference regarding the directionality of associations among internalizing symptoms, sleep-related variables, and academic burnout. In other words, it remains unclear whether internalizing symptoms lead to sleep disturbances and subsequent burnout, or whether these processes unfold bidirectionally over time. Future research should adopt longitudinal designs to clarify the temporal relationships between insomnia, chronotype, internalizing symptoms, and burnout. Moreover, experimental studies are warranted to assess whether improving sleep quantity and quality, or reducing circadian misalignment, leads to meaningful reductions in burnout symptoms. No objective measures of sleep or circadian patterns (e.g., actigraphy, melatonin onset) were included, which limits the precision in characterizing chronotype. Even if the sample was relatively large, it was drawn exclusively from a single Italian university, which may restrict the generalizability of the findings to students from other institutions, cultural backgrounds, or educational systems. A further limitation concerns the high proportion of variance explained in the regression models. Although all multicollinearity diagnostics fell within acceptable thresholds, the substantial shared variance among depressive symptoms, anxiety, insomnia, and burnout may have contributed to the high explained variance. These constructs are conceptually interrelated and assessed through self-report measures, which may introduce common method variance and reduce the ability to isolate small unique effects.

5. Conclusions

To our knowledge, this is the first study to investigate the contribution of internalizing symptoms, insomnia, and chronotype in predicting academic burnout among university students. These findings expand upon previous evidence by addressing both psychological and sleep-related factors in relation to academic burnout. The significant association found between anxiety, depression, insomnia, and chronotype suggests that integrating psychological and sleep-related aspects screening and interventions might help to prevent and manage burnout in university students. Our findings highlight the importance of assessing symptoms of anxiety and depression, which emerged as significantly associated with academic burnout. Early identification may allow for the timely implementation of evidence-based psychological treatments, such as cognitive-behavioral therapy. In addition, universities could implement flexible teaching modalities to accommodate students' circadian preferences. For instance, blended learning formats—combining in-person and online attendance—and the systematic provision of video-recorded lectures may allow students, particularly those with an evening chronotype, to engage with academic content at times that better match their peak cognitive performance. Such adjustments could reduce the chronic misalignment between biological rhythms and academic demands, potentially fostering both learning outcomes and mental health.

CRediT authorship contribution statement

Giorgia Varallo: Writing – original draft, Methodology, Conceptualization. **Matteo Reho:** Formal analysis, Data curation. **Elisabetta Ferrari:** Writing – review & editing, Data curation. **Alessia Scarano:** Writing – review & editing, Data curation. **Michela Camia:** Writing – review & editing, Data curation. **Loris Vezzali:** Writing – review & editing, Supervision. **Maristella Scorza:** Writing – review & editing, Supervision, Project administration.

Statement

During the preparation of this work no Generative AI was used.

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Declaration of competing interest

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