Lifestyle Risk Factors and Health Indicators in Students at a Bavarian University: A Cross-Sectional Study of Physical Activity, Diet, Stress, Sleep Quality, and Body Mass Index

Lifestyle Risk Factors and Health Indicators in University Students

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ABSTRACT

This study aimed to assess the frequency of selected lifestyle risk factors and health indicators among university students, and to examine their interrelationships and variation according to demographic and academic characteristics.

A cross-sectional study was conducted using an online survey among students (n = 106) at the Deggendorf Institute of Technology (DIT), a higher education institution in Bavaria, Germany. Sleep quality/insomnia and increased BMI were assessed as health indicators, while stress, physical activity, and diet were evaluated as lifestyle risk factors. Information on demographic and academic characteristics was also collected. Descriptive statistics were used to summarize the study variables. Differences in categorical outcomes across levels of continuous predictors were assessed using Student's t-test or one-way analysis of variance (ANOVA), while differences according to categorical predictors were evaluated using the Chi-square test. Associations between continuous variables were examined using Pearson correlation coefficients. Logistic regression models were used to explore potential predictors of insomnia and increased BMI after adjusting for relevant covariates.

Insufficient physical activity was the most common lifestyle risk factor among students (47.9%), followed by high stress (25.5%) and poor diet (16.7%). Regarding the selected health indicators, 45.3% of students were classified as overweight or obese and 26.9% had probable insomnia. Among complete cases, 42.6% presented none of the selected health indicators, 31.9% had increased BMI only, 12.8% had probable insomnia only, and 12.8% presented both increased BMI and probable insomnia. When examining correlations among lifestyle risk factors, only diet quality showed a significant inverse correlation with physical activity ($r = -0.289$, $p = 0.005$). Among the lifestyle risk factors, stress showed a borderline correlation with sleep quality ($r = -0.189$, $p = 0.057$). Overall, high stress (OR = 6.57, 95% CI: 1.55–27.82) and male gender (OR = 4.77, 95% CI: 1.23–18.55) were significant predictors of insomnia. No significant predictors of increased BMI were identified, although male gender showed a borderline association (OR = 2.6, 95% CI: 0.95–6.9, $p = 0.063$).

Lifestyle risk factors and health indicators such as insomnia and increased BMI were common among students, highlighting the need for targeted health promotion strategies. As an exploratory study, these findings identify trends that warrant further investigation.

KEYWORDS

Student health, stress, sleep, physical activity, diet

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1. Background

Noncommunicable diseases (NCDs) are the leading cause of mortality worldwide and account for the majority of global deaths (Li et al., 2025; WHO, 2025). Cardiovascular diseases, cancer, diabetes, chronic respiratory diseases, and stroke are strongly associated with modifiable risk factors, including unhealthy diet, insufficient physical activity, tobacco and alcohol use, and chronic psychosocial stress (Feng et al., 2025; Li et al., 2025). These risk factors often develop gradually across the life course (Kelishadi, 2019; Mikkelsen et al., 2019), and early adulthood represents a critical period during which long-term health-related behaviors may become established (Wood et al., 2018).

The transition from adolescence to young adulthood is frequently accompanied by changes in autonomy, living conditions, and daily routines, including unhealthy habits (Vanhelst et al., 2023; Winpenny et al., 2020). For many individuals, this transition coincides with entering university, a context often associated with new academic demands, financial responsibilities, altered sleep schedules, and reduced parental supervision (Aceijas et al., 2017; Zhao et al., 2023). These changes may influence health-related behaviors (Cruz et al., 2018; Deforche et al., 2015; Lesińska-Sawicka, Pisarek, & Nagórska, 2021; Oftedal et al., 2024) and increase exposure to relevant psychosocial determinants (Johannes et al., 2024; Van Dyck et al., 2015). Together, these behavioral and psychosocial factors can be considered components of students' lifestyle, which in turn may affect both the current health status and future health.

Available evidence indicates that insufficient physical activity, suboptimal dietary patterns, and elevated stress are highly prevalent among university students, although the magnitude varies across settings. Insufficient physical activity, in particular, has been consistently identified as one of the most common lifestyle risk factors in this population across different regions of the world. A pooled analysis of 1.6 million adolescents from 146 countries found that 81.0% did not meet recommended activity levels (Guthold et al., 2020), and similar patterns are observed in university samples. In Sudan, 59.5% of medical students were insufficiently active (Fadul et al., 2023), while in China, 77.6% of more than 30,000 students reported only light-intensity activity (Li et al., 2024). Earlier international data from 27 countries showed that more than half of students in the United States and Canada were not sufficiently active (Irwin, 2004), and low activity has also been documented among Spanish nursing students (Ramón-Arbués et al., 2023).

Dietary assessments in university students likewise reveal widespread suboptimal diet patterns. In a multicountry study (Chile, Mexico, Spain, Italy), only about 10% met Healthy Eating Index criteria for a healthy diet (Moral-Moreno et al., 2025). In Italy, 17.2% showed low adherence to the Mediterranean diet and 55.0% medium adherence, meaning over 70% did not follow an optimal pattern (Franchini et al., 2025). A systematic review in Iran estimated a 37% prevalence of unhealthy dietary patterns (Ahmadi et al., 2024), while in China fewer than 50% consumed vegetables daily and only 18.2% fruit daily (Liu et al., 2025). High levels of stress are also commonly reported among university students, although prevalence varies considerably across contexts. For example, stress prevalence was 34.5% in Spain (Ramón-Arbués et al., 2020) and 27.0% for moderate or higher stress in Turkey (Bayram & Bilgel, 2008), whereas 12.7% of students in Saudi Arabia reported high perceived stress (Alsaleem et al., 2021). Higher estimates have been observed in other settings, including 53.0% among Indian medical students (Iqbal, Gupta, & Venkatarao, 2015) and a pooled prevalence of 64.7% across African countries (Fentahun et al., 2025), highlighting substantial contextual variability.

Poor sleep quality and insufficient sleep duration are frequently reported health indicators among university students, although their prevalence varies considerably. A meta-analysis of 34 studies (14,704 students) indicated that approximately 30% meet criteria for insomnia and 36–68% report poor sleep quality (Gardani et al., 2022). National studies report 48.7% poor sleep quality in Germany (Schmickler et al., 2023), 39.5% insufficient sleep and 16.7% poor sleep quality in China (Li et al., 2024), and over 60% poor sleepers in U.S. samples (Becker et al., 2018; Lund et al., 2010). Even higher estimates were reported among Saudi medical students (76%) (Almojali et al., 2017) and Jordanian students, where about two-thirds rated their sleep as fairly or very bad (Albqoor & Shaheen, 2021).

An elevated BMI is another health indicator commonly observed. In a multicountry study of 15,746 students across 22 countries, 22.0% were overweight or obese overall, with a higher prevalence in men (24.7%) than women (20.3%), and rates reaching 40.0% in high-income countries (Peltzer et al., 2014). Country-specific studies report 27.9% in the United States (Odlaug et al., 2015), 21.0% in Turkey (Tokaç Er et al., 2021), 38.2% in Bangladesh (Emon et al., 2024), and 37.5% in India (Pengpid & Peltzer, 2014). In Brazil, prevalence differed markedly by sex (17.9% women; 45.8% men) (de Faria et al., 2023). These findings show that both poor sleep and an elevated BMI are common but not uniform across university contexts.

Beyond their individual frequency, evidence suggests that physical activity, diet, and stress frequently cluster and may relate to sleep and BMI, although associations are not uniformly consistent. In Greek students (n = 5,433), low Mediterranean diet adherence was associated with low physical activity (OR = 1.73; 95% CI: 1.58–1.97) and moderate/high stress (OR = 2.21; 95% CI: 1.99–2.47) (Dakanalis et al., 2025). In a U.S. national sample (n = 14,804), meeting vigorous physical activity recommendations was associated with lower perceived stress (adjusted OR = 0.75; 95% CI: 0.67–0.83) (Vankim & Nelson, 2013). Cluster analysis in an Italian undergraduate cohort identified a subgroup characterized by not meeting exercise guidelines (72.5%), high perceived stress (77.6%), and poor nutrition quality (59.7%), indicating that these lifestyle risk factors tend to cluster within the same subgroup of students (Lucini et al., 2024).

Empirical studies have further examined how these lifestyle risk factors relate to health indicators such as sleep quality and BMI, with some investigations identifying significant associations and others reporting weak or non-significant relationships. In Spain, an unhealthy diet was associated with poor sleep quality (adjusted OR = 4.20; 95% CI: 2.07–8.52) (Ramón-Arbués et al., 2022), and in Germany, perceived stress predicted worse sleep ($\beta = 0.27$, $p < 0.001$) (Schmickler et al., 2023). In an Italian university student sample, overweight/obesity has been linked to low physical activity (RR = 2.15; 95% CI: 1.87–2.41), high stress (RR = 2.43; 95% CI: 2.19–2.64), and inadequate sleep (RR = 1.86; 95% CI: 1.60–2.14) (Dakanalis et al., 2024). However, in a cross-sectional study of 2,347 Chinese university students, the physical activity level was not independently associated with poor sleep quality after adjustment for confounders (OR = 1.27; 95% CI: 0.95–1.70), although high sedentary time was significantly associated (OR = 1.37; 95% CI: 1.14–1.65) (Li & Li, 2022). Similarly, in a study of 1,125 U.S. college students, exercise frequency was not a significant independent predictor of sleep quality in multivariable regression models once stress-related variables were included (Lund et al., 2010). Also, a meta-analysis synthesizing 29 observational studies and including 141,035 university students found no significant pooled association between moderate-to-vigorous physical activity and sleep quality ($r = -0.18$; $p = 0.10$) or sleep duration ($r = 0.02$; $p = 0.76$) (Memon et al., 2021). Overall, it seems when considering sleep and BMI, associations are mixed for physical activity but clearer for diet and stress.

Although sleep quality, stress, physical activity, diet, and BMI have been examined in university students, reported prevalence estimates and observed associations vary across institutional and cultural contexts. These differences indicate that the distribution of these factors may depend on the characteristics of the student population under study. Examining these variables within a defined higher education environment therefore remains relevant, particularly when the institution includes a substantial proportion of international and culturally diverse students. In the present study, we investigated students at the Deggendorf Institute of Technology (DIT), a higher education institution with more than 9,000 students, including approximately 4,000 (45%) international students (DIT, 2025). The multicultural composition of this student body provides an opportunity to describe the prevalence of these selected lifestyle factors and health indicators and to explore their interrelationships within a diverse academic setting.

Exploring the frequency of these selected lifestyle factors and health indicators in this context may contribute to a clearer understanding of how they present within a multicultural higher education population. Exploring their associations within the same student population may help identify patterns that are consistent with, or differ from, those reported in other university settings. Such findings may provide institution-specific information for the DIT and may also offer comparative insights for other higher education institutions.

2. Research Objective

The primary aim of this study was to assess the frequency of exposure to lifestyle risk factors—physical inactivity, poor diet, and stress—and selected health indicators such as sleep quality and BMI among university students, examining how these factors relate to each other and vary across demographic and study-related characteristics. A secondary aim was to identify potential predictors of increased BMI and poor sleep/insomnia.

3. Methods

Study Design

A cross-sectional exploratory study was conducted using a web-based survey to investigate selected lifestyle risk factors and health indicators among university students. The study was carried out at the Deggendorf Institute of Technology (DIT), a public university of applied sciences located in Bavaria, Germany, with both domestic and international students enrolled in undergraduate and graduate programs across multiple academic disciplines.

Ethical Considerations

DIT guidelines for research involving human participants were followed. The study protocol was approved by the corresponding faculty authorities of the Deggendorf Institute of Technology. All procedures were conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. Participation in the study was voluntary. Prior to accessing the questionnaire, participants received an electronic information sheet describing the purpose of the study, the voluntary nature of participation, and the confidentiality of the collected data. Participants provided informed consent electronically before proceeding with the survey. All responses were collected anonymously, and no personally identifiable information was recorded. Participants were informed that they could discontinue participation at any time without consequences. Contact information for the research team and for university student counselling services was provided in case participants had questions or experienced discomfort related to the survey.

Participant Enrolment and Data Collection

Participants were recruited using a convenience sampling approach. All students enrolled at the Deggendorf Institute of Technology (DIT) at the time of data collection and aged 18 years or older were eligible to participate. The survey invitation was distributed through multiple institutional and student communication channels, including the official student mailing list, student WhatsApp groups, and posts on LinkedIn. No financial or academic incentives were offered for participation. A total of 106 students completed the questionnaire and were included in the study sample. Data were collected using a self-administered web-based questionnaire developed only in English and implemented through the LimeSurvey platform (https://www.limesurvey.org/), the official survey software supported by the DIT. The questionnaire incorporated four validated instruments commonly used in health and behavioral research to assess sleep quality, perceived stress, physical activity, and dietary patterns, together with additional items addressing demographic and academic characteristics. The questionnaire was organized into sections corresponding to the principal domains assessed in the study. To reduce respondent burden and encourage completion, the survey was designed to be brief and required approximately 5–10 minutes to complete.

Prior to the main data collection, the questionnaire underwent pilot testing with a limited number of students to assess clarity and functionality of the online survey. The adequacy and structure of the questionnaire were also reviewed in consultation with subject-matter experts. Minor adjustments were made before the final survey was distributed. Participants accessed the questionnaire through a secure web link. After reviewing the study information and providing informed consent, respondents completed

the questionnaire anonymously. Data collection took place between 18 March and 15 April 2025, and responses were stored securely on the university server through the LimeSurvey system.

A detailed description of the study variables, measurement instruments, scoring procedures, and classification criteria used in the analysis is provided in the following section.

Measures (Study Variables)

1. Lifestyle risk factors

Three lifestyle-related risk factors were assessed: perceived stress, physical activity, and diet quality. Perceived stress was measured using the Perceived Stress Scale (PSS-10) (Cohen, Kamarck, & Mermelstein, 1983), a widely used self-report instrument that assesses the degree to which individuals perceive situations in their lives as stressful. The scale consists of 10 items; each rated on a 5-point Likert scale ranging from 0 (never) to 4 (very often). Total scores range from 0 to 40, with higher scores indicating greater perceived stress. For descriptive analyses, stress levels were categorized as low (0–13), moderate (14–26), and high (27–40) following commonly used classification thresholds.

Physical activity was assessed using the Godin Leisure-Time Exercise Questionnaire (Godin & Shephard, 1985), which measures the frequency of mild, moderate, and vigorous leisure-time physical activity during a typical week. Respondents reported how many times per week they performed activities lasting at least 15 minutes in each intensity category. A Total Leisure Activity Score (TLAS) was calculated by weighting frequencies according to intensity (mild ×3, moderate ×5, vigorous ×9) and summing the results. Consistent with established recommendations, individuals with TLAS ≤ 23 were classified as insufficiently active, while those with TLAS ≥ 24 were considered active.

Diet quality was assessed using the Starting the Conversation (STC) Diet Tool (Paxton et al., 2011), a brief dietary screening instrument consisting of eight items evaluating common eating patterns such as consumption of fruits and vegetables, sugar-sweetened beverages, snack foods, and fast food. Each item is scored on a 3-point scale, producing a total score ranging from 0 to 16, where higher scores indicate less healthy dietary patterns. As the instrument does not provide a universal cut-off for cross-sectional classification, categories were created by dividing the score range into four intervals: 0–4 (very healthy), 5–8 (healthy), 9–12 (less healthy), and 13–16 (poor diet). For analytical purposes, scores ≥9 were considered indicative of an unhealthy diet.

The full versions of the Perceived Stress Scale (PSS-10), the Godin Leisure-Time Exercise Questionnaire (TLAS), and the Starting the Conversation (STC) Diet Tool are provided in Appendix 1.

2. Selected health indicators

Two health indicators were examined: sleep quality and Body Mass Index (BMI). Sleep quality was assessed using the Sleep Condition Indicator (SCI) (Espie et al., 2014), an 8-item self-report questionnaire designed to evaluate symptoms of insomnia and their impact on daily functioning over the previous month. Each item is rated on a 5-point scale, producing a total score ranging from 0 to 32, with higher scores indicating better sleep quality. In accordance with established recommendations, a score below 16 was used to indicate probable insomnia, whereas scores ≥16 indicated no insomnia.

The Body Mass Index (BMI) was calculated using self-reported weight and height provided by participants and expressed in kg/m². For descriptive and analytical purposes, the nutritional status was classified as not overweight/obese or overweight/obese using ethnicity-specific thresholds recommended by international guidelines. Participants of Asian background were classified as overweight/obese at BMI ≥23 kg/m², whereas for all other ethnic groups the threshold was BMI ≥25 kg/m² (Cole & Lobstein, 2012; WHO, 2026).

3. Sociodemographic and academic-related characteristics

The questionnaire collected information on sociodemographic and academic-related characteristics. Age was recorded as a continuous variable (years) and categorized for descriptive analyses into <25, 25–29, and ≥30 years. Gender was recorded based on participants' self-identification. Ethnicity was assessed through a self-identification item with the following response options: White/European, South Asian, Black/African descent, Arab/Middle Eastern, Southeast Asian, East Asian, Mixed/Multiracial, and Other. Categories with small numbers were combined for analysis into White, South Asian, Black/African descent, Arab/Middle Eastern, East & Southeast Asian, and Mixed/Other. The self-perceived economic situation was measured using a single-item question with five response options: very comfortable, comfortable, coping, difficult, and very difficult. These were collapsed into three categories: economically secure (very comfortable/comfortable), moderately constrained (coping), and economically insecure (difficult/very difficult). Participants also reported academic-related characteristics, including study program, degree level (Bachelor's or Master's), and stage of study, allowing characterization of the academic profile of the sample.

Data Analysis

Data Cleaning and Processing

Survey responses were exported from LimeSurvey into IBM SPSS Statistics version 26 for data preparation and analysis. Data were screened for completeness, consistency, and plausibility. Continuous variables were visually inspected using histograms and boxplots to evaluate distributional characteristics. A small number of outliers were identified but retained, as they did not meaningfully affect the distribution of the variables. Validated instruments were scored according to their published scoring procedures, as described in the Measures section. During data cleaning, minor inconsistencies in questionnaire responses were identified and corrected where possible to ensure consistency with the instruments' scoring formats.

The dataset initially contained 106 completed questionnaires. Missing data were handled using complete-case analysis, meaning that participants with missing values for variables required in a given analysis were excluded from that specific analysis. No statistical imputation was performed. Analyses examining the combined lifestyle risk factors and health indicators were conducted using 94 complete cases, while logistic regression models were estimated using 84 cases with complete information on all variables included in the models.

Statistical analysis

Descriptive statistics were calculated for all study variables. Continuous variables are presented as means and standard deviations, together with minimum, maximum, and selected percentiles, while categorical variables are reported as frequencies and percentages.

Group differences in continuous variables across categorical predictors were assessed using Student's t-tests for dichotomous variables and one-way analysis of variance (ANOVA) for variables with more than two categories. When assumptions for parametric tests were not met, the Mann-Whitney U test was used as a non-parametric alternative. Associations between categorical variables were evaluated using the chi-square test. Relationships between continuous lifestyle risk factors (exposure variables) and health indicators (outcome variables) were examined using Pearson correlation coefficients, while Spearman rank correlations were applied when assumptions for parametric correlation analysis were not satisfied. Statistical significance was defined as $p < 0.05$ (two-tailed).

To examine the combined presence of lifestyle risk factors, dichotomous indicators were created for each exposure variable (e.g., presence vs. absence of high stress, insufficient physical activity, and unhealthy diet). These variables were coded as 1 (present) or 0 (absent) and summed to create a com-

posite exposure variable representing the number of concurrent lifestyle risk factors experienced by each participant.

Finally, binary logistic regression models were fitted to estimate adjusted odds ratios (ORs) and 95% confidence intervals (CIs) for selected health indicators (outcome variables). Independent variables included the lifestyle risk factors (exposure variables), while sociodemographic and academic-related characteristics were included as covariates. Separate models were estimated for each outcome variable.

4. Results

Participants' Characteristics

A summary of the demographic and current academic study program characteristics of participants is provided in Table 1. The study included 106 participants, 51% females and 49% males. Most of the respondents were aged 25–29 years (40.2%), and the average age was approximately 27 years old. The vast majority of participants lived in Germany (92.2%). In terms of ethnicity, participants were diverse, with the largest group identifying as South Asian (33%), followed by White/European (28.2%) and Black/African descent (17.5%). Of the respondents, almost half (47.1%) considered themselves to be moderately financially constrained. Regarding education, over half of the students were enrolled in a Master's degree (61.9%) and almost half studied both on campus and online (46.5%).

Sociodemographic			**n**	**%**
Age[1]	<25 y		32	34.8
	25 to 29 y		37	40.2
	≥30 y		23	25
		Total	92	100
Gender	Female		53	51
	Male		51	49
		Total	104	100
Ethnicity	White/ European		29	28.2
	South Asian		34	33
	Black (African descendant)		18	17.5
	Arab (Middle Eastern)		12	11.7
	East/Southeast Asian		4	3.9
	Mixed/Others		6	5.8
		Total	103	100
Living in Germany	Yes		95	92.2
	No		8	7.8
			103	100
Self-perceived economic situation	Economically secure		36	35.3
	Moderately constrained		48	47.1
	Economically Insecure		18	17.6
		Total	102	100
Academic study program characteristics				
Type of study program	MSc		60	61.9
	BSc		37	38.1
		Total	97	100
Mode of study	Campus		29	28.7
	Online		25	24.8
	Both		47	46.5
		Total	101	100

n = number of valid cases (with appropriately recorded responses).

[1]Mean age (standard deviation): 26.87 (4.96) years; median (range): 27.00 (30) years.

Table 1: Sociodemographic and academic study program characteristics of participants

Patterns of lifestyle risk factors among students

Table 2 presents an assessment of selected lifestyle risk factors among university students, including perceived stress, physical activity, and diet, disaggregated by sociodemographic and academic study program characteristics. It includes both mean scores (with standard deviations) and the proportion of participants meeting risk criteria based on validated cutoffs: high stress (Perceived Stress Scale Total Score [PSS-TS] > 27), insufficient physical activity (Total Leisure Activity Score [TLAS] ≤ 23), and poor diet (Starting the Conversation Diet Score [STC-DS] ≥ 9). Statistical comparisons were performed using t-tests, ANOVA, and chi-square tests, with a significance threshold of $p < 0.05$.

Regarding perceived stress scores (PSS-TS), a mean score of 19.0 (SD = 6.1) was observed, and overall, 25.5% of students were classified as experiencing high stress (Table 2). PSS-TS differed significantly by gender ($p = 0.031$). Female students reported higher mean scores (M = 20.4, SD = 6.2) than males (M = 17.8, SD = 5.7). The proportion of students classified as having high stress was also significantly higher among females (23.1%) compared to males (8.2%; $p = 0.045$). Ethnicity was significantly associated with high stress classification ($p = 0.047$). Participants identifying as Mixed/Others showed the highest proportion of high stress (33.3%), followed by East/Southeast Asians (25.0%), South Asians (21.2%), White Europeans (13.8%), Arabs (10.0%), and Black/African descendants (5.6%). No significant differences in PSS-TS scores or high stress classification were observed by age group ($p = 0.244$ and 0.168), country of residence ($p = 0.960$ and 0.881), self-perceived economic status ($p = 0.165$ and 0.160), study program ($p = 0.573$ and 0.729), or mode of study ($p = 0.311$ and 0.548).

With regard to physical activity (Table 2), the mean TLAS was 42.8 (SD = 42.5), and 47.9% of students were classified as insufficiently active. When physical activity was examined as a categorical variable, gender was the only factor significantly associated with activity classification ($p = 0.049$), with a greater proportion of females classified as insufficiently active (58.0%) compared with males (37.8%). When TLAS was analyzed as a continuous score, mean values did not differ significantly by gender according to Student's t test ($p = 0.538$). However, because TLAS did not meet the assumption of normality, a Mann-Whitney U test was also conducted, which indicated a significant difference between males and females ($p = 0.037$). Ethnicity was not significantly associated with TLAS scores ($p = 0.403$), although descriptive differences were observed: South Asian students had the highest mean TLAS (M = 50.7, SD = 44.6), whereas East/Southeast Asian students had the lowest (M = 12.3, SD = 13.8), and all students in this group were classified as insufficiently active. When physical activity was examined as a categorical outcome, ethnicity approached statistical significance ($p = 0.092$). No significant associations were observed between physical activity and age, economic status, study program, or mode of study.

Diet quality, measured by the STC-DS, showed a mean score of 6.3 (SD = 2.2), with 16.7% of students classified as having a poor diet. Although no group differences reached statistical significance (all $p > 0.05$), some trends were noted: the proportion of students with a poor diet decreased with age, and males (22.4%) had higher rates than females (9.6%), with a borderline difference ($p = 0.077$) (table 2)

		Stress							Physical activity							Diet						
		PSS-TS			p	High level		p	TLAS			p	Insufficiently active		p	STC-DS			p	Non-healthy (poor diet)		p
		n	Mean	SD		n	%		n	Mean	SD		n	%		n	Mean	SD		n	%	
All participants		102	19.0	6.1		26	25.5		96	42.8	42.5		46	47.9		102	6.3	2.2		17	16.7	
Sociodemographic																						
Age	< 25 years	31	17.1	6	0.244	2	6.5	0.168	30	47.7	42.7	0.801	11	36.7	0.191	31	6.65	2	0.401	6	19.4	0.828
	25 to 29 years	36	19.3	6.6		6	16.7		35	40.7	47.2		18	51.4		36	6.33	2.31		6	16.7	
	≥ 30 years	23	19.4	5.5		4	17.4		21	41.5	41.6		13	61.9		23	5.83	2.25		3	13.0	
Gender	Female	52	20.4	6.2	**0.031**	12	23.1	**0.045**	50	40.2	50.5	0.538	29	58	**0.049**	52	6.23	1.9	0.722	5	9.6	0.077
	Males	49	17.8	5.7		4	8.2		45	45.6	32.4		17	37.8		49	6.39	2.51		11	22.4	
Ethnicity	East/Southeast Asian	4	19.3	6.6	0.532	1	25	**0.047**	4	12.3	13.8	0.403	4	100	0.092	4	6.0	1.41	0.229	0	0.0	0.824
	South Asian	33	19	6.7		7	21.2		34	50.7	44.6		13	38.2		33	6.36	2.16		6	18.2	
	Black/African descendant	18	20	4.5		1	5.6		15	29.3	27.8		9	60		18	6.67	2.06		3	16.7	
	Arab (Middle Eastern)	10	21.2	3.2		1	10		8	44.1	66.5		6	75		10	6.2	2.49		2	20.0	
	White European	29	17.3	7.2		4	13.8		29	43.4	40.9		12	41.4		29	6.52	2.05		5	17.2	
	Mixed/Others	6	20.5	5.5		2	33.3		5	32.2	22.4		2	40		6	4.17	2.14		0	0.0	
Living in Germany	Yes	92	19	6.3	0.960	15	16.3	0.881	89	41.8	41.5	0.798	43	48.3	0.936	92	6.36	2.08	0.743	15	16.3	0.530
	No	8	19.1	5.2		1	12.5		6	37.3	34.5		3	50		8	6.63	3.38		2	25.0	
Self-perceived economic situation	Secure	35	17.6	6.4	0.165	4	11.4	0.16	34	45.1	32.5	0.683	14	41.2	0.458	35	6.17	2.58	0.854	7	20.0	0.700
	Moderately constrained	46	19.8	5.4		7	15.2		44	43.8	53		22	50		46	6.43	1.77		6	13.0	
	Insecure	18	20.4	6.5		5	27.8		15	33.7	31.9		9	60		18	6.39	2.06		3	16.7	
Study program characteristics																						
Type of study	MSc	59	19.1	6.2	0.573	10	16.9	0.729	56	42.8	44.3	0.393	29	51.8	0.393	59	6.49	2.32	0.692	13	22.0	0.178
	BSc	36	18.4	6.2		4	11.1		33	45.2	43.6		14	42.4		36	6.31	2.01		4	11.1	
Mode of study	Onsite	28	18.1	5.8	0.311	3	10.7	0.548	26	36.2	26.1	0.548	11	42.3	0.234	28	6.43	2.2	0.638	6	21.4	0.432
	Distance	25	20.6	6.7		6	24		22	38.8	51.4		14	63.6		25	6.6	2.68		5	20.0	
	Both	45	18.9	5.8		7	15.6		44	46.8	43.6		19	43.2		45	6.11	1.81		5	11.1	

Note. SD = standard deviation; n = number of valid cases; PSS-TS: Perceived Stress Scale Total Score; TLAS: Total Leisure Activity Score; STC-DS: Starting the Conversation Diet Score. P values for group mean comparisons of TLAS, PSS-TS, and STC-DS were calculated using two-tailed Student's t tests for binary variables when the assumption of normal distribution was met within each category, and one-way ANOVA for variables with more than two categories. Because TLAS did not meet the assumption of normality, Mann-Whitney U tests were also conducted for binary variables (gender: $p = 0.037$; place of residence: $p = 0.765$; Bachelor's vs. Master's students: $p = 0.705$). Chi-square tests assessed differences across groups in the proportion of high-risk cases: high stress (PSS-TS > 27; Cohen et al., 1983), insufficient physical activity (TLAS ≤ 23; Amireault et al., 2015), and unhealthy diet (STC-DS ≥ 9). Statistical significance was set at $p < 0.05$. Significant values are highlighted in grey.

Table 2: Assessment of lifestyle risk factors among university students

Patterns of Health (Outcomes) Indicators among University Students

Table 3 presents an assessment of health-related risk indicators among university students, focusing on nutritional status and sleep quality, disaggregated by sociodemographic and study-related characteristics. The table includes both continuous measures—Body Mass Index (BMI) and Sleep Condition Indicator Total Score (SCI-TS)—and the proportion of participants classified as at risk based on validated cutoffs: overweight/obesity (BMI ≥ 23 for Asian students and ≥ 25 for others) and probable insomnia (SCI-TS < 16). Statistical comparisons used t-tests, ANOVA, and chi-square tests, with significance defined as $p < 0.05$.

Regarding nutritional status, the mean BMI across participants was 23.6 (SD = 4.3), and 45.3% were classified as overweight or obese (Table 3). Significant differences in overweight/obesity prevalence were observed by gender ($p = 0.037$), with a higher proportion among males (56.3%) than females (34.8%). Mean BMI also varied significantly by ethnicity ($p = 0.020$), with Arab ($M = 27.4$, $SD = 5.75$) and South Asian ($M = 23.4$, $SD = 3.49$) students showing higher averages, while East/Southeast Asian students reported the lowest ($M = 20.1$, $SD = 2.43$). Mode of study was also associated with BMI scores ($p = 0.046$), with onsite students reporting lower mean BMI ($M = 21.7$, $SD = 3.97$) compared to those studying through both modes ($M = 24.2$, $SD = 4.05$). No significant differences in BMI or overweight/obesity classification were observed by age, economic status, study program, or residence in Germany (table 3).

Sleep quality, assessed using the SCI-TS, showed a mean score of 18.9 (SD = 5.1), with 26.9% of students classified as having probable insomnia. When SCI-TS was analyzed as a continuous variable, most sociodemographic and study characteristics were not significantly associated with mean scores. However, the economic situation was significantly related to sleep quality: economically secure students reported higher mean SCI-TS values ($M = 20.7$, $SD = 4.1$; $p = 0.014$) compared with students who were moderately constrained or economically insecure. When sleep quality was examined as a categorical outcome (probable insomnia), the economic situation also showed a significant association ($p = 0.023$), with a lower proportion of probable insomnia among economically secure students (11.4%) compared with those moderately constrained (31.3%) and economically insecure (44.4%). Ethnicity was likewise associated with insomnia classification ($p = 0.014$); the highest proportions of probable insomnia were observed among Black students (50.0%) and Arab students (54.5%), whereas no cases were identified among East/Southeast Asian students. No significant differences in SCI-TS scores or insomnia classification were observed according to gender, age, study program, or mode of study. Similarly, no significant difference in SCI-TS scores was found by place of residence (Germany versus another country), including when evaluated using the Mann–Whitney U test due to non-normal distribution ($p = 0.789$) (table 3).

		Nutritional Status							Sleep quality						
		BMI Score (kg/m²)			p	Overweight/Obese		p	SCI-TS			p	Probable Insomnia		p
		n	Mean	SD		n	%		n	Mean	SD		n	%	
All participants		95	23.6	4.3		43	45.3		104	18.9	5.1		28	26.9	
Sociodemographic															
Age	< 25 years	29	22.3	4.05	0.086	11	37.9	0.704	32	20.1	3.6	0.328	4	12.5	0.118
	25 to 29 years	33	23.5	4.13		16	48.5		37	18.8	6.1		11	29.7	
	≥ 30 years	21	25.1	4.97		9	42.9		23	18	5.3		8	34.8	
Gender	Female	46	23.2	4.23	0.368	16	34.8	0.037	53	19.3	4.8	0.387	12	22.6	0.286
	Males	48	24	4.41		27	56.3		50	20.4	5.5		16	32	
Ethnicity	East/Southeast Asian	4	20.1	2.43	0.020	1	25	0.210	4	21	3.7	0.077	0	0	0.014
	South Asian	27	23.4	3.49		17	63		34	18.9	4.7		7	20.6	
	Black (African descendant)	16	23.6	5.16		7	43.8		18	15.9	5.9		9	50.0	
	Arab (Middle Eastern)	12	27.4	5.75		7	58.3		11	18.7	7.6		6	54.5	
	White European	28	23.3	3.18		9	32.1		29	20.6	3.7		4	13.8	
	Mixed/Others	6	21.8	4.74		2	33.3		6	19.5	3.9		1	16.7	
Living in Germany	Yes	85	23.3	4.07	0.271	38	44.7	0.774	94	18.8	5	0.971	25	26.6	0.507
	No	8	25	4.81		4	50		8	18.9	4.9		3	37.5	
Self-perceived economic situation	Economically secure	34	23.9	3.57	0.878	17	50	0.887	35	20.7	4.1	0.014	4	11.4	0.023
	Moderately constrained	42	23.6	4.65		19	45.2		48	18.5	5.4		15	31.3	
	Economically Insecure	16	23.3	5.35		7	43.8		18	16.6	5.1		8	44.4	
Study program characteristics															
Type of study program	MSc	53	23.8	4.46	0.337	27	50.9	0.275	60	18.7	5.5	0.569	19	31.7	0.169
	BSc	35	22.9	3.9		13	37.1		37	19.3	4.6		7	18.9	
Mode of study	Onsite	25	21.7	3.97	0.046	8	32	0.118	28	19.9	4.6	0.283	6	21.4	0.413
	Distance	22	24	4.26		9	40.9		25	19.1	6.4		9	36	
	Both	44	24.2	4.05		25	56.8		47	18.1	4.2		11	23.4	

Note. SD = standard deviation; n = number of valid cases; BMI: Body Mass Index; SCI-TS: Sleep Condition Indicator Total Score. P values for group mean comparisons of BMI and SCI-TS were calculated using two-tailed Student's t tests for binary variables and one-way ANOVA for variables with more than two categories. For comparisons involving binary variables, the assumption of normality was met for both BMI and SCI-TS, with the exception of SCI-TS when comparing place of residence (students living in Germany versus another country), where the normality assumption was not met. Therefore, a Mann–Whitney U test was conducted for this comparison, which indicated no significant difference ($p = 0.789$). Chi-square tests assessed differences across groups in the proportion of high-risk cases: "Overweight/Obese" (BMI ≥ 23 for Asian students and ≥ 25 for all other ethnicities; Cole & Lobstein, 2012; WHO, 2026) and "Probable Insomnia" (SCI total score < 16; Espie et al., 2014). Statistical significance was set at $p < 0.05$. Significant values are highlighted in grey.

Table 3: Assessment of selected health indicators (outcomes) among university students

Figure 1 presents the percentage of students reporting various combinations of lifestyle risk exposures, including stress, poor diet, and insufficient physical activity. Approximately one-third of the students (34%) did not report any of these risks. The most prevalent individual factor was insufficient physical activity (27.7%), followed by stress alone (11.7%) and poor diet alone (6.4%). Co-occurrence of two or more factors was less common: 10.6% of students reported both stress and insufficient physical activity, 6.4% reported poor diet along with insufficient physical activity, and only 3.2% were affected by all three. These findings indicate that while some students faced multiple lifestyle-related risks, most either reported none or only one, with insufficient physical activity being the most widespread.

Figure 1 also displays the distribution of students across four health outcome categories derived from survey responses: no adverse outcome, increased BMI only, probable insomnia only, and both increased BMI and probable insomnia. These classifications were based on data from 94 students who provided complete information on height, weight, and sleep; 12 cases with incomplete data were excluded from the analysis.

Among the 94 valid cases, 42.6% of students were categorized as having no adverse outcome. Increased BMI alone was observed in 31.9% of participants, probable insomnia alone in 12.8%, and both conditions concurrently in a further 12.8%.

Figure 2 illustrates a scatter plot matrix showing all pairwise bivariate relationships among five health-related factors in university students. These include two health indicators—Body Mass Index (BMI) (where higher scores reflect increased body mass and associated health risk) and Sleep Condition Indicator (SCI) Total Scores (where higher scores reflect better sleep quality and lower scores indicate greater sleep difficulties)—and three lifestyle-related factors: Perceived Stress Scale (PSS) Total Scores (where higher scores reflect greater perceived stress), Starting the Conversation (STC) Diet Score (where higher scores reflect poorer diet quality), and Total Leisure Activity Score (TLAS) (where higher scores reflect greater engagement in physical or leisure activities). The matrix allows for visual inspection of linear trends and potential correlation between variables. Pearson correlation coefficients, with p values in parentheses are also included in the figure.

The only statistically significant correlation was a modest inverse correlation between STC Diet Scores and TLAS ($r = –0.289$, $p = 0.005$). Given that higher STC scores reflect a poorer diet quality (i.e., greater frequency of consuming unhealthy foods such as fast food, sugary beverages, and snacks), this result suggests that students who engaged more in leisure activities tended to report better dietary patterns. Conversely, lower engagement in leisure activities was associated with less healthy eating behaviors.

A borderline association was observed between SCI Total Scores and PSS Total Scores ($r = –0.189$, $p = 0.057$), indicating a potential inverse relationship between sleep quality and perceived stress. While this trend did not reach conventional levels of statistical significance, it suggests that poorer sleep condition may be linked to higher stress levels.

No other statistically significant correlations were found. BMI was not meaningfully associated with any of the other variables, and there were no significant associations between sleep quality, stress, or diet quality beyond the relationships noted above.

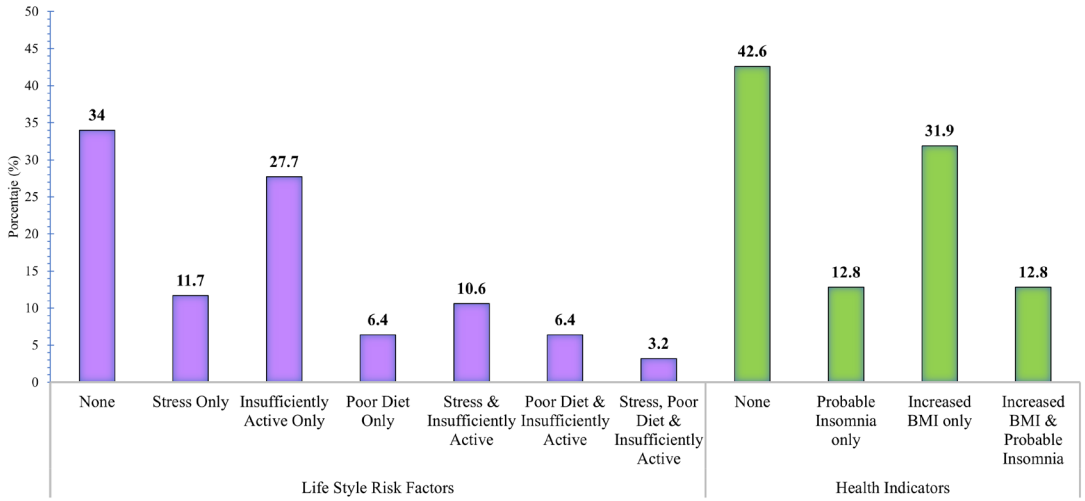

Figure 1. Estimated frequency of single and combined lifestyle risk factors and selected health indicators (outcomes) among university students.

Note. Percentages are based on 94 valid cases with appropriately recorded responses for all assessed indicators.

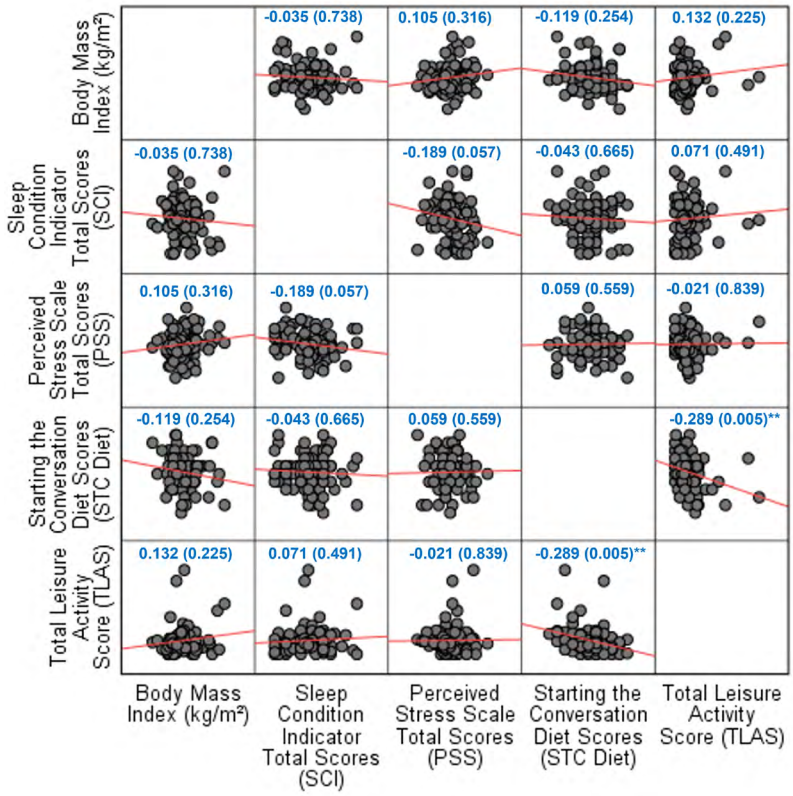

Figure 2: Scatter plot matrix of all pairwise bivariate correlations among lifestyle risk factors (stress, physical activity, diet) and health indicators (BMI and sleep quality) in university students.

Note: Values in the figure represent Pearson correlation coefficients with p values in parentheses. A significance level of $p < 0.05$ was applied. Statistically significant correlations are indicated with an asterisk. Pairwise sample sizes: BMI–SCI (n = 94), BMI–PSS (n = 93), BMI–STC Diet (n = 93), BMI–TLAS (n = 86), SCI–PSS (n = 102), SCI–STC Diet (n = 102), SCI–TLAS (n = 96), PSS–STC Diet (n = 101), PSS–TLAS (n = 95), STC Diet–TLAS (n = 95).

Table 4 presents the results of a multivariable logistic regression analysis examining demographic and lifestyle risk factors as predictors of insomnia and increased Body Mass Index (BMI) among university students. Adjusted odds ratios (ORs) and 95% confidence intervals (CIs) are reported for each variable, with statistical significance evaluated using the Wald test at a threshold of $p < 0.05$.

For insomnia, a total of 84 students were included in the analysis after excluding 22 individuals with incomplete responses. Two predictors showed statistically significant associations with insomnia. Students reporting high levels of perceived stress were significantly more likely to experience insomnia, with an OR of 6.57 (95% CI: 1.55–27.82; p = 0.011), compared to those with low or moderate stress. Similarly, male students had significantly higher odds of insomnia than female students (OR = 4.77; 95% CI: 1.23–18.55; p = 0.024). Physical inactivity was a borderline predictor, with inactive students showing higher odds of reporting insomnia (OR = 3.42; 95% CI: 0.97–11.98; p = 0.055), although this association did not reach statistical significance. Other variables showed no significant association with insomnia but suggested possible trends. Students aged 25–29 had slightly higher odds compared to those under 25 (OR = 1.27; 95% CI: 0.28–5.80; p = 0.760), and those aged 30 or older also showed a non-significant trend toward an increased risk (OR = 2.64; 95% CI: 0.55–12.55; p = 0.223). Poor diet was associated with lower odds of insomnia (OR = 0.44; 95% CI: 0.08–2.47; p = 0.351), although this result was not statistically significant.

Regarding BMI, 77 students were included in the final analysis after excluding 29 with incomplete responses. None of the predictors reached statistical significance. Male students showed higher odds of an increased BMI compared with females (OR = 2.56; 95% CI: 0.95–6.88; p = 0.063), although this association did not reach statistical significance. Age was not significantly associated with BMI, with ORs of 1.83 (95% CI: 0.51–6.59; p = 0.353) for students aged ≥ 30 years and 2.03 (95% CI: 0.65–6.30; p = 0.222) for those aged 25–29 years compared with students under 25. Lifestyle variables also showed no significant associations. Poor diet was associated with lower odds of increased BMI (OR = 0.41; 95% CI: 0.11–1.60; p = 0.201), while insufficient physical activity showed an OR of 0.66 (95% CI: 0.25–1.75; p = 0.400). High perceived stress was not associated with increased BMI (OR = 0.80; 95% CI: 0.23–2.81; p = 0.722).

Variables in the model		Probable insomnia				Increased BMI			
		OR	95% CI		p	OR	95% CI		p
			LL	UL			LL	UL	
Gender	Males	4.77	1.23	18.55	0.024*	2.56	0.95	6.88	0.063
	Females (ref)	-				-			
Age	≥30 years	2.64	0.55	12.55	0.223	1.83	0.51	6.59	0.353
	25–29 years	1.27	0.28	5.80	0.760	2.03	0.65	6.30	0.222
	<25 years (ref)	-				-			
Diet	Poor diet	0.44	0.08	2.47	0.351	0.41	0.11	1.60	0.201
	Healthy diet (ref)	-				-			
Physical activity	Insufficiently Active	3.42	0.97	11.98	0.055	0.66	0.25	1.75	0.400
	Active (ref)	-				-			
Stress level	High	6.57	1.55	27.82	0.011*	0.80	0.23	2.81	0.722
	Low/moderate (ref)	-				-			

OR: Odds ratios; CI: Confidence interval; LL: Lower limits; UL: Upper limits; Ref: Reference category.
Note: Here an adjusted OR is reported for each predictor included in the model. A significance level of $p < 0.05$ was applied based on a Wald Test.

Table 4: Exploration of demographic and lifestyle risk factors as potential predictors of insomnia and increased Body Mass Index (BMI) among university students using multivariable logistic regression

5. Discussion

Overview of Key Findings

This exploratory cross-sectional study examined the distribution of selected lifestyle risk factors and health indicators among university students in a multicultural higher education setting and explored how these factors appeared to relate within the same student population. Several general patterns were observed.

First, among the lifestyle risk factors examined, insufficient physical activity appeared to be the most common, while elevated perceived stress was also present in a notable proportion of students. Poor diet was reported less frequently. When these lifestyle risk factors were considered together, most students appeared to report either none or only one of them, whereas the simultaneous presence of multiple lifestyle risk factors was less commonly observed. This pattern may suggest that, within this sample, these factors tended to occur individually rather than accumulating within the same individuals.

Second, regarding health indicators, increased BMI appeared more common than probable insomnia. Although both health indicators were present within the population, most students did not appear to report both conditions simultaneously, suggesting that these outcomes were often observed independently.

Third, when relationships among lifestyle risk factors were examined, a modest association was observed between diet quality and physical activity, suggesting that students who reported higher levels of leisure activity also tended to report healthier dietary patterns. Other lifestyle risk factors did not show clear relationships with one another.

Finally, when the relationships between lifestyle risk factors and health indicators were explored, perceived stress showed an association with probable insomnia, while no clear associations were observed between the lifestyle risk factors and increased BMI in the multivariable models. Overall, the findings suggest that lifestyle risk factors and health indicators may occur within the same student population, although the relationships among them appear to be modest and not uniformly consistent across factors.

Comparison with Previous Studies

Frequency of Selected Lifestyle Risk Factors

The distribution of lifestyle risk factors observed in the present study appears broadly consistent with the general pattern described in the literature, although the magnitude of these factors varies substantially across student populations and institutional contexts.

Insufficient physical activity was the most common lifestyle risk factor in the present sample. Studies conducted in university populations across different regions have reported wide variability in the prevalence of insufficient physical activity, often ranging from approximately 40% to more than 70% of students (Fadul et al., 2023; Irwin, 2004; Li et al., 2024; Ramón-Arbués et al., 2023). For example, a large epidemiological survey of 30,475 university students from 104 universities across China reported that 77.6% of students engaged predominantly in low levels of physical activity, indicating a high prevalence of insufficient activity patterns in this population (Li et al., 2024). Within this spectrum, the prevalence observed in the present study appears to fall within the lower-to-middle range of estimates reported in the literature. Differences in academic schedules, campus infrastructure supporting physical activity, and broader lifestyle patterns during university life have been suggested as possible contextual factors influencing activity levels among students (Deforche et al., 2015; Winpenny et al., 2020).

In contrast, poor diet appeared less frequent in the present sample than in many previously reported studies. Available evidence indicates that unhealthy dietary patterns among university students often affect roughly one third or more of students in several settings (Ahmadi et al., 2024). Other studies focusing on

adherence to recommended dietary patterns suggest that only a minority of students meet optimal nutritional guidelines, indicating that suboptimal diet is widespread even when specific classification criteria differ (Franchini et al., 2025; Moral-Moreno et al., 2025). The relatively lower prevalence observed in the present study may therefore reflect contextual factors related to the university environment, differences in dietary assessment instruments, or variation in how dietary quality is classified. Institutional food environments, cultural dietary habits, and affordability of healthy food options have all been suggested as factors that may influence diet patterns among university students (Aceijas et al., 2017).

Perceived stress was also observed in a notable proportion of students in the present study. Previous research indicates that the prevalence of elevated stress among university students varies widely, with estimates ranging from approximately 25% in some European student populations to more than 60% in certain settings or academic programs (Bayram & Bilgel, 2008; Fentahun et al., 2025; Iqbal, Gupta, & Venkatarao, 2015; Ramón-Arbués et al., 2020). Within this range, the level observed in the present study appears closer to the lower end of reported estimates. Differences across studies may reflect variation in academic pressures, institutional environments, social support systems, and the measurement instruments used to assess perceived stress.

Overall, the available evidence suggests that insufficient physical activity and elevated perceived stress are recurrent lifestyle risk factors in university populations across different settings. In contrast, dietary patterns appear to show greater variability between studies, likely reflecting differences in cultural norms, food environments, and institutional contexts. This suggests that while some lifestyle risk factors may be broadly characteristic of student populations, others may be more strongly shaped by local conditions.

Frequency of Health Indicators

The prevalence of the health indicators observed in the present study also appears to fall within the broad range reported in university student populations internationally.

Increased BMI was observed in a substantial proportion of students in the present sample. Previous multicountry research involving more than 15,000 university students reported that approximately 22% of students were overweight or obese overall, although prevalence approached 40% in high-income countries (Peltzer et al., 2014). Country-specific studies have documented estimates ranging from approximately 20% in some university populations to more than one third of students in others (Emon et al., 2024; Odlaug et al., 2015; Pengpid & Peltzer, 2014; Tokaç Er et al., 2021). Within this range, the prevalence observed in the present study appears toward the higher end of previously reported estimates. Differences in age distribution, cultural dietary patterns, levels of physical activity, and socioeconomic environments have all been suggested as factors that may influence weight-related health indicators among university students (de Faria et al., 2023).

Sleep difficulties were also present among a notable proportion of students in the present study. A systematic review and meta-analysis estimated that approximately 30% of university students meet criteria for insomnia, while reports of poor sleep quality often range between roughly one third and two thirds of students depending on the measurement approach (Becker et al., 2018; Gardani et al., 2022; Lund et al., 2010; Schmickler et al., 2023). Within this spectrum, the prevalence observed in the present study appears to fall within the lower-to-middle range of reported estimates. Several factors have been proposed to contribute to sleep difficulties among university students, including irregular sleep schedules, academic workload, stress, and screen use (Oftedal et al., 2024).

When considered alongside previous studies, the findings suggest that sleep-related difficulties appear to emerge with notable regularity across university populations, whereas the distribution of increased BMI tends to vary more markedly between settings. This contrast may reflect differences in the processes underlying these health indicators. Sleep disturbances may arise more readily from features

commonly associated with student life, such as irregular schedules, academic demands, and psychosocial pressures, while body weight reflects longer-term interactions between dietary patterns, physical activity, and broader environmental influences. Also, cultural differences in sleep habits, such as later bedtimes or daytime napping practices, may also contribute to these observed differences (Jeon, Dimitriou, & Halstead, 2021) and should be considered when interpreting the results.

As a result, the prevalence of increased BMI may be more sensitive to contextual and population characteristics, whereas sleep problems appear to be a more consistently observed feature of student populations.

Relationships among Lifestyle Risk Factors

In the present study, the only statistically significant relationship observed among the lifestyle risk factors was a modest inverse association between diet quality and physical activity. Students reporting higher engagement in leisure activity tended to report healthier dietary patterns, whereas other pairwise relationships among lifestyle risk factors were not statistically significant. Although the strength of this association was moderate, it suggests that some lifestyle behaviors may align within individuals rather than occurring independently.

Similar patterns have been reported in other university populations. For example, in a large cross-sectional study of Greek university students, lower adherence to the Mediterranean diet was associated with lower physical activity levels (OR = 1.73; 95 % CI 1.58–1.97) and higher perceived stress (OR = 2.21; 95 % CI 1.99–2.47) (Dakanalis et al., 2025). Likewise, cluster analysis conducted among Italian undergraduates identified a subgroup characterized by the concurrent presence of insufficient physical activity, elevated stress, and poorer nutrition quality (Lucini et al., 2024). Evidence from U.S. national student samples has also shown that students meeting vigorous physical activity recommendations tend to report lower perceived stress (adjusted OR = 0.75; 95 % CI 0.67–0.83) (Vankim & Nelson, 2013). Collectively, these findings have been interpreted as suggesting that lifestyle behaviors may partially cluster within the same individuals or student population.

However, the pattern observed in the present study was more limited, with a detectable relationship only between diet and physical activity and no statistically significant associations involving perceived stress. One possible explanation is that the determinants of these behaviors may only partially overlap. Physical activity and diet may be more closely linked through daily routines and behavioral choices, for example, individuals who actively engage in sports or structured exercise may also adopt dietary habits that support those activities. In contrast, perceived stress may be influenced by different mechanisms, such as academic workload, financial concerns, and psychosocial pressures, which do not necessarily translate directly into dietary or activity behaviors.

Another plausible explanation relates to heterogeneity within the student population. University students may adopt diverse coping strategies in response to stress, some of which involve increased physical activity, while others may involve sedentary behaviors or changes in eating patterns. Such variation could weaken observable statistical relationships between stress and other lifestyle factors at the population level. In addition, previous studies that identified stronger clustering patterns often relied on larger samples or cluster-analytic approaches specifically designed to detect behavioral profiles (Lucini et al., 2024), whereas the present study examined pairwise relationships within a smaller sample.

Considered alongside previous studies, the pattern observed here suggests that lifestyle risk factors in student populations do not necessarily accumulate in a uniform way. While behaviors related to daily routines, such as diet and physical activity, may occasionally move in the same direction, other factors like perceived stress appear to follow more independent trajectories. This may reflect the diverse ways in which students organize their daily lives and cope with academic and social demands, resulting in lifestyle profiles that are more heterogeneous than often assumed.

Relationships between Lifestyle Risk Factors and Health Indicators

When the relationships between lifestyle risk factors and health indicators were examined, the most prominent finding in the present study concerned the association between perceived stress and sleep outcomes. Students reporting high levels of perceived stress had markedly greater odds of meeting the threshold for probable insomnia. Although the cross-sectional nature of the data does not allow conclusions about directionality, the magnitude of this association suggests that stress and sleep disturbances tend to appear together within student populations.

Evidence from several university-based studies points in a similar direction. Research conducted among German students identified perceived stress as one of the strongest correlates of poor sleep quality after adjusting for demographic and behavioral factors (Schmickler et al., 2023). Comparable relationships have been reported in Middle Eastern student populations, where higher perceived stress levels were linked to poorer sleep quality and longer sleep latency (Albqoor & Shaheen, 2021). Observations from U.S. university samples likewise indicate that psychological strain, including stress and related emotional states, is closely intertwined with sleep disturbances (Becker et al., 2018). Syntheses of the broader literature also suggest that insomnia symptoms affect roughly one third of university students and frequently coexist with elevated psychological distress (Gardani et al., 2022). Viewed together, these findings suggest that the coexistence of stress and sleep difficulties represents a recurring feature in many student populations, even though the magnitude of the association varies across studies.

Several processes may plausibly contribute to this relationship. Elevated perceived stress can be accompanied by cognitive hyperarousal, rumination, and difficulty disengaging from academic or per-sonal concerns, all of which may interfere with sleep initiation and continuity. At the same time, disrupted sleep may impair emotional regulation and coping capacity, which can heighten perceived stress during waking hours. Within university environments, often characterized by irregular schedules, academic deadlines, and multiple competing demands, these processes may interact in ways that make the coexistence of stress and sleep difficulties particularly common. Rather than reflecting a single directional pathway, the relationship between these two indicators may therefore be better understood as part of a dynamic interplay between psychological strain and sleep regulation in student life.

The relationship between physical activity and sleep outcomes appeared less pronounced in the present study. Physical inactivity showed a borderline association with probable insomnia, suggesting that students reporting lower activity levels tended to have higher odds of sleep difficulties, although the association did not reach conventional statistical significance. The literature on this relationship among university students is notably inconsistent. Some investigations have reported modest associations between higher levels of physical activity and improved sleep quality (Schultchen et al., 2019), while others have found that these relationships become attenuated once additional behavioral or psychological factors are taken into account. For example, a meta-analysis including more than 140,000 university students did not identify a significant pooled association between moderate-to-vigorous physical activity and either sleep quality or sleep duration (Memon et al., 2021). Similarly, research in Chinese university cohorts found that physical activity was not independently associated with sleep quality after accounting for sedentary behavior and mental health indicators (Li & Li, 2022). Within this broader evidence base, the borderline association observed in the present study may reflect a relationship that exists but is relatively modest and potentially influenced by other factors shaping students' daily routines.

In contrast, none of the lifestyle risk factors examined showed statistically significant associations with increased BMI in the adjusted models. Studies conducted in other student populations have sometimes reported links between weight status and lifestyle patterns. Multicountry analyses involving more than 15,000 students found that overweight and obesity were more common among those reporting lower physical activity and less favorable lifestyle profiles (Peltzer et al., 2014). Other investigations have similarly described higher BMI values among students characterized by sedentary behavior, elevated stress, or poorer diet quality (Dakanalis et al., 2024; de Faria et al., 2023). Nevertheless, such associations are not observed consistently across all university settings.

Several factors may help account for this variability. Unlike sleep outcomes, which can respond relatively quickly to psychological and behavioral conditions, the BMI reflects cumulative energy balance over longer periods of time. Consequently, lifestyle behaviors measured at a single time point may not correspond closely with current body weight. Early adulthood is also a period marked by substantial lifestyle transitions, including changes in diet, activity patterns, and daily schedules, which may introduce variability in behaviors without immediately translating into measurable differences in BMI. Differences in population composition, cultural dietary practices, and measurement approaches may further contribute to the heterogeneity observed across studies.

It seems that, overall, the relationships between lifestyle risk factors and health indicators in university populations appear to differ according to the outcome examined. Sleep outcomes show a clearer alignment with psychosocial factors such as perceived stress, whereas relationships involving BMI appear less readily detectable in cross-sectional analyses and may depend on longer-term behavioral trajectories and environmental influences.

Sociodemographic and Study Program Characteristics in Relation to Lifestyle Risk Factors and Health Indicators

Although the primary aim of this study was to examine lifestyle risk factors and health indicators, several sociodemographic and study program characteristics showed associations with some outcomes, helping to contextualize the observed patterns and generating questions for future research. In the present sample, gender was one of the few characteristics consistently related to several variables. Female students reported higher perceived stress levels and were more frequently classified as insufficiently physically active, whereas male students showed a higher prevalence of increased BMI and greater odds of probable insomnia in the multivariable analysis. Similar patterns have been described in other university populations, where female students tend to report higher perceived stress and lower physical activity, while male students more often present higher BMI levels (Du et al., 2021; Peltzer et al., 2014; Schultchen et al., 2019). These differences may partly reflect gender-related variations in coping strategies, social expectations around physical activity, and differences in body composition and lifestyle patterns during early adulthood.

The economic situation was also associated with sleep outcomes. Students who perceived themselves as economically secure reported better sleep quality and a lower prevalence of probable insomnia compared with those experiencing financial constraints. Financial concerns are widely described as an important stressor among university students and may influence sleep through psychological strain, competing work or study responsibilities, and uncertainty about academic or financial stability (Lund et al., 2010).

Some differences were also observed across ethnic groups and mode of study. Mean BMI varied by ethnicity, and students attending classes exclusively on campus showed lower BMI values compared with those studying online or in hybrid formats. Although these observations should be interpreted cautiously, they may reflect differences in daily routines, dietary practices, and sedentary time associated with remote learning environments, which have been linked to reduced physical activity and weight gain in some student populations (Romero-Blanco et al., 2020).

It is important to note that most of these observations were derived from bivariate analyses without adjustment for potential confounding factors. Therefore, they should be interpreted as descriptive patterns rather than independent associations. While not a primary objective of the study, these findings highlight potentially relevant sociodemographic dimensions that may warrant more focused investigation in larger studies designed to explore these relationships in greater depth.

Limitations

Several limitations should be considered when interpreting the findings of this study. The cross-sectional design limits the ability to determine the directionality of the observed relationships, and the

results therefore describe patterns of association between lifestyle risk factors and health indicators at a single point in time rather than temporal relationships between them. Longitudinal designs would be necessary to better understand how changes in lifestyle risk factors and health indicators may evolve and interact over time during the university years.

The study was conducted within a single higher education institution and relied on a convenience sample recruited through institutional mailing lists and student communication channels. Although the student population included individuals from diverse cultural backgrounds, participation was voluntary and the final sample size was relatively small. These factors limit the generalizability of the findings and raise the possibility of selection bias, as students with a particular interest in health-related topics may have been more likely to participate. The modest sample size may also have influenced the statistical power of the analyses, particularly the multivariable models. Consequently, some associations may not have reached statistical significance due to limited statistical power rather than the absence of an underlying relationship.

All data were based on self-reported information, which introduces the possibility of recall bias and social desirability bias. Participants may unintentionally overreport favorable lifestyle patterns or underreport behaviors perceived as less healthy (Althubaiti, 2016). In addition, height and weight were self-reported and therefore the calculated BMI values may not fully reflect measured anthropometric data.

Although validated instruments were used to assess the main study variables, certain measurement limitations should be acknowledged. The dietary assessment tool captured general dietary patterns but did not collect information on portion size or total energy intake, which may reduce the precision of dietary assessment, particularly in a multicultural student population with diverse dietary habits. In the case of physical activity, a small number of participants appeared to misinterpret the response format of the questionnaire and reported minutes rather than session frequency, which may have introduced some variability in the calculation of activity scores.

Some potentially relevant factors were not included in the survey. Information on alcohol consumption, smoking, caffeine intake, medication use, and medical history was not collected, even though these variables may influence sleep patterns or body weight. In addition, some sociodemographic and study-related characteristics that could also influence the observed patterns, such as students' fields of study or academic workload, were not specifically examined in this analysis. The absence of these variables limits the ability to more fully explore contextual factors that may influence the observed associations. In addition, BMI has well-recognized limitations as a measure of adiposity, particularly in multi-ethnic populations where the relationship between BMI, body fat distribution, and health outcomes may vary across groups (Nuttall, 2015). Complementary anthropometric measures such as waist circumference or waist-to-hip ratio could provide additional insight in future studies. Furthermore, BMI may also be influenced by a range of behavioral, environmental, and genetic factors that were not measured in this study.

Additionally, several of the exploratory analyses examining potential relationships between sociodemographic and study program characteristics and lifestyle risk factors and selected health indicators, were based on bivariate comparisons without adjustment for potential confounding factors. These observations should therefore be interpreted cautiously and primarily as descriptive patterns that may help generate hypotheses for future research rather than solid evidence of independent relationships.

Moreover, multiple statistical tests were conducted in this study, and no formal adjustment for multiple comparisons (e.g., Bonferroni or Benjamini–Hochberg correction) was applied. Such adjustments are commonly used to reduce the risk of type I errors (false positives) when many hypotheses are tested (Ludbrook, 1998). However, given the relatively small sample size of the present study, the main statistical concern is limited power and therefore an increased risk of type II errors (false negatives), meaning that true associations may not have been detected. For this reason, the analyses should be interpreted as exploratory.

Implications for Policy and Practice

The findings of this study may be particularly relevant for institutional planning and health promotion strategies within higher education settings. Although the study was exploratory and conducted within a single institution, the results provide institution-specific information on the distribution of selected lifestyle risk factors and health indicators among students. Such data can help universities identify areas where preventive strategies may be most relevant. Institutional surveillance of student health patterns has been recommended as an important step in developing evidence-informed campus health promotion programs (Aceijas et al., 2017; Dooris, Doherty, & Orme, 2017). In this context, the present findings may assist local planning by highlighting areas that could warrant attention, such as perceived stress, sleep difficulties, and insufficient physical activity.

For example, the observed association between perceived stress and sleep outcomes suggests that interventions addressing stress management may also have relevance for sleep-related problems. Universities have increasingly implemented integrated well-being programmes that combine mental health support, time management training, and stress reduction strategies, with some evidence indicating beneficial effects on students' well-being and sleep quality (Amanvermez et al., 2022; Schmickler et al., 2025). While the present study cannot determine the effectiveness of such approaches, the findings support the potential value of considering mental health and sleep as interconnected domains when designing student well-being initiatives.

Similarly, the high frequency of insufficient physical activity observed in the sample suggests that opportunities for regular movement may represent an important area for campus health promotion. Previous research has shown that university environments can play a meaningful role in shaping activity patterns through the availability of sports facilities, active campus design, and structured exercise programs (Keating et al., 2005; Plotnikoff et al., 2015). Institutions may therefore benefit from considering how both physical infrastructure and programmatic initiatives support student engagement in physical activity, particularly for students who spend substantial time in online or hybrid learning environments.

The findings may also have relevance beyond the specific institutional context. The Deggendorf Institute of Technology hosts a multicultural student population with a large proportion of international students, a characteristic increasingly common in many higher education institutions. As a result, the patterns observed in this study may offer comparative insights for other universities seeking to understand how lifestyle risk factors and health indicators manifest in diverse student populations. Health promotion initiatives that take into account cultural diversity, varying study formats, and different socioeconomic circumstances may be particularly important in such settings.

Overall, the study illustrates how institution-specific assessments of lifestyle risk factors and health indicators can provide useful information for guiding locally relevant health promotion strategies. Even when broader international evidence is available, understanding how these patterns appear within a particular student population may help universities tailor interventions that better reflect the needs and circumstances of their students.

Implications for Future Research

The findings of this exploratory study highlight several areas that could be examined in greater depth in future research. Longitudinal designs would be particularly valuable for understanding how lifestyle risk factors and health indicators evolve over time during the university years. Tracking students across different stages of their academic trajectory could help clarify whether changes in perceived stress, physical activity, or dietary patterns are followed by changes in sleep quality or body weight.

Future studies may also benefit from including a broader range of behavioral and contextual variables. Factors such as alcohol consumption, smoking, caffeine intake, medication use, academic workload, and financial stress were not assessed in the present study but may influence both lifestyle risk

factors and health indicators in student populations. Including these variables could provide a more comprehensive understanding of the behavioral and environmental contexts in which these patterns occur.

In addition, the use of objective measurement methods could help improve the accuracy of reported information. Wearable devices and digital monitoring tools may provide more precise estimates of physical activity and sleep patterns, while direct anthropometric measurements or alternative indicators of adiposity could complement BMI when assessing body composition.

The differences observed according to mode of study suggest that academic environments themselves may influence daily routines related to activity, diet, and sedentary behavior. As hybrid and online learning formats become more common in higher education, further research examining how study formats shape lifestyle patterns and health indicators among students could provide valuable insight for both research and institutional health promotion.

6. Concluding Remarks

This exploratory study provides an institution-specific overview of selected lifestyle risk factors and health indicators among students in a higher education setting. Given the small sample size, the cross-sectional design, and the exploratory nature of the analysis, the findings should be interpreted with caution and cannot be considered representative of the broader student population. Instead, the results should be understood primarily as a local snapshot of health-related patterns within this academic context.

Examining these factors together within a single institutional environment offers an initial perspective on how lifestyle behaviors and health indicators may coexist during the university years. Although limited, such local assessments may help identify areas that warrant attention within the institution and can serve as a starting point for further investigation. In this sense, the findings contribute to the expanding body of research examining student health and lifestyle patterns, adding institution-level evidence that may complement and inform similar assessments across diverse higher education settings.

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8. Conflicts of Interest

The authors declare no conflicts of interest.

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10. Appendix

Supplementary file 1. Composition of scales used in the study

1. Sleep Condition Indicator (SCI)

Item	Question
1	How would you rate your sleep quality?
2	How long does it take you to fall asleep after turning off the lights?
3	How many nights per week do you have a problem with sleep?
4	To what extent has poor sleep troubled you in general?
5	How noticeable to others is your sleep problem?
6	To what extent has your sleep problem interfered with daily functioning (e.g., mood, energy, concentration)?
7	To what extent are you concerned about your current sleep pattern?
8	How long have you had problems with sleep?

Response scale: 4-point Likert scale
Score range: 0–32
Interpretation: higher scores = better sleep quality.

2. Perceived Stress Scale (PSS-10)

Item	Question
1	In the last month, how often have you been upset because of something unexpected?
2	How often have you felt unable to control important things in your life?
3	How often have you felt nervous or stressed?
4	How often have you felt confident about your ability to handle personal problems?
5	How often have you felt that things were going your way?
6	How often have you felt unable to cope with all the things you had to do?
7	How often have you been able to control irritations in your life?
8	How often have you felt that you were on top of things?
9	How often have you been angered because of things outside your control?
10	How often have you felt difficulties were piling up so high that you could not overcome them?

Response scale: 0–4 (Never → Very often)

3. Starting the Conversation (STC) Diet Tool

Item	Question
1	How often do you eat fast food meals or snacks?
2	How often do you eat fruit?
3	How often do you eat vegetables?
4	How often do you drink sugary beverages (soft drinks, energy drinks)?
5	How often do you eat desserts or sweets?
6	How often do you eat chips, crackers, or salty snacks?
7	How often do you eat processed meats (sausages, burgers, etc.)?
8	How often do you eat meals prepared at home vs outside?

Response: frequency categories
Interpretation: lower scores = healthier diet, higher scores = poorer diet quality.

4. Godin Leisure-Time Exercise Questionnaire (GLTEQ)

Question	Item	Response format
1. During a typical 7-day period (a week), how many times on average do you engage in the following kinds of exercise for more than 15 minutes during your free time?		
	a. Strenuous exercise (e.g., running, vigorous swimming, competitive sports)	Number of times per week
	b. Moderate exercise (e.g., fast walking, easy bicycling, recreational swimming)	Number of times per week
	c. Mild exercise (e.g., easy walking, yoga, stretching)	Number of times per week
2. During a typical 7-day period, how often do you engage in any regular activity long enough to work up a sweat (heart beats rapidly)?	Never / Sometimes / Often	Categorical response

The Total Leisure Activity Score (TLAS) is calculated by multiplying the weekly frequency of strenuous activities by nine, moderate activities by five, and mild activities by three, and then summing these values. Higher scores indicate greater engagement in leisure-time physical activity. In this study, participants were classified as active if their TLAS was 24 or higher and as insufficiently active if their score was 23 or lower.

Supplementary table 1. Distribution of study scale scores overall and stratified by sociodemographic and study-related characteristics.: BMI and SCI (continuation)

Categories	n	BMI			SCI		
		Mean (SD)	Median (Min–Max)	p25–p75	Mean (SD)	Median (Min–Max)	p25–p75
All participants	104	23.6 (4.3)	23.4 (13.6–36.8)	20.4–26.3	18.9 (5.1)	19.0 (8–32)	15.3–22.0
Gender							
Female	52	23.2 (4.2)	22.8 (15.2–35.0)	20.3–25.6	19.3 (4.8)	19.0 (10–32)	17.0–23.0
Male	49	24.0 (4.4)	23.5 (13.6–36.8)	20.6–27.0	18.4 (5.5)	19.5 (8–32)	13.8–22.0
Type of study program							
MSc	59	23.8 (4.5)	23.8 (13.6–36.8)	20.6–26.1	18.6 (5.5)	19.0 (10–32)	13.0–23.0
BSc	36	22.9 (3.9)	22.9 (15.2–31.6)	20.3–26.4	19.3 (4.6)	19.0 (8–29)	17.5–22.0
Ethnicity							
White/European	29	23.3 (3.2)	22.5 (18.9–29.6)	20.4–26.3	20.6 (3.7)	21.0 (13–29)	18.0–23.0
East Asian	1	20.0 (—)	20.0 (20–20)	20–20	19.0 (—)	19.0 (19–19)	19–19
South Asian	33	23.4 (3.5)	23.4 (13.6–31.6)	22.7–25.3	18.9 (4.7)	19.0 (10–28)	17.0–23.0
Southeast Asian	3	20.2 (3.0)	18.7 (18.3–23.6)	18.3——	21.7 (4.2)	23.0 (17–25)	17——
Black/African descent	18	23.6 (5.2)	22.6 (15.2–35.0)	20.3–26.8	15.9 (5.9)	16.5 (8–32)	10.8–20.3
Arab/Middle Eastern	10	27.4 (5.8)	27.0 (19.4–36.8)	22.3–32.7	18.7 (7.6)	15.0 (11–32)	13–25
Other ethnic groups	5	20.5 (3.8)	20.7 (15.6–25.2)	16.8–24.0	19.8 (4.3)	22.0 (13–23)	15.5–23
Country of residency							
Reside in Germany	92	23.3 (4.1)	23.2 (13.6–34.5)	20.3–26.1	18.8 (5.0)	19.0 (8–32)	15.0–22.0
Reside in other country	8	25.0 (4.8)	24.7 (18.7–35.0)	21.8–26.7	18.9 (4.9)	20.5 (12–24)	13.0–23.0
Mode of study							
Study on Campus (on site)	28	21.7 (4.0)	21.5 (13.6–29.6)	18.9–24.9	19.9 (4.6)	20.0 (10–29)	17.3–22.8
Distance (remote study)	25	24.0 (4.3)	23.8 (18.7–35.0)	20.2–26.5	19.1 (6.4)	19.0 (10–32)	13.0–23.0
Hybrid	45	24.2 (4.0)	23.8 (15.2–34.5)	20.8–27.3	18.1 (4.2)	18.0 (8–26)	17.0–21.0
Self-perceived socioeconomic condition							
No difficulties	35	23.9 (3.6)	23.9 (18.0–36.8)	21.1–26.0	20.7 (4.1)	21.0 (13–32)	18.0–23.0
With some limitation	46	23.6 (4.7)	23.1 (13.6–34.5)	20.3–27.0	18.5 (5.4)	18.5 (10–32)	14.0–22.0
With difficulties	16	23.6 (5.4)	21.1 (15.6–35.0)	19.8–27.5	15.9 (5.1)	16.0 (8–25)	12.0–20.5

Note: BMI = body mass index (kg/m²); SCI = Sleep Condition Indicator score; SD= standard deviation; p25 = 25th percentile; p75 = 75th percentile; BSc= Bachelor of Science; MSc= Master of Science.

Supplementary table 1. Distribution of study scale scores overall and stratified by sociodemographic and study-related characteristics.: TLAS, STC Diet, and PSS

Categories	n	TLAS			STC Diet			PSS		
		Mean (SD)	Median (Min–Max)	p25–p75	Mean (SD)	Median (Min–Max)	p25–p75	Mean (SD)	Median (Min–Max)	p25–p75
All participants	104	42.8 (42.5)	35.5 (0–270)	18.0–52.8	6.3 (2.2)	6.0 (1–12)	5.0–7.0	19.0 (6.1)	18.5 (4–34)	15.0–23.3
Gender										
Female	52	40.2 (50.5)	28.0 (0–270)	14.8–47.5	6.2 (1.9)	6.0 (1–11)	5.0–7.0	20.4 (6.2)	20.0 (6–34)	16.0–25.8
Male	49	45.6 (32.4)	45.0 (0–162)	23.5–66.0	6.4 (2.5)	6.0 (2–12)	5.0–8.0	17.8 (5.7)	18.0 (4–29)	14.0–21.0
Type of study program										
MSc	59	42.8 (44.3)	35.0 (0–270)	17.3–52.3	6.5 (2.3)	6.0 (2–12)	5.0–8.0	19.1 (6.2)	18.0 (4–34)	15.0–24.0
BSc	36	45.2 (43.6)	41.0 (0–235)	18.0–61.5	6.3 (2.0)	6.0 (2–12)	5.0–7.0	18.4 (6.2)	19.5 (6–29)	15.3–22.0
Ethnicity										
White/European	29	43.5 (40.9)	36.0 (3–235)	23.0–53.0	6.5 (2.0)	7.0 (2–11)	5.0–7.5	17.3 (7.2)	18.0 (6–34)	10.0–22.5
East Asian	1	32.0 (—)	32.0 (32–32)	32–32	4.0 (—)	4.0 (4–4)	4–4	16.0 (—)	16.0 (16–16)	16–16
South Asian	33	50.7 (44.6)	47.0 (0–270)	24.5–66.0	6.4 (2.2)	6.0 (2–11)	5.0–7.0	19.0 (6.7)	18.0 (4–32)	13.5–23.5
Southeast Asian	3	5.7 (4.9)	8.0 (0–9)	0——	6.7 (0.6)	7.0 (6–7)	6——	20.3 (7.6)	17.0 (15–29)	15——
Black/African descent	18	29.3 (27.8)	26.0 (0–92)	0–44	6.7 (2.1)	6.0 (3–12)	5–8	20.0 (4.5)	20.5 (14–28)	16–25
Arab/Middle Eastern	10	44.1 (66.5)	12.0 (0–162)	2.3–109.5	6.2 (2.5)	6.0 (2–10)	4.8–7.8	21.2 (3.2)	20.5 (17–27)	19–24.3
Other ethnic groups	5	29.8 (25.1)	22.5 (9–65)	10.5–56.3	3.6 (1.8)	4.0 (1–6)	2–5	19.0 (4.6)	18.0 (16–27)	16–22.5
Country of residency										
Germany	92	41.8 (41.5)	36.0 (0–270)	18.0–51.0	6.4 (2.1)	6.0 (2–12)	5.0–7.0	19.0 (6.3)	19.0 (4–34)	15.0–23.8
Other country	8	37.3 (34.5)	26.0 (0–92)	11.3–71.8	6.6 (3.4)	6.0 (1–12)	5.0–9.5	19.1 (5.2)	17.5 (12–27)	16.0–24.8
Mode of study										
On Campus (on site)	28	36.2 (26.1)	34.0 (0–119)	16.5–52.3	6.4 (2.2)	6.0 (2–12)	5.0–7.8	18.1 (5.8)	18.0 (6–29)	15.3–21.0
Distance (remote study)	25	38.8 (51.4)	23.5 (0–235)	2.3–53.8	6.6 (2.7)	6.0 (1–12)	5.0–8.0	20.6 (6.7)	19.0 (8–34)	16.0–26.5
Hybrid	45	46.8 (43.6)	38.0 (0–270)	22.3–55.5	6.1 (1.8)	6.0 (2–10)	5.0–7.0	18.9 (5.8)	18.0 (7–29)	15.0–23.5
Self-perceived socio-economic condition										
No difficulties	35	45.1 (32.5)	39.0 (0–162)	19.8–62.3	6.2 (2.6)	6.0 (2–12)	4.0–8.0	17.6 (6.4)	17.0 (6–34)	13.0–21.0
With some limitation	46	43.8 (53.0)	33.0 (0–270)	17.3–47.8	6.4 (1.8)	6.0 (3–11)	5.0–7.0	19.9 (5.4)	19.5 (9–32)	16.0–24.3
With difficulties	16	36.8 (32.9)	36.0 (0–119)	13.5–49.0	6.4 (2.2)	6.0 (4–12)	5.0–7.0	20.3 (6.6)	20.5 (7–29)	16.3–26.8

Note: TLAS = Total Leisure Activity Score (Godin Leisure-Time Exercise Questionnaire); STC Diet = Short Test of Dietary Compliance score; PSS = Perceived Stress Scale score; SD= standard deviation; p25 = 25th percentile; p75 = 75th percentile; BSc= Bachelor of Science; MSc= Master of Science.